

**Supplemental Specification
2012 Standard Specification Book**

SECTION 01721

SURVEY

Delete Section 01721 and replace with the following:

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Construction surveying, staking, measurement, and calculations essential to complete the project and properly control the entire work.
- B. Directed surveying as requested by the Engineer.
- C. Processes and procedures for implementing Machine Control Guidance (MCG) technology. MCG uses Global Positioning System (GPS) and Robotic Total Station (RTS) in conjunction with three-dimensional computer models to determine the precise location and elevation of the materials being moved.

1.2 RELATED SECTIONS

- A. Section 02765: Pavement Marking Paint

1.3 REFERENCES

- A. Plan Sheet Development Standards
- B. UDOT CADD Standards
- C. UDOT Survey & Geomatics Standards Manual
- D. Utah Administrative Code
- E. Utah Code

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. The Department requires that all submittals be signed and sealed by a Professional Land Surveyor licensed in the State of Utah.
- B. Re-submittals may be required depending on completeness and correctness of the work.
- C. Submit a statement before award date indicating all Department provided horizontal and vertical survey control has been field checked and the control has been determined to be accurate within the tolerances specified in the UDOT Survey and Geomatics Standards Manual. Refer to <http://www.udot.utah.gov/go/standardsreferences>.
 - 1. Attach field survey information used to verify control.
 - 2. Notify the Engineer verbally and in writing if discrepancies are found.
 - 3. Include any additional survey points required to implement the MCG/RTS technology.
- D. Provide a written description of the equipment before beginning work including calibration certifications, manpower, methods, and data storage format proposed for use to complete all survey activities.
- E. Record keeping – Keep all field notes, diaries, and books according to standard surveying practice.
 - 1. Loose leaf books are not acceptable.
 - 2. Make available at any time all survey records including field notebooks and forms used for the work to the Engineer upon verbal or written request.
 - 3. Electronic records and reports are acceptable
- F. Surveying and design data requirements:
 - 1. Return all survey and design data to the Engineer after project completion with compliance to the UDOT Survey and Geomatics Standards, Plan Sheet Development Standards, and UDOT CADD Standards. Refer to <http://www.udot.utah.gov/go/standardsreferences>.
 - 2. Complete the following if design plans were included with the advertising package for the project:
 - a. Provide a red-lined hard copy plan set showing "As-built" features denoting changes from the original design.
 - b. Provide an electronic copy of the red-lined 11 x 17 "As-built" plan, containing the "As-Built" stamp dated and signed by the Engineer, in a colored PDF format as follows:
 - 1) Resolution of not less than 400 dpi.

- 2) Individual file sizes not greater than 100 megabytes.
 - 3) Group similar sheet types together into individual PDF files such as Summary Sheets grouped together in a single PDF file or Summary Sheets and Plan and Profile Sheets grouped together in a single PDF file.
3. Complete the following if the Department provides 3D elements, 3D models, or both at advertising:
 - a. Provide all files, named and placed in accordance to the UDOT CADD Standards Manual, Plan Sheet Development Standards, and submitted into the UDOT Projectwise System.
 - b. Update 3D model with "As-built" features denoting changes from the original design.
 - c. Provide final model incorporating all design changes.
 - d. Intermediate models at request of the Engineer.
 - e. Support paperless inspection.
 - f. Provide documentation of quality control measurements when requested by the Engineer.
 - g. Submit completed "As-Built" electronic files into the UDOT Projectwise System in accordance with the UDOT Survey and Geomatics Standards, Plan Sheet Development Standards, and UDOT CADD Standards.
 4. Submit an "As-Built" model with approval of the Engineer to document design changes if construction of a project was based on a model prepared by the Contractor or a project that was not designed using paperless methodology.

G. Survey Monuments

1. Refer to this Section, article 3.12, paragraph C3 for submittal of drawings and notes.

H. Provide the following for MCG technology implementation:

1. Written notification to the Engineer that MCG will be used on the project.
2. Electronic or hand written stakeout/cut-fill reports or both for cross section stakes, according to this Section, Article 3.5.
 - a. Reports are not required when measurement of work is by "Plan Quantity" or Weight.

I. Alternate methods of calculating quantities.

1. Engineer may approve alternate methods of calculating quantities. Submit proposed alternate method of quantity calculation before beginning item of work.

1.6 MEASUREMENT PROCEDURES

- A. Directed Survey – Use a survey crew measured by the hour authorized if extra survey work is needed. Department makes no additional payment for travel time to and from the project.

1.7 PAYMENT PROCEDURES

- A. Include the costs in all items of work that require survey if contract does not include separate pay item for survey. Failure to comply with any portion of this specification may result in withholding up to 25 percent of contract payments until the deficiencies are corrected.
- B. Directed survey work is paid for in the accepted quantities if needed and approved at a standard negotiated rate.
- C. Include the costs of all machine control equipment in equipment cost. Include all survey equipment and labor in the bid item for survey.

