

CITY UTILITIES DESIGN STANDARDS MANUAL

**Book 1
General Requirements (GR)
GR6 Surveying**

June 2015

GR6.01 Purpose

This Chapter discusses the various tasks associated with field surveys required for the design, construction, and approval of City Utilities projects. Projects requiring CUE approval and/or acceptance of constructed facilities should also follow these guidelines, unless otherwise instructed. Design engineers and survey crew chiefs should familiarize themselves with this and all other chapters of these Standards prior to commencing any field survey effort. Familiarity with the requirements will enable the field survey crew to efficiently obtain the necessary field information for design and construction and minimize the occurrence of unnecessary activities.

GR6.02 General

The members of the survey crew are normally the first project representatives to come in contact with the property owners/residents along the route of the proposed project. It is imperative, therefore, that the survey crew conduct themselves properly, both on the project site and in the surrounding community.

Proposed work should be explained to the affected property owners/residents and to the public, insofar as necessary. The survey crew should carefully refrain from outlining any specific plans or policies which might be misconstrued by individual property owners. If approached, the survey crew should not convey any project specific information to the property owners. If a citizen has project specific questions, they should be referred to the CUE project manager assigned to the project.

The survey crew shall be courteous at all times when interacting with the public and the crew members shall maintain a record of the names of owners/residents with whom they converse. During these conversations, survey crew should inquire as to the location of survey corners or monuments located on the property.

GR6.03 Survey Notification

Notification to property owners/residents is required when the survey crew must gain access to private property. The entity conducting the survey shall be responsible for the notifications. The survey notification procedure shall be as follows:

- generate a list of property owners who are within the project, adjacent to the project, and/or have lands that have to be accessible to the Professional Surveyor;
 - complete a Surveying and Inspection Notice, form provided in [Exhibit GR6-1](#);
 - submit property owner list and a copy of the Survey and Inspection Notice to the Project Manager; and
 - survey crew(s) shall maintain copies of Survey and Inspection Notice and Property Owner list with them when working in the field.
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GR6.04 Damage

Damage to public and private property resulting from the activities of survey crews are the sole responsibility of the entity providing the service. City Utilities assumes no responsibility for damage to public or private property during contracted field activities.

GR6.05 Horizontal and Vertical Control

Project control shall be established by setting temporary project control points with coordinates (horizontal and vertical). The temporary project control points shall be tied to either field located and verified property monuments or documented control points such as section corners, subdivision corners, control points established during route surveys, or other control points previously documented by City Utilities.

1. U.S. Survey Foot

All references to “foot” or “feet” in this Chapter shall mean US Survey Foot, which is the basis for the Indiana State Plane system.

2. Trees

Trees are not to be used for surveying purposes except in remote areas where there is no practical alternative. No spikes, nails, etc., are to be driven into a tree. Trees shall not be “blazed” under any circumstances and only water based paint may be used if it is necessary to mark a tree.

3. Guidelines

Horizontal and vertical control shall be established according to the guidelines defined by the following publications:

- Federal Geodetic Control Committee (FGCC), Standards and Specifications for Geodetic Control Networks;
- NOAA Technical Report NOS 88 NGS 19, *Horizontal Control*;
- NOAA Manual NOS NGS 3, *Geodetic Leveling*;
- FGCC, Geometric Geodetic Accuracy Standards and Specifications Using GPS Relative Positioning Techniques (or its subsequent revisions); and
- The Route Surveying Portion of Rule 12 as defined in Title 865 IAC 1-12-12 thru 1-12-26.

4. Datum

All control shall be related to existing monuments that have been approved by City Utilities and shall reference the appropriate datum as indicated below.

- Horizontal control shall be referenced to the Indiana State Plane Coordinate System, East Zone/HAC (1983).
- Vertical control shall be referenced to North American Vertical Datum (NAVD) 1988 unless otherwise requested.

5. Location Witness

All project horizontal control points, temporary or permanent, shall be witnessed to the nearest one-hundredth of a foot, at three or more exactly definable points on permanent structures with no reference being more than one hundred feet from the control point. If no permanent structures are nearby, two or more exactly definable points are to be set and occupied for measurement of angle and distance from each other to the control point. Each line of sight is to have an exactly definable back sight.

Permanent monuments placed during the survey process shall be individually documented using the Data Control Card form presented in [Exhibit GR6-2](#). Temporary control points and bench marks shall be documented in the format shown in [Exhibit GR6-3](#). Documentation for each monument or control point, whether permanent or temporary, shall be submitted to the Project Manager during the submittal of final plans or drawings.

All bench marks are to be exactly defined and shall be referenced to the survey project control points in addition to other field references such as addresses, etc., in field notes, plans and any other pertinent documents submitted.

6. Vandalized Survey Project Points and Bench Marks

The City will not assume responsibility for any damage done to project control points and bench marks until after the survey has been accepted. Any damage done to those points up to that time will be repaired or replaced by the Professional Surveyor at the Professional Surveyor's expense, if the vandalized points have not been properly field referenced before the occurrence of damage.

7. Degree of Accuracy

Horizontal surveys will adhere to Third Order, Class I specifications, except that adjustments may be made by either the Least Squares or Compass Rule Method. Vertical control will adhere to Third Order specifications, except that the error of closure will be equal to or exceed Second Order, Class II requirements. The specified criteria for surveys may vary according to their purpose. All surveys are subject to conform to Title 865 IAC 1-12-22.

The instruments used shall meet the specifications indicated in these guidelines or in following articles. All instruments shall be certified to National Institute of Standards and Technology standards and manufacturer's specifications. Certification shall be performed by the previously mentioned institute, the instrument manufacturer or a certified instrument repairs facility.

8. Control Points

Control points used for the completion of surveys may be existing or recorded monuments, or temporary control points set specifically for the project. The following articles outline the requirements for control points.

a. Temporary Project Control Points and Temporary Bench Marks

Temporary Project Control Points (TCPs) and Temporary Bench Marks (TBMs) are distinct from horizontal and vertical control monuments. TCPs may consist of, but are not limited to the following:

- a 2-inch minimum masonry nail in pavement
- a metal tack in a 1-inch x 2-inch wooden hub
- iron rebar or pipe

TBMs shall be established at a maximum of 500-feet and shall be located within a public easement or right-of-way. Acceptable TBMs include, but are not limited to, the following:

- a 2-inch minimum masonry nail in pavement
- a bolt on a fire hydrant which is not used for operation of the hydrant
- a painted or etched box or "x" in a curb, sidewalk, or other concrete structure

b. Documented Control Point Placement

There shall be a minimum of two horizontal control points. All horizontal control shall be located within the easement or public right-of-way. Each monument shall be placed to avoid movement caused by construction or other activities. Each and every horizontal control monument shall also be a vertical control and shall be set per Title 865 IAC 1-12-24(1) on all projects.

Vertical control monuments shall be placed similarly to horizontal control monuments at maximum intervals of 500-feet. When horizontal-vertical control monuments are also set, they shall be considered vertical control monuments. For projects less than 1,000-feet in length, the requirements for the placement of horizontal and vertical control shall be as directed by the project manager, and shall conform to Title 865 IAC 1-12-24(1).

c. Documented Control Point Monumentation

Monumentation of documented horizontal and vertical control shall meet or exceed the requirements of Title 865 IAC 1-12-24 (2 through 6). Standard permanent vertical control of bench marks, consisting of a 3½-inch diameter, or larger, domed disk set in the top of a 12-inch x 36-inch poured concrete post shall be used when vertical control monuments are specifically requested.

d. Documented Control Point Horizontal and Vertical Control Approval

When the final control work has been completed and checked, all computations shall be prepared on 8.5 inch x 11 inch sheets and shall be submitted to the Project Manager for review and approval.

The computations shall be indexed and bound in a neat and orderly manner, along with hard copies and electronic files of the actual field notes and all related drawings. If the horizontal traverse has been closed on a computer, the appropriate computer run showing any unadjusted data shall also be submitted.

