

## VI. SURVEY STANDARDS

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### A. General

In surveying for the alignment of sewer outfalls, extensions, and water lines, it is important for the Survey section to collect as much information as possible to assist the Design Section in preparing a clear, concise, and accurate set of construction plans and right-of-way maps. In order to assist the Drafting Technicians and Civil Engineers and to avoid confusion between the respective sections, a standard set of survey symbols, abbreviations, nomenclature, and field notes will be used by the Survey Section and are available upon request.

In preparing a set of field notes, keep in mind these general requirements of good note keeping:

1. Use a sharp pencil of medium hardness (2H or 3H).
2. Do not erase. If an item is recorded in error, draw a line through it without destroying its legibility and record the correct item above it.
3. Avoid copying notes. If notes must be copied, turn in the original notes with the copied notes.
4. Record notes in the field as you get your measurements, not at a later time from memory.
5. Make a sketch. Be sure to decide what you want to show and organize your sketch before you begin.
6. Don't crowd your sketch. If your sketch is too small, void it and start over (use a legal pad if necessary).
7. Use a straight-edge and templates in drawing sketches.
8. Show a north arrow on all sketches.
9. Use standard symbols and abbreviations on sketches.
10. Start each day's notes on a new page.
11. Show the job number and date on each page of field notes.
12. Number each page of field notes.
13. Review your notes before leaving the field to be sure they are complete.
14. Use the checklist to make sure that you have all the necessary information.

### B. Preliminary

The preliminary steps in any sanitary sewer project fall under the responsibility of the Design Engineer and the Survey Supervisor. These persons work together to make sure that all necessary information pertaining to the project is gathered together prior to assignment to the Survey Party Chief.

The information that should be gathered and included in the project folder is:

1. Topographic map(s) showing approximate route of sanitary sewer.
2. Tax map(s) showing property owners being affected and adjoining the proposed sewer route.

3. Water map(s) showing size and approximate location of existing water mains, valves, blow offs, etc.
4. Gas map(s) showing approximate location of gas mains and valves.
5. Location and elevation of available bench mark descriptions or designation of existing flow line elevation.
6. Locator service number and place to meet representatives or locating companies.
7. Project schedule showing project name and job number; this name and number should be reflected on all field notes and daily reports.
8. Available record maps and/or deeds.

The Survey Supervisor will review the project file with the Survey Party Chief prior to beginning the job. The Survey Party Chief should be certain that they understand what is required. This is the time to ask questions relating to the project, not after the job is completed.

If a problem relating to location arises, contact the Survey Supervisor and/or Design Engineer and someone will come to the site to assist you in determining the route. On all major projects, the Design Engineer should walk the project with the Survey Party Chief prior to establishing the alignment.

### **C. Sanitary Sewer Outfall & Trunk Lines**

#### **Plan view:**

Outfalls and trunk lines are the major collector lines for wastewater throughout the system. The purpose of these lines is to collect the flows within a particular basin and carry the wastewater to the treatment plants. These are gravity lines of 8" to 72" in diameter that follow the low areas of a basin.

Important points to remember in the surveying of these lines are:

1. Follow the low points of the drainage area as much as possible.
2. Maintain a working distance from any creek banks, generally 15'-20' is sufficient depending upon size and depth of line.
3. Set up the proposed line so that the line of sight is maintained between proposed manholes. Try to minimize the number of manholes needed to complete the project.
4. Proposed manholes are to be located with rebar or iron pipes of at least 1/2 inch diameter. (This helps to relocate manholes during construction.)
5. If possible, the proposed line should be parallel with and adjacent to existing property lines.
6. Locate all important physical features relating to the proposed line; i.e. locate creek, wire fences, other utility lines, property corners, buildings, large trees, R/W monuments, road and railroad crossings. A good rule to remember, "If in doubt, locate it".
7. When locating creeks, be sure to show the distance to creek banks and the width of the banks.
8. On the profile, show flow line elevation of creek and elevation of top of

- creek banks.
9. When crossing existing utility easements (gas, electric, etc.) show width of R/W or clearing and angle relationship to proposed sanitary sewer.
  10. When crossing existing roads, show the road name and number, R/W width (if known or find monuments), type surface, width of surface, and angle relationship to proposed line.
  11. Locate any significant trees within the proposed easements. These may be larger trees than the average or particular species such as walnut, dogwood, etc.
  12. Be sure to locate any significant ground features that may affect construction. Pay particular attention to rock outcrops and swampy ground conditions.
  13. Remember to follow the maximum spacing guidelines for the size sewer being proposed (see IV.E.2b).
  14. When locating for plan view, locate all features within the right-of-way and temporary construction easement (see pages 11-13 for symbols). Generally, locate within 25' of either side of centerline.
  15. Show centerline station on guard stakes at proposed manholes.
  16. All angles on the proposed centerline should be "doubled" with difference not to exceed 20" (seconds).
  17. Get backsight distance and bearing to existing manhole at beginning of the project.
  18. Trunk lines and outfalls should be "tied" to NCGS or CMUD monuments.
  19. Locate any wells within 100' of centerline of outfalls.

**Profile:**

1. On all outfalls and trunk lines, elevations must be based on NGS, NCGS, or City of Charlotte established bench marks.
2. Verify elevation of flow line, shelf, and rim of existing manhole where the proposed line begins.
3. Along proposed route, temporary bench marks (TBM) must be set at each manhole.
4. Additional temporary bench marks should be placed adjacent to any road or underground utility crossings, as well as creek crossings that may require piers or a siphon.
5. Obtain bank of creek and flow line of creek elevations at each proposed manhole.
6. When crossing overhead utilities, get elevation of lowest wire or pipe.
7. When crossing underground utilities, get depth and size of utilities.
8. At road or street crossings, get elevations along the road in either direction for 200'-300'.
9. On areas of extreme side slopes, take cross-sections to either side of centerline at least 25'.
10. Locate, size, and get elevations on all storm drainage pipes and culverts that cross or parallel the centerline.
11. If outfall terminates at an existing pump station or treatment plant, be sure to get elevations on all existing lines running to the existing station.

#### D. **Sanitary Sewer Street Extensions**

Street extensions are the collector lines whose purpose is to bring the wastewater to the trunk lines and outfalls. These lines are generally 8" in diameter, and are usually located within the right-of-way of dedicated streets. It is to these lines that the individual lateral connections are made.

Important points to remember while surveying for street extensions are:

1. Survey line must begin at an existing line, preferably at a manhole.
2. A backsight should be taken on the existing downstream manhole.
3. Show "as-built" bearing to backsight manhole, or show azimuth as taken from magnetic reading in the field. (Even if bearing is shown on "as-builts", field azimuth is helpful to verify bearings.)
4. Be sure to obtain backsight distance.
5. If it is necessary to set a "straddle" manhole on the existing line, occupy one manhole and sight the next manhole and record bearing and distance between existing manholes, then set new proposed manhole on line and record distance to it.
6. Locate proposed manholes outside of paved street surface where possible. On state maintained roads, locate proposed manholes as far as possible from the pavement.
7. Locate all physical features within the street right-of-way (or adjacent if feature could impact construction; i.e., property irons, utility poles, existing valves and meters, curbs, driveways (give type), storm drainage, planters, mailboxes, signs, fences, trees and shrubs, gas lines, telephone cable, and electric lines.
8. Locate on both sides of the street. It may be necessary to shift to the other side during design.
9. Show width of street surface.
10. When running proposed sewer on the "outside" of a curved street, station proposed manholes so that the chords do not cut the pavement surface.
11. Locate end manhole approximately 5' within the lot (sideline extended) of the lot being served.
12. If lateral has been laid from the existing structure, locate it from the end manhole.
13. If proposed line must be extended within the pavement, try to stay in one lane. Traffic must be maintained during construction.
14. P. K. nails should be used to locate proposed lines if in existing pavement.
15. Show centerline station on guard stakes at proposed manholes. If proposed manhole is in pavement, mark with paint on pavement.
16. Angles on proposed centerline should be "doubled" with difference not to exceed 20" (seconds).
17. Continue locations 100'-150' past the end manhole if the line may be extended in the future.
18. Locate any wells within 100' of centerline of proposed sanitary sewer.

### **Profile for Street Extensions:**

1. When available, elevations should be based on NCGS or City of Charlotte established bench marks.
2. If established bench mark is not available, flow line out of the existing manhole may be used.
3. Verify flow line, shelf, and rim of existing manhole where extension begins.
4. Check existing manhole to determine whether or not there is a outside drop in the manhole.
5. If a "straddle" manhole is to be use for the beginning manhole, obtain flow line, shelf, and rim elevations of both upstream and downstream manholes.
6. Set a temporary bench mark near the beginning of the line (do not use the existing rim), at the end of the extension, and approximately every 500' between if necessary.
7. Locate, size, and get elevations on all storm drainage pipes either crossing or running parallel with proposed extension.
8. Locate and get elevations of any structure (finished floor and ground) or vacant lot lower than the street. Pay particular attention to those structures with basements.
9. If there is a depression between the street main and any existing structure, run a profile to the structure.
10. Locate and get elevation of the structure to be served. If lateral is installed, get flow line elevation.
11. If proposed extension does not extend to the crest of hill, continue profile to that point. Get size and elevation of any storm drainage that may be encountered.

### **E. 16" and Larger Water Mains**

#### **Plan:**

Within the CMUD system, water mains of 16" and larger diameter comprise the main feeder lines of the system. Because of their size, they cannot easily be deflected to miss an obstruction in their routing.

