CHAPTER 7

LOCATION SURVEYS

Chapter Contents

Sec. 7.01 General Remarks

In using these policies and procedures, the Department depends on the professional skills and initiative of the Consultants, Engineers, and Survey staff to create an efficient and cost effective survey scope that provides adequate design deliverables for all disciplines. This will ensure that only needed topographical data is obtained based on professional judgement of each discipline.

State Survey Personnel or Consultants will make all location surveys, using current guidelines and instructions, from the Virginia Department of Transportation's (VDOT) "Survey Manual" in addition to all other VDOT manuals. This survey manual covers almost all policies and procedures concurrent with a location survey. Additional VDOT Manuals, Guides and Instructional and Informational Memoranda can be found on the Department's website at http://www.virginiadot.org/business/manuals-default.asp#Location.

Right of entry needs to be secured prior to the commencement of any site visits on private property per Chapter 4 of this manual and the Code of Virginia (Section **§33.2-1011)**. **Entry to railroad property must be coordinated through** the VDOT Right of Way and Utilities Division, Rail Section. **The Rail Section** is located in the Central Office at 1401 East Broad Street, Richmond, VA, 23219 (804)-786-2932. It is the responsibility of the professional in responsible charge to ensure that all right of entry procedures are followed when and where applicable.

The CADD Section has made a conscious effort in creating unique cells, levels, and line styles for topography and utilities that may be encountered by a survey party or consultant staff. All text, levels, weights and line styles entered into any survey or SUE file are required to adhere to the standards outlined in the VDOT CADD Manual & OpenRoads Standards.

All dgn files created, either engineering or survey, must match the original survey file datum and the working units.

All survey deliverables inclusive of field files will be developed and stored within the ProjectWise environment, **no exceptions**. < > - denotes the .dgn file where information is stored.

Sec. 7.02 Survey Scope

The survey scope shall be detailed and comprehensive enough to provide the needed deliverables for the project based on coordination meetings with the following teams:

- Project management
- Design
- Hydraulics – See Chapter 8
- Utilities – See Chapter 12 and Appendix A
- Bridge - See Chapter 8 and Chapter 6, Section 6.07
- Environmental
- Traffic

Consultant/District Survey staff are required to develop the survey hydraulics/structures/SUE scope based on this coordination effort and review this with all survey personnel assigned to the project prior to commencing field work. Topographical and SUE limits shall be established from this coordination meeting. The primary SUE limits in most cases shall be inside of the topographical limits. The SUE scope shall also include "point location" of those utility appurtenances which lie outside of the primary limits that are necessary to properly define crossing utilities (i.e. one-off manholes, utility poles, water valves, etc.). See Section 7.04.2

This collaboration shall create an efficient and cost effective scope that provides adequate deliverables for all design disciplines. This will ensure that only needed topographical data is obtained based on professional judgement of each discipline.

Open lines of communications with these teams are required and should be established to address specific questions while onsite prior to commencement of survey. A point of contact for each discipline shall be designated and provided to the Survey Team.

Upon receipt of a survey authorization, the Survey Manager will review the scope then assign the project to a Land Survey Supervisor in the district or Consultant staff (see Sec. 1.02.2). This scope shall be reviewed with all survey team members prior to commencing field work. The Survey Manager will review the work for conformance with current instructions and ascertain that the survey data is complete per the scope provided.

Sec. 7.03 Field Data

All field data will be secured by Static GPS (GNSS), GNSS RTK, Mobile LiDAR (M-LiDAR), Static LiDAR (STLS), Robotic / Manual Total Station, and/or differential leveling survey methods and will be processed in accordance with the procedures outlined in this manual. Field data also includes the daily diary, notes, sketches, diagrams, photographs and other information collected by the survey crew. This information should be accurate and complete and will be used to prepare the finished plan base.

Sec. 7.04 Topography

Topography will be secured by the use of Survey Total Station, Mobile/Static Lidar, and/ or Photogrammetric methods and procedures. All topographic surveys must comply with the ***Model Virginia Map Accuracy Standards* and the *National Map Accuracy Standards*** as well as the minimum standards and procedures for topographic surveys outlined in the current ***DPOR regulations***. Survey personnel should be familiar with these standards and regulations and any field survey(s) shall be conducted in such a manner as to ensure compliance.

Sec. 7.04.1 General Topography (planimetric file) <s(UPC#)>

The following features shall be included in the topographic location:

Bridges/Drainage/Hydraulics

See Survey Manual - Chapter 8

Buildings

Buildings are to be shown at the overhang and the type of construction should be noted (frame, brick, etc.), the height (one story, two story, etc.) and condition other than good, should also be noted. Porches, steps and carports are also to be shown.