Computations shall be submitted and stamped by a registered Professional Surveyor in the State of Indiana attesting to the accuracy of the survey.

e. Documented Control Point Horizontal and Vertical Control Map (Route Survey Plat)

A horizontal and vertical control map, otherwise known as a route survey plat; as shown in [Exhibit GR6-4](#) is required for all surveys completed for sanitary sewer projects, major stormwater projects, and potable water main projects, as designated by the project manager. Each route survey plat shall be prepared on a standard plan sheet and shall be included in the final plans. The final route survey plat shall include final stations, station equations, all curve data, and the final location and description of bench marks.

Horizontal control and vertical control information placed on the route survey plat shall be in accordance with Title 865 IAC 1-12-23, "Publication of Route Survey Results". The plat shall be submitted to the Allen County Recorder's Office and shall conform to the requirements and specifications of the Allen County Recorder.

Required horizontal information includes:

- angles at all baseline points of intersection and ties to available acceptable monuments
- bearings and distances on the final project centerlines and available baselines
- angles and stations with adjacent projects
- final coordinates (State plane or assumed)
- all bearings, coordinates, angles, and point designations on baselines in the design segment
- source of horizontal control
- any and all monuments marking the Public Land Surveying System as can be recovered with reasonable efforts
- any and all monuments marking subdivided lots, centerline control, and public project centerlines or baselines.

Vertical information to be shown includes:

- new bench marks - their designations, locations, descriptions and elevations
 - USGS, City or County bench marks - their designations, elevations and locations
 - source of vertical control
- f. Drawings and Field Notes of Desired Survey Locations

Survey drawings for all CUE Projects shall be provided to the Project Manager. All control points, bench marks, and topographic features shall be clearly identified.

GR6.06 Requirements for Survey Information and Data Collection

Requirements for survey information and data collection for CUE Projects have been developed to accurately define and assess the areas to be impacted by proposed projects. The following articles discuss the criteria governing survey information and data collection. A Surveying Scope Checklist for Design Surveys form is provided in [Exhibit GR6-5](#) to assist in determining the project-specific requirements of each survey.

1. Area to be Surveyed

Prior to the initiation of field activities, the development of the project area to be surveyed shall be coordinated with the Project Manager. Survey corridors and routes shall be developed specifically for each project. The corridor defined for surveys shall be sufficient in size to identify all physical characteristics of the project's topography.

Each survey shall include a sufficient number of shots, located approximately 10 to 20-feet, outside the existing right-of-way or survey corridor to assess the impacts of proposed limits on adjacent areas. Due to the varying requirements for each survey, the location of survey points outside the proposed survey corridor shall be coordinated with the project manager.

2. Physical Features to be Identified

All topography and physical features critical to the design of and potentially affected by the improvement shall be located and recorded in the field notes. The requirements for the location of man-made and natural physical features on the proposed survey shall always be discussed with the Project Manager prior to mobilization of field activities. Plan view requirements specific for Stormwater, Sanitary Sewer and Water are provided in their respective Books in the Standards.

Topography generated from aerial photography shall be identified and field checked for any errors or omissions. Omitted topography shall be located by field survey and appropriately recorded. This work is the specific responsibility of the engineer or Professional Surveyor, even

though the aerial photography may have been provided from other sources. All topography within the proposed project construction limits and/or easements and rights-of-way shall be field located.

3. Survey Information Needed for Trees

Unless otherwise directed, the following information shall be provided for trees within the proposed survey boundaries.

- Species of Tree (Use the Audubon Society Field Guide to North American Trees, Eastern Region)
- Size (DBH - Diameter at Breast Height)
- Dripline (Diameter)
- Location:
 - All trees 6-inches in diameter or greater and within 30-feet of the centerline of the pipe or 30-feet outside the toe of slope of ditches shall be located and the species given.
 - All trees less than 6-inches in diameter shall be located and species given, when within an existing or proposed sewer, water or drainage easement.
 - When trees are grouped together at a very close interval, locate the approximate limits of the grouping and list the most dominant species, average DBH, and approximate drip line of the group.

4. Field Profile Requirements

All field topography and profile activities shall conform to Title 865 IAC 1-12. Profile elevations shall be determined along stormwater sewers, sanitary sewers, potable water mains, and/or through drainage systems. Survey points to support the generation of profiles are to be collected at intervals of 25-feet nominally, where possible; at intervals of 50-feet nominally on paved streets, and at all intermediate breaks. Profiles shall delineate existing structures, roads, streams, etc. Elevations shall be established to the nearest one-tenth of a foot on natural terrain and to one-hundredth of a foot on artificial surfaces.

5. Cross sections

Cross sections shall be generated at 50-foot intervals and as needed at critical locations when it is necessary to determine what effect open cuts or trenching might have on other facilities such as structures, utilities, pavements, fences, trees, or landscaping. Survey points are to be taken to support the generation of the cross sections. Sufficient original ground elevations shall be determined to establish the slopes necessary to adequately serve the property. The project manager may modify these requirements to suit specific projects.

6. Subsurface and Overhead Utilities

All publicly and privately owned subsurface and overhead utilities affected by the proposed project shall be located and identified by the field survey and by use of maps supplied by the utilities. Locations,

elevations, and other pertinent data as may be required for possible relocation or adjustment shall be secured for all such utilities to the limits of information currently available.

The survey crew shall request that the underground utilities be marked by calling the Indiana Underground Plant Protection Services (IUPPS 811). The ticket number for the locate request shall be documented and submitted with the plans. The utility members notified by the request shall also be documented.

All sewer manhole structures within the survey corridor shall be surveyed. The next structures upstream/downstream from the survey corridor shall also be surveyed. A Structure Data Sheet, form in [Exhibit GR6-6](#), shall be completed for each structure. Manholes are considered confined spaces per OSHA and shall only be entered with the appropriate procedures and personnel.

Overhead power lines shall be accurately located within the survey corridor. The sag elevation of the overhead lines between poles shall be documented.

7. Summary of Topographic Survey Elements

Complete topographic survey data along proposed project corridor, including the natural and man-made features of the land, as well as its elevations. Facilities to be located shall include, but are not be limited to:

- sanitary and storm sewer manhole rim and invert elevations
- stormwater inlet and catch basin rim and invert elevations
- water valves, valve vaults and hydrants
- power poles and supports
- electrical vaults
- traffic signal equipment
- utility locations as marked by IUPPS 811

Data from all utility locates marked on the site from IUPPS shall include horizontal locations and depths where available. The IUPPS service shall be notified at least 48 hours prior to any necessity for verification of location, size, and material of utilities.

All sewer structures shall be sketched and structure data details provided to show pipe size, Identification number, flow direction, and invert elevation, and be referenced to the horizontal notes with a reference point.

Record the location of all existing natural and man-made features such as bridges, rivers, ponds, trees, landscaping, driveways, edge of pavements, curb and gutters, sidewalks, edge of buildings, fences, signs, guardrails, street lights, existing top of bank and toe of slope, etc.

Curved features, such as a curved roadway, shall have sufficient points collected in the field to accurately depict the field condition on the base plan.

Establish and reference the design/construction centerline for all roads affected by the project.

For additional information about facilities to be located in the field refer to the checklist provided in [Exhibit GR6-5](#).

At least two (2) horizontal control points will be necessary for projects 500-feet or less in length. The distance between referenced control points shall not exceed 1,000-foot intervals for projects greater than 500-feet long.

Control points shall be semi-permanent in nature (PK nails, RR spikes, hardwood hubs, iron rods, etc.) and be witnessed to at least three permanent objects.

All projects shall be tied to the same vertical datum, North American Vertical Datum 1988 (NAVD 88) as the current FEMA Flood Insurance Rate Maps (FIRM).

Horizontal datum coordinates shall be Indiana State Plane Coordinates East, North American Datum 1983 (NAD83).

Each project shall have at least one (1) temporary bench mark for projects 500-feet or less in length for vertical control. The spacing of temporary bench marks shall not exceed 500-feet for projects with a length greater than 500-feet.

Notes relating to vertical positions shall include data on all bench marks established and provide reference to the source of the control. Bench marks shall be described and/or sketched to ensure proper identification. Elevation notes shall also include a periodic check from bench mark control to traverse points to ensure the data collector is recording accurate elevations.

