APPENDIX E
TOPOGRAPHIC DATA REQUIRED FOR STORMWATER ANALYSIS

Introduction

This appendix discusses the field data that is required to conduct a hydraulic analysis of a storm drain system. This data is required for stormwater systems that are new, replacements, additions or modifications of pipes, inlets, manholes, storm water control, stormwater treatment and other storm drain facilities. The hydraulics designer should meet onsite with the survey party chief to go over the required limits of the survey beyond the edge of pavement or back of sidewalk and other unique data requirements of the site. This will ensure that the survey will be cost effective, gather the necessary data and avoid repeat visits to the site by the surveyors to gather additional data.

Required Field Data

1. GENERAL

   a. Vertical Reference should be identified. All brass disks within project limits should be referenced and identified. Surveys in FEMA floodplains need to tie the reference marks used in the Flood Insurance Study to the project survey. The hydraulics designer can supply the locations and descriptions of the reference marks. The preferred vertical reference hierarchy is:

      - known benchmark,
      - assumed datum (as shown on plans), or
      - other assumed datum.

   b. Sketch should be prepared for each drainage structure (manholes, inlets, etc). The sketch should include north arrow, pipe alignment, benching details, internal apparatus configuration, internal dimensions, manhole rings, and manhole lid orientation to manhole base.

   c. Photographs. Each photograph should include a description of the item(s) shown. Record the name and address of the photographer and the date the photos were taken. Take photographs, either film or digital, of:

      - Existing pipe outfall. Take a photo of the outlet of the pipe and any energy dissipater structure or material.
      - Channel downstream from the pipe outfall. Take a photo looking upstream and a photo looking downstream while standing near the outfall.
      - Erosion or scour problem areas.

- Take a photo looking ahead on line and a photo looking back on line from the pipe outfall.
- Locations where floor elevations are obtained.
- Hydraulic controls such as rock outcrops, rock ledges, weirs, dams, valves, gates etc. (See chapter text.)
- Developed property in or adjacent to the waterway, such as pump intakes, retaining walls, fences, pedestrian bridges, structures, etc. These photos will record the condition of the facilities before the project is constructed. They may be valuable if there is future litigation.
- Ordinary High Water elevation marks. Usually these elevations are located and staked by individuals knowledgeable in stream geomorphology such as the project fisheries biologist or hydraulics designer. See **Chapter 6** for guidance.

d. Describe significant debris accumulation near the pipe outfall or in the channel within project limits.

e. Obtain floor elevation and location of upstream houses and buildings.

2. ROADWAY DRAINAGE FEATURES

a. The following data is needed for projects that are replacing or modifying an existing storm drain system. Most of this data may be available from existing roadway plans, but it should be field verified.
b. Obtain information on roadway drainage features. Roadway drainage features include roadside ditches, overside drains, curbs, curb & gutters, valley gutters, inlets (grates, curb openings, slotted drains, etc), manholes, and junction structures. The information should reflect the location, size, and elevation of each feature.
c. Collect data on all drainage features within the project R/W and features outside the project R/W that contribute stormwater runoff to the system being evaluated. This includes roof drains, area drains, parking lot drains, etc.
d. Inlet Information
   - Size of Grate/Opening
   - Type of Grate
     (1) Type 1: Bars in two directions; Bicycle Safe.
     (2) Type 2: Bars in one direction
   - Invert elevations of all pipes
   - Sump Description (Depth of sump below lowest flowline, depth of sediment in sump)
   - Material of inlet box if visible.
   - Internal Parts
     (1) Identify location of pipes protruding into inlets and distance of protrusion.
     (2) Diameter of Orifice Plate openings
     (3) Weir Height, width, thickness

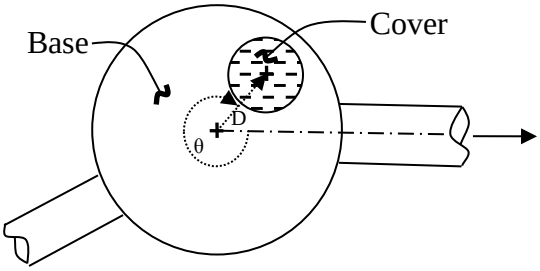
Table 1: Inlet Types

I.D.	Configuration	Where Used	Standard Drawing No.
G-1	Single Grate*	Small areas with no debris; recommended for two-lane highways.	RD364
G-2	Double Grate*	Where considerable water or debris is anticipated; recommended for multiple-lane highways	RD364
G-2M	Single Grate	Areas without traffic, bicycles or pedestrians such as medians and ditches.	RD364
G-2MA	Single Grate with Concrete Apron	Areas without traffic, bicycles or pedestrians such as medians and ditches having variable 1V:10H-1V:20H side slope.	RD364
CG-1	Single Grate* plus Curb Opening	Where debris or trash is anticipated and in sags; recommended for two-lane highways.	RD366
CG-2	Double Grate* plus Curb Opening	Where considerable water or debris is anticipated and in sags; recommended for multiple-lane highways	RD366
CG-3	Curb Opening only	Where longitudinal grade is relatively flat and bicycle traffic is anticipated; good debris passage capabilities.	RD372
Curb Inlet Channel	Curb Opening Extension for attachment to CG-1 or CG-2 inlets.	Where longitudinal grade is relatively flat and bicycle traffic is anticipated; good debris passage capabilities.	RD366
D	Single Grate* on Inclined Slope	Side drainages and at end of ditches where debris is anticipated; functions as a trash rack.	RD370
Type 3 C.B.	Single Grate*	Where minimal debris or trash is anticipated and where pedestrians may be present.	RD378
Area Drainage Basin or Field Inlet	Single Round Grate* with Concrete Apron.	Where No Traffic is anticipated. Medians, ditches, flat vegetated areas.	RD374
Slotted Drain	CMP Slotted Drain	To collect shallow sheet flow or along narrow shoulders. Areas with minimal debris ; not recommended for sags.	RD328
Trench Drain	Long Narrow Grates	To collect shallow sheet flow or along narrow shoulders.	N/A
Deck Drain Type A	Single Grate* Deck Drain.	Bridge deck drain	BR120