Individual house numbers, where assigned, are to be shown in lieu of block numbers in cities, towns, and built-up areas. Where house numbers have not been assigned, the block numbers should be prominently shown. The building number should be shown within the limits of the building, if possible. If this is not practical, the building number should be shown as close to the building as possible.

On rural and urban surveys, it will be necessary to obtain elevations on floors, porches, steps, etc. to determine the impact of the proposed design. See Chapter 8 for instructions.

Cemeteries

The extremities of cemeteries must be shown. The graves closest to centerline must be shown per above ground evidence and the approximate number of graves noted.

The outside limits of all automobile graveyards will be shown.

Entrances

Entrance profiles shall be taken on all existing entrances their entire length. Where, due to excessive length, this would be impractical, the length should be restricted to an appropriate distance by the survey supervisor to provide adequate coverage for the designer.

Fences

All types of fences, whether barbed wire, woven wire, rail, board, or other material should be shown and annotated with type and height.

Government Control

All government benchmarks, triangulation stations, traverse stations, azimuth marks, reference marks, etc., must be located. If anticipated construction will disturb or destroy these control markers, the disk number should be recorded and sent to the Central Office GeoSpatial Survey Support group at GeoSpatial-info@VDOT.virginia.gov. The Central Office GeoSpatial Survey Support group will request a new disk from the appropriate agency. The Central Office staff will coordinate the replacement of the mark with the Survey Manager using VDOT or consultant staff. The removed original disk and the new description and values of the reset mark are to be sent back to the federal agency concerned.

Hazardous Material/Waste Sites

- Prior to the survey, the Project Manager will request that the District Environmental Manager provide any known areas of significant contamination. The Office of Safety and Health will be requested to provide recommendations for safety precautions to protect the surveyors.

Location and Design Division staff should assist in the identification of any known or potentially contaminated sites early in the project development stage.

Listed below are some sources which have potential for hazardous material waste from underground tanks or associated sources. This is a partial list and should not be taken as all inclusive. The surveyor should use common sense and the research information, as well as their working knowledge of the areas to be surveyed, in order to identify sites with potential underground tanks.

Possible Underground Tank Locations:

Airports
Banks
Churches and/or cemeteries
Construction Companies
Convenience Stores
Distribution Companies
Engraving Firms
Federal and State Government
Hospitals and Nursing Homes
Grocery Stores
Bulk Terminal
Marinas
Recreational Facilities
Restaurants
Shopping Centers
Transportation Services
Utility Companies
Auto Dealers and Repair Shops
Car washes
Colleges/Schools/Education Facilities
Government Services Offices (Fire/Police Dept., etc.)
Delivery Services (UPS, FedEx, etc.)
Dry Cleaners
Farms
Home Owners
Hotels/Motels
Installations and Offices
Manufacturing Plants
Mining Companies
Residential Apartment Buildings
Service Stations
Tire Stores
Truck Stops/Firms

All hazardous material/waste (or potential) sites should be located and/or identified. **Caution should be taken and at no time should Department employees touch, smell, move or otherwise be exposed directly to a potential hazardous material.**

The survey party will locate and annotate the following:

- Storage tanks (above-ground and underground)
- Environmental monitoring wells (marked “Monitoring Well” and stick up well casings)
- Oil/water separators
- Dumping areas
- Drums
- Waste lagoons
- Obvious surface contamination (e.g., staining and odors)
- Obvious surface water contamination (e.g., oil sheen)

The Land Surveyor Supervisor shall make a statement in the Survey Report indicating whether any hazardous materials were encountered or found, then provide the following:

- The route survey will include notes of any potential sites or conditions identified by the survey party.
- Areas of contamination, as provided by the District Environmental Manager, are to be shown on the plan sheet (hatching, crosshatching, etc.).
- The Project Manager, with the assistance of the Survey Manager, should communicate the findings of the route survey where potential contamination sites were identified, to the District Environmental Manager for further review.

Historical Markers

Historical markers should be located, and the identifying number recorded. In the securing of location survey data on any type of survey, special attention should be given to any site that is of historical or archeological significance. Some of these sites are well marked and are easily identifiable by markers placed by the Association for the Preservation of Virginia Antiquities, the Virginia Department of Conservation and Economic Development or by local governments. Some are not so well marked and require knowledge of the area and local research on the part of the Land Survey Supervisor. If the surveyor has been provided documentation detailing the probability that a site of historical or archeological significance exists in the area of any survey, it should be conspicuously noted in the Survey Report.

Pavement

Location of edges of pavement and curb shall be shown. The type of pavement shall be shown. If concrete pavement has been overlaid with asphalt, this shall be noted along with the approximate depth of the overlay.

Railroads

All projects with railroad right of way shall be coordinated with Rail Projects Program Manager prior to entering, no exceptions. All railroad access and safety procedures must be secured and followed prior to commencement of the survey including permits flagger, etc. When

railroads parallel or cross beneath the roadway, topography of the tracks shall be secured. The high-rail of the tracks shall be located with elevations by conventional survey methods. The location and elevation of the railroad bed may be secured by photogrammetric methods. All railroad switches, mileposts, signal equipment, right of way, size and type of all culverts under the railroad, etc., shall be located. On multiple track lines, the elevations of all rails shall be secured.

Whenever a railroad is shown in the topography, it is imperative that the nearest railroad milepost be located and shown in reference to the survey centerline crossing. In the event there is no milepost, as may be true in the case of some spur tracks, the railroad should be run out or tied into the survey showing a clear and concise reference to the railroad evaluation maps, including the railroad stationing. A print of the railroad right of way map should be secured and submitted with the survey. If this is not possible, the drawing number and any other information available should be included in the Survey Report letter.

Elevations are required where the centerline intersects railroad rails and all other points that will influence or govern the final grade of the proposed highway.

Roads

Centerline elevations shall be determined at even stations, plus fifty **(+50)** stations, all equalities, all crests or sags, and elsewhere as required to define the profile of the centerline. When a centerline crosses a different surface (i.e., soil to pavement), a reading is to be obtained at that point and noted. Elevation data shall cover all alignments beyond the beginning and end of the project so suitable grades can be worked out at these points. The road profile should be carried to a point ± two feet **(2 ft)** above the high water elevation where applicable.

Posted road names and/or route numbers and posted speed limits should be noted and any corresponding signage within the survey limits should be located. Road and street names, in addition to Route numbers, will be shown on plans and correspondence. If feasible, the name will be shown within the roadway limits, otherwise, the name should appear in close proximity to the road or street.

Should a question arise concerning the correct road name, the survey party will check with the current Traffic Engineering road name listing (available in each District and Residency Office) to obtain the correct road name.

Signs

The location and description of all special signs, such as overhead truss signs, electrical traffic signal lights, railroad protective devices, traffic light actuating treadles etc., should be shown in detail. On all surveys, the survey party should show all outdoor advertising signs and indicate the O.A. license number, the size of the sign and support(s) and the sign owner.

Soils

The following sites have the potential of contaminating the surrounding soil: dumps, waste water treatment sites, abandoned lagoons, landfills, dry cleaners, funeral homes, service stations, vehicle maintenance areas, paint companies, photography labs, machine shops, medical facilities, printing companies, pesticide operations, fertilizer operations, paper industries, electric companies (storage yards), chemical manufacturing facilities, electronic facilities, wood treatment plants (creosote or salt). Any indication of these sites should be noted on the survey and communicated to Environmental.

Surveys Near Airports

When the proposed location is within three (3) miles of an airport, the Central Office Aerial Coordinator will be notified to help with securing the necessary information listed below. The survey party should secure the following data so that the glide angle can be determined:

1) Airport Security, TSA or other Airport authorities will need to be notified if it is necessary to access any of the airport property for any purpose.
2) If the runway is perpendicular or skewed, the distance from the end of the runway to the survey centerline measured on line with the centerline of the runway (may be obtained from suitable map if clearances are not critical). When the runway generally parallels the survey centerline, locate the closest end of the runway and establish a bearing for the runway.
3) The pavement elevation at the end of the runway shall be secured.
4) Width of the landing area and runway number if available.
5) The airport property boundary shall be tied.
6) Class and type of service, such as private, secondary feeder, trunk line, express, continental, inter-continental, or Department of Defense Air Base shall be noted in the file.
7) During the late 1980's all public access airports were surveyed. It may be beneficial to acquire these surveys from the Virginia Department of Aviation.
8) The following information may be needed for a survey to be completed adjacent to airport property. This information is usually available on the plans. One is the Airport or Runway Approach Slope(s). This design element may show contours in and around the airport and is usually expressed as a run to rise ratio (25:1, 34:1, 50:1, etc.). It also assists designers in verifying that their road design does not hinder takeoffs or landings. Another element is the Runway Protection Zone which lies beyond and in line with the runway centerline(s). These are usually trapezoidal in shape and may not allow for any ground elevation changes within the RPZ. Although it may be permissible, in some cases, for a roadway to traverse through the RPZ, preferably at a right angle. Runways also have a side transitional slope (run:rise), or safety area, that may affect roadway design and elevation changes when parallel to a runway. Most airports will also have an airport overlay district or airport safety zone surrounding the airport with additional restrictions on heights and/or elevations.

Trees/Shrubs

Location of shrubbery, hedges, wood lines, and trees. The sizes of trees will be measured **4.5 feet** above the ground, or Diameter at Breast Height (DBH), to obtain the diameter of the tree. Isolated or cultivated trees should be located and described.

Sec. 7.04.2 **Subsurface Utilities** <su(UPC#)>

A comprehensive standard of practice for designations and locations are addressed in Chapter 12 and Appendix A of this manual.

The SUE team is responsible for the location of all utility features above and below ground unless otherwise agreed upon prior to commencement of the survey.

Interstate, Primary, Secondary, and Urban projects, requiring surveys, shall have subsurface utilities designated at a Quality Level B by a SUE Consultant unless an exception is granted as outlined in Chapter 12 and Appendix A of this manual. Miss Utility markings are NOT to be used during the design phase unless it is for study purposes only.

Prior to commencement of the survey and/or SUE, survey and SUE teams shall coordinate responsibilities, share primary control and MOT if practical.

Under no circumstances shall the Survey and/or Subsurface Utility Engineering (SUE) teams duplicate location efforts on the subsurface utilities (above or below ground).

Photogrammetric deliverables WILL NOT include utilities unless a waiver is granted by the GeoSpatial Program Manager or the State Photogrammetry Supervisor.

Wells, Septic Tanks & Drain fields (Private)

Private water supply and sewage disposal systems shall be shown on each individually developed property unless the Department excludes this during the survey scoping. If the facilities are a considerable distance from centerline, a note indicating how these properties are served will suffice.

These private utilities shall be the responsibility of the SUE consultant to locate unless the Department indicates otherwise. Private drain field locations are to be shown by the professional providing the designation. Survey teams should use the ‘S’ file and SUE teams should use the ‘SU’ file. Care should be taken to place all utility information on the appropriate Utility Level.

Sec. 7.04.3 **Wetlands/Environmental** <swl(UPC#)>

Once an environmental scientist has marked the limits of wetland areas and/or waters of the US, the flags shall be located and stored in a swl file. This data will not be merged in the survey file. The data shall be shown on the appropriate level and the scale shall be the job scale.

Sec. 7.05 **DTMs** <s(UPC#)>

DTMs (Digital Terrain Models) are to be secured by the use of Total Survey Station, Photogrammetry, or LiDAR methods in the required file formats. DTMs shall be taken at a sufficient density to approximate traditional cross section intervals at a minimum of 50 ft. along tangents or 25 ft. along curves, and everywhere necessary to accurately represent the existing conditions.

DTM readings are to be collected in a manner as to define all existing ground breaks. The ground breaks shall be taken as either a line string or curve string readings. All other readings can be secured as spot readings. VDOT CADD Standards are described in the CADD Manual and the OpenRoads Standards.

Sec. 7.06 **Bridge Site Plans** <s(UPC#)b(bridge#)>

The Survey Manager is required to review the scope and extents of the Bridge Survey with the District Bridge and Drainage personnel prior to commencing the survey and in accordance with Chapter 8 of this manual. The topo limits and existing bridge features needed will be determined during this scoping meeting.

For Bridge Site plans - Highways and Railroads, secured by Photogrammetric Surveys, see Sec. 6.07 of this manual.

Sec. 7.06.1 **Bathymetric Surveys** <s(UPC#)>

All Bathymetric Surveys shall follow the current Hydrographic Surveys Specifications and deliverables established by the U.S. Department of Commerce National Oceanic and Atmospheric Administration, National Ocean Service (NOAA), https://nauticalcharts.noaa.gov/publications/standards-and-requirements.html. Depths shall be achieved using either Multibeam Echosounder or Single Beam systems. Methods for completing surveys of subsurface areas are complete coverage, set line spacing, or trackline survey operations.

Sec. 7.07 Minimum Plan Projects

The fundamental objective of a "Minimum Plan" project is to provide a satisfactory basis for competitive bids without the development of fully detailed plans and cross-sections. In plain language, such projects will employ varying degrees of the "eyeball" concept of construction with special provisions in the bid proposal covering such items. The full extent and amount of survey information needed to accomplish this goal will need to be determined on a per project basis. The following are the minimum guidelines:

1. Establish survey traverse, provide existing centerline, drainage structures crossing the road, edge of pavement, slopes that may impact construction, property lines and property ownership, fences, utilities, property development and improvements. This topographic information is essentially the same as normally secured for any project but on a minimum width unless otherwise directed by the Department per Sec. 7.02.

2. Obtain centerline profiles but DTMs or cross-sections are not to be taken unless specifically designated or requested and usually only at certain specified locations within a proposed project. One of the basic provisions of a "Minimum Plan" project provides for grading as a lump sum bid item. Earthwork quantities are not computed and generally the plans show the centerline profile and perhaps a spline grade line without specific elevations at each station.

See the current edition of VDOT's Road Design Manual, Appendix A, Section A-7, titled "Section A-7 – "No Plan" and "Minimum Plan" Projects".

Sec. 7.08 Additional Survey Data Requests

Ideally, all survey information required should be secured in the initial survey, but from a practical standpoint, this will not always happen. Some items, such as entrance profiles for new private entrances must be secured after the Field Inspection. Updated right of entry letters will need to be sent to all affected parcels per Section 4.01.

On projects being designed by the Districts, requests for additional data should be handled by memorandum within the District. Should the original survey be secured by Photogrammetric Survey methods and the capability to secure the additional data is available by this method, the request for this additional data should be forwarded to the Central Office, attention to the State Photogrammetry Supervisor.

The additional data is to be requested by Form LD-261, See Figure 7-A this request is to be reviewed by the Survey Manager in the Districts or the GeoSpatial Program Manager or State Photogrammetry Supervisor.

It is important that a kmz or kml file of the additional area be provided for clarity of request. Requests for additional data should be handled on a priority basis according to current established schedules. Copies of letters transmitting additional data to the Design Units should be sent to the appropriate individuals per Section 1.08.

Sec. 7.09 Submission of Survey Report and Data

Before submitting the survey data, all information should be checked by the Land Survey Supervisor. They shall ascertain that the survey embodies all of the required information and that it is recorded and plotted in accordance with these instructions.

The Land Survey Supervisor will then write the Survey Report (a copy of which shall be titled "**sUPC#.doc**" and shall be included on the ProjectWise server). The narrative will give a description of the survey and report all features and conditions not fully covered in the notes that will affect the location, design and construction of the road. Any part of the survey not conforming to the standards herein specified or generally accepted shall be fully explained.

It is the responsibility of the Survey Manager to check each survey for correctness, completeness and notifying the Project Manager and GeoSpatial Program Manager that the survey is complete. The Survey Manager will verify that the survey has been secured in accordance with the authorization and these instructions and all pertinent information such as subdivision plans, tract plats and deed book descriptions from court records are included.

Sec. 7.10 Digital Sealing of MicroStation and Adobe or BlueBeam Revu (PDF) Files

Beginning July 1st, 2009, all newly submitted survey, utility, and update digital files will contain a digital signature certifying the MicroStation file meets an accepted professional standard and quality. (IIM-LD-243). This IIM is very specific on what will and will not be sealed by a licensed professional. All plans submitted for Right of Way approval shall be Sealed and Signed by a Virginia Licensed Land Surveyor. The MicroStation digital signature has been provided to VDOT's Licensed Surveyors (L.S.)**. It is the consultant's responsibility to acquire ProjectWise access and digital signatures for submission of files to VDOT upon Notice to Proceed.**

Form LD-261

LD-261
(8-26-19)

VIRGINIA DEPARTMENT OF TRANSPORTATION
LOCATION AND DESIGN
REQUEST FOR ADDITIONAL SURVEY INFORMATION

Date: Click to enter a date.	
To:	District Survey Manager
From:	

Project Information

UPC	VA_UPC	State Project Number	VA_PRJ_NUM
City/County	VA_CO_CTY_NAME	Route	VA_ROUTE
Start Location (From)	VA_POOL_START_LOC		
End Location (To)	VA_POOL_END_LOC		

Survey Information

The following additional survey information is needed in preparing the plans on the above captioned project.	
The following data is being handed to you.	

☒ Yes ☐ No	Survey control information, MicroStation files, design files, etc., on ProjectWise?
☐ Yes ☐ No	Marked up plan sheets, tax map, or ADC map depicting coverage area.
☐ Yes ☐ No	Drainage information /DTM's, required
☐ Yes ☐ No	Benchmarks or vertical datum information.
☐ Yes ☐ No	Subsurface Utility Designation has been outlined on the prints, required?

Subsurface Utility Locating (Test Hole) has been reviewed by		Utility Engineer	
Requested by (Project Manager)		Phone No.	
Request has been reviewed by (Project Designer)			
Remarks			

Please Do Not Write Below This Line

Survey Authorization

Survey authorized by		Date	