Important points to remember in surveying for these lines include:

1. Initial alignment is very important to insure that the project begin without difficulty. Locate the valve and blow-off at the end of the existing line. If possible, locate another valve or locate the existing line to get alignment.
2. Locate the proposed line as far from the existing pavement as possible. Try to locate the line 5' from the right-of-way.
3. Locate all physical features along the proposed route; pavement, existing utilities, storm drainage, sanitary sewer, property corners, R/W monuments, driveways, street intersections, bridges and culverts.
4. Stations shall be measured along the arc of curve, not chord of curve.

5. If necessary to deflect proposed line, use standard pipe bends ( $45^\circ$ ,  $22\text{-}1/2^\circ$ ,  $11\text{-}1/4^\circ$ ).
6. At creek crossings, use  $45^\circ$  bends to deflect around bridge abutment.
7. When deflecting around bridge footings, line should be no closer than 10' to footing at any point.
8. Downward deflection to cross creek should be approximately 10' from creek bank.
9. Locate all street intersections with angular relationship to proposed water line.
10. Locate all major gas transmission lines with relationship to proposed water line.
11. Locate all railroad crossings with angular relationship to the centerline of railroad tracks and distance to nearest milepost.

**Profile:**

1. On all 16" and larger water mains, elevations must be based on NGS, NCGS, or City of Charlotte established bench marks.
2. Existing valve or water line elevation must be taken.
3. Along proposed route, establish temporary benchmarks near intersections and at all creek crossings.
4. Centerline profile will be taken at every 100' station, or intermediate station as necessary.
5. At all railroad or creek crossings, a detailed profile is necessary.
6. At street intersections, profile 200'-300' along crossing street for future extensions.
7. Get size and elevations of any storm drainage and sewer that is crossed.

**F. Water Mains Less Than 16"**

In some instances, it is necessary to conduct a location survey for the purpose of drafting plans for 12" and smaller lines. When surveying for 12" and smaller lines the following is required:

1. Locate all physical features within the road right-of-way along the proposed route: pavement, existing utilities, storm drainage, sanitary sewer, property corners, R/W monuments, driveways, street intersections, culverts.
2. Locate all railroad crossings with angular relationship to the centerline of railroad tracks and distance to nearest milepost.

Generally, a profile along the proposed route is not necessary. However, it is important to get a relationship from the ground to the invert of any storm drainage, sewer, water lines, or other utilities that may be crossed. If the proposed route requires a creek crossing, a profile will be required beginning at the point of deflection of the centerline and ending where the line will again parallel the edge of pavement.

## **G. Construction Stakeout - Sanitary Sewer**

CMUD is responsible for furnishing to the contractor a cut sheet for any sanitary sewer that is being built under CMUD contract.

It is the contractor's responsibility to request any needed cut sheets from the construction inspectors at least 72 hours prior to the time that he needs them.

Items to remember when construction staking:

1. When staking centerline and offsetting manholes prior to clearing, verify proposed manhole irons with plans, both angle and distance. (Alignment changes are sometimes made by design after field work is done.)
2. If there is a discrepancy between the plan and what is indicated on the ground, use the plan information.
3. Try to place first offsets for manholes outside of permanent right-of-way but within the temporary construction easement.
4. Construction stakes shall be set at every manhole.
5. If bench marks have been destroyed during clearing, set new temporary bench marks for contractor and inspectors to use.
6. Levels on all construction stakes will be double run. (This eliminates chance of error from misreading the level rod on offsets and turning points.)
7. Mark the offset from the manhole and the station number on the guard stake adjacent to each offset hub.
8. All proposed piers, concrete collars, and bores should be referenced both left and right of centerline.
9. Reference the centerline of all bores approximately 50' before beginning of bore and 50' past the end of bore.
10. Set an offset stake at any existing manhole at the beginning of the project. (Do not use existing rim as a reference, rims may be disturbed during excavation around existing manhole.)
11. Verify flow line elevations at existing manholes. Also check for drop inlets.
12. Cut sheets **are not** to be prepared in the field and given to contractor. If a situation arises where contractor must have cut sheets, the Survey Supervisor may authorize that a segment be prepared by the Survey Party Chief and a copy given to the project construction inspector for use on the project. Construction inspector will verify computations and initial original cut sheet.
13. All cut sheets will be prepared on CMUD cut sheet form.

## **H. Construction Stakeout - Water Mains**

The Survey Section provides the necessary construction staking to assist the Construction Inspectors and contractors on water main projects.

Such staking may include:

1. Stake centerline or offset for alignment of water mains.

2. Offsets and/or elevations for horizontal and/or vertical bends.
3. Grades for cut sheets on areas of critical elevation.
4. Alignment and grades for bores under road or railroads. (Construction staking for these bores will be done in the same manner as bores for sanitary sewer construction.)