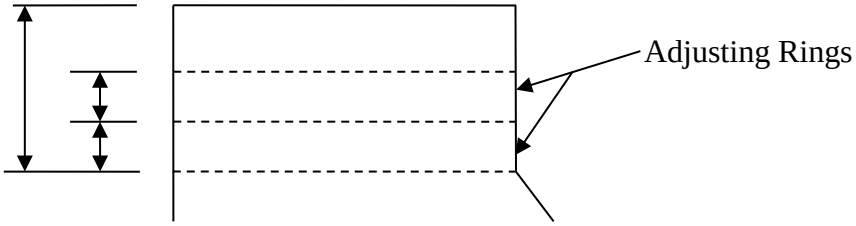
* Bicycle safe grate(s)

e. Manhole Information

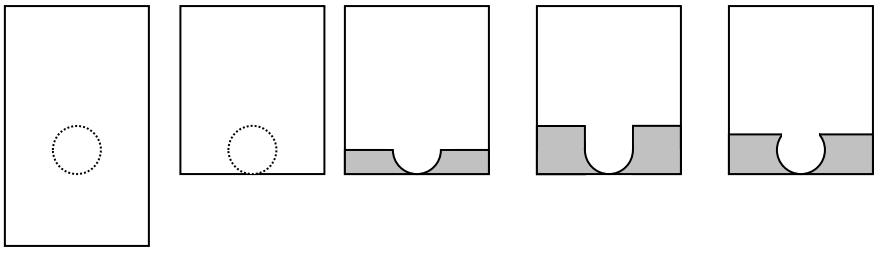
- Invert elevations of all pipes
- Center of Manhole Cover
- Center of MH Base
  During design and construction manholes are located and described by station of the center of the manhole base rather than the manhole cover.
  - Offset distance, D; and from center of manhole base to center of cover (± 0.2 ft).
  - Rotation angle, θ; from centerline of outlet pipe [largest diameter pipe if split flow manhole] measured clockwise to the center of manhole cover (± 10°).



- Material of manhole structure if visible.
- Inside Manhole Diameter
- Drop Manhole (Y/N); refer to standard drawing RD352.
- Measure number of adjusting rings on manhole riser and riser height.



- Benching: Describe type of benching in bottom of Manholes (see below).



- Sump Description (Depth of sump below lowest flowline, depth of sediment in sump)

- Internal Parts

(1) Identify location and of pipes protruding into manholes and distance of protrusion.
(2) Diameter of orifice openings
(3) Weir Height, width, thickness

3. STORM DRAIN SYSTEM PIPES

a. Pipe Condition: T.V. inspection should be used for projects that contain storm drain pipe. Storm drain pipes in poor condition may need to be replaced or rehabilitated. The Storm Drain Pipe Inspection Form in Appendix F can be used to evaluate the condition of a pipe.

b. Type of storm drain (i.e., rectangular (box), circular, pipe-arch, etc.)

c. Storm drain material (i.e., concrete, metal, or plastic)

d. Invert elevation on each end

e. Size

f. Length

g. End treatment (i.e., sloped, mitered, or projecting ends, headwall with wingwalls, etc.)

h. Pipe outfall and any energy dissipater structure or material.

4. STORM DRAIN PIPE PROFILE

a. The profile should extend a sufficient distance upstream and downstream from the project site to accurately determine the affects of any proposed modifications.

b. Profile 500-1000 feet upstream and downstream for storm drains smaller than 24- inches. Profile 1500-3000 feet upstream and downstream for storm drains 24 inches and larger. Adjust the profile length as necessary to satisfy 4a. Elevations should be located along the storm drain flowline (lowest point) and be taken at every structure or junction.

c. Report inaccessible flowlines due to appurtenances or obstructions.

5. CROSS-SECTIONS and STREAM PROFILE

   Cross-sections and a stream profile may be necessary if an analysis is required downstream of a pipe outfall to determine tailwater or downstream impacts. Any significant roadside ditches or channels may also require this data be collected. Refer to Appendix C.

6. LOCAL KNOWLEDGE OF PAST FLOODS

   a. Source of historic flood information is from local residents or maintenance personnel. If local knowledge is obtained, give name and phone number of contact, otherwise give name and phone number of people that can be contacted later.

   b. Highest water elevation and date of occurrence. If a high-water elevation is available, the exact location and elevation of the high-water mark should be surveyed.

   c. Is roadway flooded into traveled lanes? If so, obtain spread width of water into roadway and length of roadway flooding.

   d. Any debris or ice problem?

   e. Photos of past flooding?

   f. Sediment problem?

7. UTILITIES

   The location, size, and elevation of all utilities should be obtained in areas where construction of new, modified, or replacement storm drainage facilities are anticipated. Utility conflicts discovered during construction can cause major project delays and cost overruns.

8. SPECIAL DATA

This data would only be required if specifically requested by the designer.

- Describe or show where flowline is measured
- Inside dimensions of Inlet Box
- Absolute confidence of flow direction and flowline elevation
- Material (Not visible from surface)
- Identify eccentricity of MH – Provide Sketch and internal dimensions.

Sample Sketch: