6. Data Collection

6.1. Overview

6.1.1 Introduction

It is necessary to identify the types of data that will be required prior to conducting the engineering analysis. The effort necessary for data collection and compilation shall be tailored to the importance of the project. Not all of the data discussed in this chapter will be needed for every project. A well planned data collection program leads to a more orderly and effective analysis and design that is commensurate with:

- project scope,
- project cost,
- the complexity of site hydraulics, and
- regulatory requirements.

Data collection for a specific project must be tailored to:

- site conditions,
- scope of the engineering analysis,
- social, economic and environmental requirements,
- unique project requirements, and
- regulatory requirements.

Uniform or standardized survey requirements for all projects may prove uneconomical or data deficient for a specific project. Special instructions outlining data requirements may have to be provided to the survey party by the designer for unique sites.

6.1.2 Data Requirements

The purpose of this chapter is to outline the types of data that are normally required for drainage analysis and design, possible sources, and other aspects of data collection. The following subjects are presented in this chapter.

- Sources of Data
- Types of Data
- Survey Information
- Field Reviews
- Data Evaluation

6.1.3 Survey Methods/Computation Accuracy

The publication "Accuracy of Computed Water Surface Profiles," U.S. Army Corps of Engineers, Dec. 1986, focuses on determining relationships between:

- survey technology and accuracy employed for determining stream cross sectional geometry,
- degree of confidence in selecting Manning's roughness coefficients, and
- the resulting accuracy of hydraulic computations.

The report also presents methods for determining the upstream and downstream limits of data collection for a hydraulic study requiring a specified degree of accuracy.

Computer software has been developed to perform the calculations for the various routines presented in this manual. HY-11, Survey Accuracy, is available from the McTrans Center.

6.2. Sources of Data

6.2.1 Objectives

- Identify possible sources of data.
- Rely on Department experience as to which sources will most likely yield desired data.
- Utilize the guides in this chapter for data sources. Acquaint the designer with available data and Department procedures for acquiring it.

6.2.2 Sources

Much of the data and information necessary for the design of highway drainage facilities may be obtained from some combination of the sources listed in

Appendix A of this chapter. The following information is given for each data source on the list:

- type of data,
- address of source, and
- comments on data.

6.3. Types of Data Needed

6.3.1 General

The designer must compile the data that are specific to the subject site. Following are the major types of data that may be required:

- watershed characteristics;
- stream reach data (especially in the vicinity of the facility);
- other physical data in the general vicinity of the facility such as utilities, easements, etc.;
- hydrologic and meteorologic data (stream flow and rainfall data related to maximum or historical peak as well as low flow discharges and hydrographs applicable to the site);
- existing and proposed land use data in the subject drainage area and in the general vicinity of the facility;
- anticipated changes in land use and/or watershed characteristics; and
- flood plain and environmental regulations.

Watershed, stream reach and site characteristic data, as well as data on other physical characteristics can be obtained from a field reconnaissance of the site. Examination of available maps and aerial photographs of the watershed is also an excellent means of defining physical characteristics of the watershed.

6.3.2 Drainage Surveys

A complete field or aerial drainage survey of the site and its contributing watershed should always be undertaken as part of the hydraulic analysis and design. Survey requirements for small drainage facilities such as 36 inch culverts are less extensive than those for major facilities such as bridges. However, the purpose of each survey is to provide an accurate picture of the conditions within the zone of hydraulic influence of the facility. Appendix B contains the Department's instructions for minor and major drainage surveys.

Following are the data that can be obtained or verified:

- contributing drainage area characteristics;
- stream reach data - cross sections and thalweg profile;
- existing structures;
- location and survey for development, existing structures, etc., that may affect the determination of allowable flood levels, capacity of proposed drainage facilities, or acceptable outlet velocities;
- drift/debris characteristics;
- general ecological information about the drainage area and adjacent lands; and
- high water elevations including the date of occurrence.
- icing conditions

Much of these data must be obtained from an on-site inspection. It is often much easier to interpret published sources of data after an on-site inspection. Only after a thorough study of the area and a complete collection of all required information should the designer proceed with the design of the hydraulic facility. All pertinent data and facts gathered through the survey shall be documented as explained in the Documentation Chapter.

6.3.3 Watershed Characteristics

Following is a brief description of the major data topics that relate to drainage facility analysis and design. Additional discussion is contained in the AASHTO Drainage Guidelines, Chapter 2.

Watershed Characteristics

1. **Contributing Size:** The size of the contributing drainage area expressed in acres or square miles, is determined from some or all of the following.
    - Direct field surveys with conventional surveying instruments.
    - Use of topographic maps together with field checks to determine any changes in the contributing drainage area such as may be caused by:
        - terraces,

- lakes, sinks,
- debris or mud flow barriers,
- reclamation/flood control structures, and U.S.G.S. topographic maps are available for most areas of the State. Topographic maps can also be obtained from municipal and borough entities and local developers.
- Aerial maps or aerial photographs. Many areas of the State have been photographed and mapped. These are available through the Department's mapping section, University of Alaska Geophysical Institute, and private agencies.

In determining the size of the contributing drainage area, any subterranean flow or any areas outside the physical boundaries of the drainage area that have runoff diverted into or out of the drainage area being analyzed shall be accounted for in the total contributing drainage area. In addition, it must be determined if floodwaters can be diverted out of the basin before reaching the site.

2. **Slopes:** The slope of the streambed, the slope of the water surface, the average slope of the watershed (basin slope), and mean basin elevation should be determined. Hydrologic and hydraulic procedures in other chapters of this manual are dependent on watershed slopes and these other physical characteristics.

3. Watershed Land Use

- Define and document the present and expected future land use, particularly the location, degree of anticipated urbanization, and data source.
- Information on existing use and future trends may be obtained from:
    - aerial photographs (conventional and infrared),
    - zoning maps and Master plans,
    - USGS and other maps,
    - municipal planning agencies, and
    - satellite images such as LANDSAT, SAR, SPOT, etc.
- Specific information about particular tracts of land can often be obtained from owners, developers, realtors, and local residents. Care should be exercised in using data from these sources since their reliability may be questionable and these sources may not be aware of future development within the watershed which might affect specific land uses.
- Existing land use data for small watersheds can best be determined or verified from a field survey. Field surveys shall also be used to update information on maps and aerial photographs, especially in basins that have experienced changes in development since the maps or photos were prepared. Infrared aerial photographs may be particularly useful in identifying types of urbanization at a point in time.

4. Streams, Rivers, Ponds, Lakes and Wetlands

At all streams, rivers, ponds, lakes, and wetlands that will affect or may be affected by the proposed structure or construction, the following data shall be secured. These data are essential in determining the expected hydrology and may be needed for regulatory permits.

- Outline the boundary (perimeter) of the water body for the ordinary highwater.
- Elevation of normal as well as high water for various frequencies.
- Detailed description of any natural or manmade spillway or outlet works including dimensions, elevations, and operational characteristics.
- Detailed description of any emergency spillway works including dimensions and elevations.
- Description of adjustable gates, soil and water control devices.
- Profile along top of any dam and a typical cross section of the dam.
- Determine the use of the water resource (stock water, fish, recreation, power, irrigation, municipal or industrial water supply, etc.).

Determine riparian ownership(s) as well as any water rights.

- Note the existing conditions of the stream, river, pond, lake or wetlands as to turbidity and silt.

5. Environmental Considerations

The need for environmental data in the engineering analysis and design stems from the need to investigate and mitigate possible impacts due to specific design configurations. Environmental data needs may be summarized as follows.

- Information necessary to define the environmental sensitivity of the facility's site relative to impacted surface waters, e.g., water use, water quality and standards, aquatic and riparian wildlife biology, and wetlands information. Some of this information is available in the water quality standards and criteria administrated by the Alaska Department of Environmental Conservation.

- Physical, chemical and biological data for many streams are also available from the Alaska Departments of Environmental Conservation, Natural Resources, Fish and Game, Federal water pollution control agencies, the U.S.G.S. and from municipalities, water districts and industries which use surface waters as a source of water supply. In unique instances a data collection program possibly lasting several years and tailored to the site may be required.

- Information necessary to determine the most environmentally compatible design. Data on circulation, tides, water velocity, water quality and wetlands are available from the U.S. Coastal and Geodetic Survey, U.S. Army Corps of Engineers, U.S. Geological Survey, universities, marine institutes, State, Federal, and local agencies and organizations. Information on sediment transport is vital in defining the suitability of a stream for most beneficial uses including fish habitat, recreation and water supply. It may be essential for projects in critical water use areas such as near municipal or industrial water supply intakes.

- Information necessary to define the need for and design of mitigation measures shall be obtained, e.g., fish characteristics (type, size, migratory habits), fish habitat (depth, cover, pool riffle relationship), sediment analysis and water use and quality standards. Fish and fish habitat information is available from the Alaska Department of Fish and Game.

- Wetlands are unique and data needs can be identified through coordination with municipalities, boroughs, state and federal agencies.

6.3.4 Site Characteristics

A complete understanding of the physical nature of the natural channel or stream reach is of prime importance to a good hydraulic design - particularly at the site of interest. Any work being performed, proposed or completed, that changes the hydraulic efficiency of a stream reach must be studied to determine its effect on the stream flow. The designer should be aware of plans for channel modifications, and any other changes which might effect the facility design. The stream may be classified as:

- rural or urban,
- improved or unimproved,
- narrow or wide,
- rapid or sluggish flow,
- stable, transitional, or unstable, and
- sinuous, straight, braided, alluvial, or incised.

Geomorphological data are important in the analysis of channel stability and scour. Types of needed data are:

- sediment transport and related data,
- stability of form over time (braided, meandering, etc.),
- scour history/evidence of scour, and
- bed and bank material identification.

Roughness Coefficients

Roughness coefficients, ordinarily in the form of Manning's "n" values should be estimated for the entire flood limits of the stream. A tabulation of Manning's "n" values with descriptions of their applications can be found in the Channels Chapter.

Stream Profile

Stream bed profile data should be obtained and these data should extend sufficiently upstream and downstream to determine the average slope and to encompass any proposed construction or aberrations. Identification of "headcuts" which could migrate to or from the site under consideration are particularly important. Profile data on live streams shall also be obtained from the water surface. Where there is a stream gage relatively close, the discharge and/or stage, date and hour of the reading should be obtained for the time that the profile data were obtained.

Stream Cross-Sections

Stream cross-section data should be obtained that will represent the typical conditions at the structure site as well as other locations where stage discharge and related calculations will be necessary. The type of hydraulic analysis performed will govern the density of site data required. Surveys for computerized terrain modeling will require additional site information such as definition of slope break lines and distribution of survey points with regard to the triangular networks used in contouring routines.

Existing Structures

The location, size, description, condition, observed flood stages, and channel section relative to existing structures on the stream reach and near the site should be secured in order to determine their capacity and effect on the stream flow. Any structures, downstream or upstream, which may cause backwater or retard stream flow should be investigated. Also, the manner in which existing structures have been functioning with regard to such things as scour, overtopping, debris and ice passage, fish passage, etc. should be noted. With bridges these data shall include span lengths, type of piers, and substructure orientation which usually can be obtained from existing structure plans. The necessary culvert data includes other things such as size and length, inlet and outlet geometry, invert elevations, end treatment, culvert material, and flow line profile. Photographs and high water profiles or marks of flood events at the structure and past flood scour data can be valuable in assessing the hydraulic performance of the existing facility.

Acceptable Flood Levels

Improvements, property use, and other developments adjacent to the proposed site both upstream and downstream may determine acceptable flood levels. Incipient inundation elevations of these improvements or fixtures shall be noted. In the absence of upstream development acceptable flood levels may be based on freeboard requirements of the highway itself. In these instances, the presence of downstream development becomes particularly important as it relates to potential overflow points along the road grade.

Flood History

The history of past floods and their effect on existing structures are of exceptional value in making flood hazard evaluation studies, as well as needed information for sizing structures. Information may be obtained from newspaper accounts, local residents, flood marks or other positive evidence of the height of historical floods. Changes in channel and watershed conditions since the occurrence of the flood should be evaluated in relating historical floods to present conditions.

Recorded flood data are available from agencies such as:

- U.S. Army corps of Engineers and / or FEMA,
- U.S.G.S.,
- Bureau of Reclamation, and
- Departmental hydraulics files.

Debris and Ice

The quantity and size of debris and ice carried or available for transport by a stream during flood events should be investigated and such data obtained for use in the design of structures. In addition, the times of occurrence of debris and ice in relation to the occurrence of flood peaks should be determined; and the effect of backwater from debris and ice jams on recorded flood heights should be considered in using stream flow records. The extent and depth of aufeis and other icing problems should be recorded. Data related to debris and ice considerations can be obtained from the Department's maintenance personnel, and some federal agencies such as the USGS.

Scour Potential

Scour potential is an important consideration relative to the stability of the structure over time. Scour potential will be determined by a combination of the stability of the natural materials at the facility site, tractive shear force exerted by the stream and sediment transport characteristics of the stream. Data on natural materials can be obtained from the Department's existing bridge files or by tests of samples obtained at the site.

Bed and bank material samples sufficient for classifying channel type, stability, and gradations, as well as a geotechnical study to determine the substrata if scour studies are needed, will be required. The various alluvial river computer model data needs will help clarify what data are needed. Also, these data are needed to determine the presence of bed forms so a reliable Manning's "n" as well as bed form scour can be estimated.

Controls Affecting Design Criteria

Many controls will affect the criteria applied to the final design of drainage structures including allowable headwater level, allowable flood level, allowable velocities, and resulting scour, and other site specific considerations. Data and information related to such controls can be obtained from Federal, State and local regulatory agencies and site investigations to determine what natural or manmade controls shall be considered in the design. In addition, there may be downstream and upstream controls which should be documented.

1. **Downstream Control:** Any ponds or reservoirs, along with their spillway elevations and design levels of operation, should be noted, as their effect on backwater and streambed aggradation or degradation may directly influence the proposed structure. Also, any downstream confluence of two or more streams should be studied to determine the effects of backwater or streambed change resulting from that confluence.

2. **Upstream Control:** Upstream control of runoff in the watershed should be noted. Conservation and/or flood control reservoirs in the watershed may effectively reduce peak discharges at the site, cause streambed degradation due to sediment trapping, and may also retain some of the watershed runoff. Capacities and operation designs should be obtained. The Soil Conservation Service, Corps of Engineers, Bureau of Reclamation, electrical utilities, consulting engineers, and other reservoir sponsors often have complete reports concerning the operation and design of proposed or existing conservation and/or flood control reservoirs.

The redirection of flood waters can significantly affect the hydraulic performance of a site. Some actions that redirect flows are, debris jams, mud flows, and highways or railroads.

6.4. Survey Information

6.4.1 General

Complete and accurate survey information is necessary to develop a design that will best serve the requirements of a site. The Survey Party Chief in charge of the drainage survey shall have a general knowledge of drainage design and as such shall coordinate the data collection with the hydraulics engineer. The amount of survey data gathered shall be commensurate with the importance and cost of the proposed structure and the expected flood hazard as discussed in Section 6.3.2 and Appendix B.

At some large sites photogrammetry is an excellent method of securing the topographical components of drainage surveys. Planimetric and topographic data covering a wide area are easily and cost effectively obtained in many geographic areas. A supplemental field survey is required to provide ground truth data and data in areas obscured on the aerial photos (underwater, under trees, etc.).

Data collection shall be as complete as possible during the initial survey in order to avoid repeat visits. Thus, data needs must be identified and tailored to satisfy the requirements of the specific location and size of the project early in the project design phase. Coordination by the regional Locations Section with all projects requiring drainage related survey data before the initial field work is begun will help insure the acquisition of sufficient, but not excessive survey data.

6.4.2 Departmental Requirements

The Department's instructions for hydraulic surveys are contained Appendix B. Example forms and check lists are provided in Appendix C.

6.5. Field Reviews

6.5.1 On Site Inspection

Field reviews should be made by hydraulics engineer (designer) in order for the designer to become familiar with the site. The most complete survey data cannot adequately depict all site conditions or substitute for personal inspection by someone experienced in drainage design. Factors that most often need to be confirmed by field inspection are:

- channel geometry,
- selection of roughness coefficients,
- evaluation of apparent flow direction and diversions,
- flow concentration,
- estimate of bed material D50,
- observation of land use and related flood hazards,
- geomorphic relationships,
- highwater marks or profiles and related frequencies, and
- qualitative assessment of sediment transport.

An actual visit to the site where the project will be constructed should be made before any detailed hydraulic design is undertaken. This may be combined with the visit by others, such as the roadway and structural designers, environmental reviewers, and even local officials. The designer may visit the site separately, however, because of interests which are different from the others and the time required to obtain the data as warranted below.

There are several criteria that should be established before making the field visit. Does the magnitude of the project warrant an inspection, or can the same information be obtained from maps, aerial photos, or by telephone calls? What kind of equipment should be taken, and most important, what exactly are the critical items at this site? Photographs should be taken. As a minimum, photos should be taken looking upstream and downstream from the site as well as along the contemplated highway centerline in both directions. Details of the stream bed and banks should also be photographed along with structures in the vicinity both upstream and downstream. Close up photographs complete with a scale or grid should be taken to facilitate estimates of the stream bed gradation.

6.5.2 Check List

The forms to be used by the Department in identifying and cataloging field information are shown in Appendix C.

6.6. Data Evaluation

6.6.1 Objective

Once the needed data have been collected, the next step is to compile it into a usable format. The designer must ascertain whether the data contains inconsistencies or other unexplained anomalies which might lead to erroneous calculations or results. The main reason for analyzing the data is to draw all of the various pieces of collected information together, and to fit them into a comprehensive and accurate representation of the hydrologic and hydraulic characteristics of a particular site.

6.6.2 Evaluation

Experience, knowledge, and judgment are important parts of data evaluation. It is in this phase that reliable data should be separated from that which is less reliable and historical data combined with that obtained from measurements. The data should be evaluated by the hydraulics engineer for consistency and to identify any changes from established patterns. Reviews should be made of such things as previous studies, old plans, etc., for types and sources of data, how the data were used, and any indications of accuracy and reliability. Historical data should be reviewed to determine whether significant changes have occurred in the watershed and whether these data can be used. Data acquired from the publications of established sources such as the U.S.G.S. can usually be considered as valid and accurate. Data should always be subjected to careful study by the hydraulics engineer for accuracy and reliability.

Basic data, such as stream flow data derived from nonpublished sources, should be evaluated and summarized before use. Maps, aerial photographs, satellite images, and land use studies should be compared with one another and with the results of the field survey and any inconsistencies resolved. General references should be consulted to help define the hydrologic character of the site or region under study and to aid in the analysis and evaluation of data.

6.6.3 Sensitivity

Often sensitivity studies can be used to evaluate data and the importance of specific data items to the final design. Sensitivity studies consist of conducting a design with a range of values for specific data items. The effect on the final design can then be established. This is useful in determining what specific data items have major effects on the final design and the importance of possible data errors. Time and effort should then be spent on the more sensitive data items making sure these data are as accurate as possible. This does not mean that inaccurate data are accepted for less sensitive data items, but it allows prioritization of the data collection process given a limited budget and time allocation.

The results of this type of data evaluation should be used so that as reliable a description as possible of the site can be made within the allotted time and the resources committed to this effort. The effort of data collection and evaluation should be commensurate with the importance and extent of the project and/or facility.

Appendix A Sources of Data

Principal Hydrology Data Sources

- Meteorological Data
  National Oceanography and Atmospheric Agency (NOAA)
  Climatic Data Center
  Asheville, North Carolina 28801
- Regional and local flood studies
- U.S. Geological Survey regional and any site studies
- Surveyed high water marks and site visits.
- Hydrology data from others (see below)

Principal Watershed Data Sources

- U.S. Geological Survey maps ("Quad" sheets)
  U.S. Geological Survey
  Rocky Mountain Mapping Center
  Stop 504
  Denver Federal Center
  Denver, Colorado 80225
  (303) 236-5829
- EROS aerial photographs
  U.S. Geological Survey
  EROS Data Center
  Sioux Falls, South Dakota 57198
  (605) 594-6151
- U.S. Geological Survey
- State and local maps and aerial photos
- State geological maps
- Soil Conservation Service and BLM Soils Maps
- Borough Soils Maps
- Site visits
- Watershed data from others (see below)

Principal Site Data Sources

- DOT&PF files of aerial drainage surveys
- DOT&PF files for existing facilities
- Site visits by DOT&PF
- Field or aerial surveys from others (see below)

Principal Regulatory Data Sources

- Federal Flood Plain delineations and studies
  Federal Emergency Management Agency
  Flood Map Distribution Center
  6930 (A-F) San Tomas Road
  Baltimore, Maryland 21227-6227
  Watts 71-800-638-6620
- State floodplain delineations and studies
- FHWA design criteria and practices
  Alaska Division
  Federal Highway Administration
  U.S. Department of Transportation
  709 W. 9th St. Room 851
  P.O. Box 21648
  Juneau, Alaska 99802-1648
- State laws
- Local ordinances and master plans
- Agency Policy Statements
- Corps of Engineers Section 404 permit program (see Environmental below)
- U.S. Coast Guard
- U.S. Environmental Protection Agency (EPA) (see Environmental below)
- Alaska Department of Environmental Conservation (see Environmental below)
- Federal Registers
  Superintendent of Documents
  U.S. Printing Office
  Washington, D.C. 20402
  (202) 783-3238

Principal Environmental Data Sources

- U.S. Environmental Protection Agency data and studies
- Corps of Engineers data and studies
- U.S. Geological Survey water quality data
- Alaska Department of Environmental Conservation water quality data
- Environmental statements prepared by other Federal, State, and local agencies as well as private parties
- Environmental data from others (see below)

Principal Demographic, Economic and Political Data Sources

- Alaska Department of Community and Regional Affairs
- U.S. Department of Interior, Bureau of Indian Affairs
- City and Boroughs
- Site visits
- Internal reports, memorandums, minutes, and verbal communications

Other Data Sources

- U.S. Bureau of Reclamation (USBR)
  U.S. Bureau of Reclamation Center
  Denver, Colorado 80225
  (303) 236-8098
- Regional and State U.S. Bureau of Land Management (BLM)
- Regional U.S. Environmental Protection Agency (EPA)
- Regional U.S. Federal Emergency Management Agency (FEMA)
- Regional and State U.S. Fish and Wildlife Service (USFWS)
- Regional and State U.S. Forest Service (USFS)
- Regional and State U.S. Soil Conservation Service (SCS)
- Regional and State U.S. Corps of Engineers (COE)
- Regional U.S. Coast Guard (USCG)
- Regional and State U.S. Geological Survey (USGS)
- Regional and State Federal Highway Administration (FHWA)
- National Weather Service (NWS)
- National Marine Fisheries Service (NMFS)
- National Oceanic and Atmospheric Administration (NOAA)
- Alaska Department of Fish and Game
- Alaska Department of Environmental Conservation
- Alaska Department of Natural Resources
- State or local drainage, flood control, and watershed districts
- Native Corporations and Indian councils
- Municipal governments
- Any river basin compacts, commissions, committees, and authorities
- Private citizens
- Private industry

Appendix B Hydraulic Survey Instructions

General

Hydraulic surveys for the Department are normally performed by the regional hydraulics engineer and by a survey party. The regional hydraulics engineer performs a field survey for specific hydraulic information (see Appendix C - Field Investigation Form) while the survey party develops the site plan and cross section information.

By definition, all directions (i.e. left bank, right bank) are given looking downstream. All channel stationing is given from downstream to upstream.

Site Survey Requirements for Bridges

Existing structures should be located horizontally and vertically (stations, offsets, and elevations). Bearings for tangents to an existing bridge should be provided and compared to as-built bearings. New surveys must always be reconciled with As-built drawings, with elevation and station conversion between new and old supplied. Points normally needed are the existing Begin Bridge and End Bridge at centerline, and the four corners of the bridge. If asphalt is present, alternate shots such as wingwalls or rails should be made or the asphalt removed. Contact Bridge Design for preferred alternate shot locations for the specific bridge.

Shots on an existing bridge should be specific points that are thoroughly described so that they are identifiable and repeatable. The surveyor should use a copy of As-built drawings and consult with Bridge Design for which locations would be the "best" to shoot.

Surveyed point density should be greatest around existing and proposed bridge site (if different). Centerline of roadway at least 100'-200' from bridge ends should be surveyed and reconciled with As-built drawings. Definition of existing and proposed embankment approaches to bridge are important to defining wingwall and retaining wall design as well as hydraulic design of the structure. It is useful also to have some points shot directly under the bridge to define the streambank/embankment there.

The survey crew chief should coordinate with Bridge Design for additional project specific requirements and to arrange for As-built copies prior to field work.

Bridge Hydraulic Survey Requirements

As a general rule of thumb, channel cross-sections normal to flow direction should be measured at intervals up and downstream of approximately one channel width. A minimum of four cross sections downstream of centerline and three upstream of centerline should be performed. Hydraulic modeling considerations require a cross section at the downstream edge of a bridge, so this should be used as the baseline for determining where all cross sections are located. If the bridge is skewed with respect to flow direction then the baseline should be located at the downstream corner of the bridge. If a proposed bridge location is different than existing location then cross section should be located with respect to existing conditions and an additional cross section located at the approximate downstream edge of proposed structure, if known. Each cross section should be long enough to encompass the limits of the floodplain so that overbank flood areas can be defined. Each cross section should have surveyed points (X,Y,Z) at each breakpoint. Relying on the digital terrain model (DTM) to generate cross sections does not give adequate accuracy.

An accurate depiction of the channel cross section is needed. Providing points at the edge of bank and deepest point of channel at a cross section (thalweg) is insufficient. For shallow streams, wading will be required. For deeper rivers, a hydrographic (boat) survey will have to be performed.

In addition to cross sections, both edges of water should be surveyed at the midpoint between each cross section or a maximum of every 50 feet, whichever is less. The Ordinary High Water Elevation line within (at a minimum) the construction corridor along both banks is needed. Ordinary High Water Elevation is generally defined at a given point along the streambank as the elevation of the "trimline" of perennial vegetation.

The State Hydraulics Engineer should be contacted by the survey crew chief prior to survey to identify any other specific survey requirements for hydraulic analyses.

Site Survey Requirements for Culverts (48" in diameter or greater)

Cross sections, as described above, should be located at the estimated catch point of the embankment at top of streambank upstream and downstream of centerline. Cross sections should be oriented normal to flow direction. Provide at least two additional cross sections downstream and one additional cross section upstream at an interval of one stream width. The thalweg line should be surveyed at a minimum of 20 foot intervals for entire stream reach within cross sections. Thalweg is defined as the line of deepest channel along a river reach.

Provide existing and proposed (if available) horizontal and vertical alignment of centerline and typical section. Existing culverts should have points surveyed at both upstream and downstream inverts, identify size and type of culvert, and station/offset. The survey crew chief should coordinate with the hydraulics engineer prior to fieldwork for specific requirements.

Data Requirements and DTM Considerations
Site plan information and drawings should be transmitted to the designer in both hard copy and in the appropriate digital format for the digital terrain model (DTM). The digital information required by the designer includes contous, TIN, fault lines, point file with descriptions, and horizontal and vertical alignments and typical sections. Standard point descriptions used in all regions should be used so that different field crews (and different regions) use the same notation.

DTM considerations: Avoid long narrow triangular elements if possible. Provide fault lines at topographic breaks. Faultlines should be identified on the DTM in a unique layer. Contours must be verified/ground truthed.

Provide description of basis of survey, monuments, local coordinate system with sketch, and true north direction. Datum must be identified and reconciled with As-Builts plans. If the site is coastal (ie. stream crossing may be affected by tide) datum should be MLLW.

Form 1

Field Visit Investigation Form

UNITS: ENGLISH __________

METRIC: __________

STRUCTURE TYPE_________________________

SIZE OR SPAN_____________________________

OF BARRELS OR SPANS__________________

CLEAR HT_________________________________

ABUT TYPES______________________________

INLET TYPE_______________________________

EXISTING WTWY COVER__________________

OVERFLOW BEGINS @ EL._________________

MAX AHW (FT)_____________________________

REASON:___________________________________

UP OR DOWNSTREAM RESTRICTION:_______

OUTLET CHANNEL, BASE__________________

MANNING'S n VALUE:_____________________

STREAMBED MATERIAL___________________

PONDING__________________________________

BRIDGES UPSTREAM AND DOWNSTREAM

LAND USE UPSTREAM AND DOWNSTREAM

SURVEY REQUIRED? YES_____ NO_____

REMARKS:

DATE_______________________________________

PROJECT____________________________________

BY____

PIERS: TYPE________________________________

SKEW_______________________________________

INLET______________________________________

OUTLET_____________________________________

% GRADE OF ROAD____________________________

% GRADE OF STREAM__________________________

LENGTH OF OVERFLOW_________________________

CHECK FOR DEBRIS___________________________

CHECK FOR ICE______________________________

SIDE SLOPES________________________________

HEIGHT OF BANKS____________________________

PHOTOGRAPHS:

LOOKING UPSTREAM___________________________

LOOKING DOWNSTREAM_________________________

STRUCTURE ELEVATION VIEW___________________

HIGHWATER MARK_____________________________

OTHER______________________________________

Form 2

Hydraulic Survey Field Inspection Check List

I. GENERAL PROJECT DATA

1. Project Number:______________________________ 2. Borough:______________________________________

3. Road Name____

4. Site Name:__________________________________, Station____________________M.P.__________________

5. Site Description: ( ) Cross drain, ( ) Storm Drain, ( ) Long. Encroach, ( ) Channel. Ch., ( ) Other

____

6. Survey Source: ( ) Field, ( ) Aerial, ( ) Other____

7. Date Survey Received:__________________, From____

8. Site Inspected by _____________________________, on______________________ (name)

(name) (date)

II. OFFICE PREPARATION FOR INSPECTION

1. Reviewed:

Aerial Photos - ( ) Yes, Photo #'s________________________, ( ) None Available

Mapping/Maps - ( ) Yes, Map #'s_________________________, ( ) None Available

Reports - ( ) Yes, ( ) No, ( ) None Available at this time

Department Permanent File – ( ) Yes, ( ) No, ( ) No file data found

2. Special Requirements and Problems Identified for Field Checking:

( ) Hydrologic Boundary – obtain hydrologic channel geometry

( ) Adverse Flood History – obtain HW Marks/dates/eye witness

( ) Permits Required – ( ) COE ( ) Ch. Ch., ( ) Dam, ( ) Coast Guard

( ) Other____

( ) Adverse Channel Stability and Alignment History – Check for headcutting, bank caving, braiding, increased meander activity, debris

( ) Structure Scour – check flow alignment, scour at culvert outlet or evidence of bridge scour

( ) Obtain bed/bank material samples at____

III. FIELD INSPECTION

(The following details obtained at the site are annotated on the Drainage Survey)

1. Survey appears correct: - ( ) Yes, ( ) Apparent errors are:____

____

which were resolved by:____

2. Flooding Apparent? – ( ) No, ( ) Yes, HW marks obtained, ( ) Yes, but HW marks not obtained

because____

3. Do all Floods Reach Site? – ( ) Yes, ( ) No and details obtained, ( ) No but details not obtained because ____

4. Hydrologic Ch. Geom obtained? – ( ) Yes, ( ) No because____ ____

5. Channel Unstable? – ( ) No, ( ) Yes because of ( ) headcutting observed and ( ) amount/location obtained, ( ) bank caving, ( ) braiding, ( ) increased meander activity, ( ) Other_______________________

6. Structure Scour in Evidence? – ( ) No, ( ) Minor, ( ) Yes and ( ) obtained bed/bank samples and ( ) noted any flow alignment problems, ( ) Yes and ( ) bed/bank materials samples not obtained and ( ) flow alignment not noted because____ ____

7. Main Channel and Overbank Manning's "n" obtained? – ( ) Yes, ( ) No because______________________ ____

8. Property damage due to backwater – ( ) No ( ) Yes and elevation/property type checked, ( ) Yes but elevation/property type not obtained because____ ____

9. Environmental Hazard Present? – ( ) No, ( ) Yes, detailed obtained, ( ) Yes, details not obtained because____ ____

10. Ground Photos Taken? – ( ) Upstream floodplain and all property, ( ) Downstream floodplain and all property, ( ) Site looking from downstream, ( ) Site looking from upstream, ( ) Channel Material w/scale, ( ) Evidence of channel instability, ( ) Evidence of scour, ( ) Existing structure inlet/outlet, ( ) Other_____ ____

11. Effective drainage area visually verfied? – ( ) Yes, ( ) No because__________________________________ ____

IV. POST INSPECTION SURVEY ANNOTATION

1. Section II Findings annotated on survey? – ( ) Yes, ( ) No and see section attached (attach typed explanation by site station and site name, and check list section and number).
2. Survey Originals and check lists forward to ( ) Yes, ( ) ADOT&PF Regional Design,____________ea., and the ( ) DOT&PF Hydraulics Unit,__________________ea. for hydraulic design.

______________________/s/____________________

(Designer Making Inspection)