Establish property ownership/addresses and apparent property lines for right-of-way.

Provide sufficient control for the contractor to layout the proposed work.

All ground features pertinent to the required end product shall be collected as part of the field effort.

Points shall be systematically collected in the field and addressed as follows:

- each point shall be described by a City Utilities approved description line and point code, see [Exhibit GR6-7](#); and
- if a point requires a more extensive description for clarity, the additional description shall be added to the description code

after a comma is inserted, in the note or comment field if the data collector has that capability.

Most building dimensions and other data and comments that cannot be recorded in an electronic field book shall be noted as a sketch in a field book. While the sketches will not require the minute dimensions and detail once necessary for a manual survey, they should be explicit enough so that the design engineer can orient position on the electronic drawing and complete the topographic map/base plan.

Building footprints shall include overhangs and cantilevered improvements.

After the topographical field survey is completed, the recorded data shall be processed using a compatible software package and drafting standards approved by the City to create the topographic map/base plan.

Apparent property corners located in the field shall be shown on the base plan. Owner's names, addresses, and deed references shall be shown along with approximate property lines pertinent to the project. Layout data is to be shown on the base plan indicating the coordinates, bearing, distances and stations between changes in geometry of the alignment.

All coordinate values shall be to four (4) decimal places, linear values and elevations shall be to two (2) decimal places, and direction bearings shall be to the second.

GR6.07 Special Surveys and Topographical Information

1. Property Surveys

Surveys covered by the requirements of this article include: route, original, and retracement surveys.

Where the relationship of the project's location and adjacent property line is critical, the location of the existing property line and other boundaries shall be established by a property survey sufficient to define the easement. All property surveys shall comply with the "Minimum Standards for Competent Practice for Land Surveying in Indiana" and Title 865 IAC 1-12. Plats and descriptions for easements shall conform to the requirements defined in [Chapter GR7 - Easements](#).

2. Railroad and Highway Surveys

When the centerline of a proposed linear project such as sewer or a water main crosses a railroad or highway, all existing and proposed railroad tracks, roadways, and affected structures shall be tied to the centerline of the proposed project. The topography data shall be collected on both sides of the proposed crossing to the extent required by the affected reviewing agencies.

a. Railroads

Information for railroads shall include, but not be limited to, the following:

- top of rails - 300 feet minimum in either direction to be located horizontally and vertically at 50-foot intervals
- angle between centerline of tracks and centerline of improvement
- name and address of railroad company
- location of railroad rights-of-way and easements (source of record where possible)
- horizontal information relative to transmission lines, such as telephone or electric (when possible)
- stations on the centerline of each track
- mile post locations, measured from centerline crossing

Permission to be on the railroad right-of-way shall be secured from the railroad company prior to entering the right-of-way.

Trespassing on railroad right-of-way is a Class D felony. City will not be responsible for any violations or resulting penalties associated with trespassing on railroad property.

b. Highways (INDOT Controlled Roadways).

Information for highways shall include, but may not be limited to, the following:

- station on centerline of highway and each edge of pavement, or front face of curb, as may be appropriate
- angle between centerline of highway and centerline of improvement
- location of highway rights-of-way and easements (source of record where possible)
- location of any crossings, or parallel utilities, or drainage structures which may be in conflict with the improvement construction
- number and width of lanes and the type and condition of the surface

Additional information relative to requirements in the vicinity of railroads and highways may be required on a project specific basis.

GR6.08 Deliverables and Submittals

All required deliverables and submittals, as indicated in the project scope, shall be submitted to City Utilities in conformance to the applicable requirements of the Standards.

GR6.09 Construction Staking

The staking of all baselines, control points, monuments, and all other items associated with the plans for proposed project construction shall be the responsibility of the contractor to perform prior to the initiation of construction. CUE will provide the contractor with the necessary information for reinstating control points and baselines for the project in the field. The staking of all proposed work shall comply with Title 865 IAC. Specific items that shall be staked and identified in the field prior to construction activities include all proposed permanent and temporary easements and project control points and monuments.