1.8 QUALITY ASSURANCE

- A. Assume responsibility for survey and control of the work and for correcting errors whether the errors are discovered during the actual survey work or in subsequent phases of the project and bears any cost overruns resulting from errors.
- B. Perform all work according to the plans and specifications and standard Engineering and Surveying practices under the responsible charge of a Professional Engineer or Professional Land Surveyor licensed in the State of Utah.
- C. The Engineer may spot check the work for accuracy and may reject unacceptable portions of work. Resurvey rejected work and correct work that is not within the specified tolerances at no additional cost to the Department.
- D. Any 3D model used in conjunction with MCG must be verified by a Professional Engineer or Professional Land Surveyor licensed in the State of Utah.
- E. Correct any construction errors that result from errors in a 3-D model once the design 3D model has been accepted.

PART 2 PRODUCTS

2.1 EQUIPMENT

- A. Furnish tools, supplies, and stakes suitable for use in highway survey work.
- B. Furnish stakes and hubs of sufficient length to provide a solid set in the ground with sufficient surface area above ground for necessary legible markings.
- C. Furnish survey instruments and supporting equipment capable of achieving the specified tolerances.
 - 1. Calibrate survey equipment yearly and check for accuracy before beginning survey work and as required throughout the duration of the project. Make the calibration certificate available upon request by the Engineer.

2.2 EQUIPMENT FOR DEPARTMENT USE

- A. Provide and maintain the following equipment when MCG is to be used on the project:
 - 1. GPS Capable Rover compatible with the other GPS equipment being used on the project.
 - 2. Other hardware and software associated with the equipment so that Department personnel can operate the equipment for quality assurance purposes.
 - 3. Provide adequate training so that Department personnel can operate the survey equipment.
 - 4. Make GPS rover available immediately upon request from the Engineer.
 - 5. Develop a process with the Department to check-in and check-out equipment from the Contractor.

PART 3 EXECUTION

3.1 PREPARATION

- A. Discuss and coordinate the following with the Engineer before survey work begins:
 - 1. Required submittals
 - 2. Survey and staking methods
 - 3. Stake markings
 - 4. Grade control
 - 5. Referencing

6. Structure control
 7. Any other procedures and control necessary for the work
 8. Documentation procedures
- B. Establish construction survey points, elevations, and grades as necessary to control layout and complete the work. Verify all control surveying and staking meet specified tolerances before beginning work.
- C. Calculate all grades, elevations, offsets, and alignment data necessary for staking or setting items of work. Obtain approval from the Engineer for alternate methods of establishing grade control with wire lines, computer, or laser controlled grading or other suitable methods.
- D. Provide appropriate traffic control for all survey activities.
- E. The Department furnishes:
1. Horizontal and vertical control points
 2. Cross sections developed during design, if any
 3. Electronic project data
 4. Digital Terrain Model used for design
 5. 3-D data consisting of:
 - a. LandXML files for the Design Digital Terrain Models, including features for projects implementing MCG
 - b. LandXML files for the Design Alignments
 - c. A Bentley iModel may be substituted for LandXML data.
- F. Contract Provision Disclaimer
1. Provide a written request to the Engineer to obtain electronic data points.
 2. Electronic data points are available in UDOT standard CADD formats only.
 3. Data points are prepared by the Department for its own purposes and not for the benefit of private individuals or businesses.
 4. Waive any claims that may result from the use of or reliance on the data points.
 5. Indemnify the Department and hold it harmless for any damages, costs, attorney fees, or other liabilities that might be incurred as a result of the Department's use and reliance on the Contractor's modified data.

3.2 DIRECTED SURVEY

- A. Conduct directed surveying if requested by the Engineer.
1. Includes work needed for changes and extra work. Provide all labor, materials, and equipment including total stations, global positioning system (GPS), LiDAR scanning or other equipment.

2. Obtain written authorization from the Engineer documenting the affected work and requirements before performing work under these items.

3.3 COMPUTATIONS AND PLOTS

- A. Use cross-sections to calculate volume measurements.
 1. Superimpose final cross sections with original cross sections and calculate final quantities using the average end area method.
 2. Develop cross-sections from field measurements.
 - a. Take cross section measurements both before and after excavation and before backfill.
 - b. Take cross sections at a maximum centerline spacing of 15ft when the centerline curve radius is less than or equal to 500 ft.
 - c. Take cross sections at a maximum spacing of 30 ft when the centerline curve radius is greater than 500 ft.
 - d. Take additional cross sections at breaks in terrain and at changes in typical sections.
 - e. Measure and record points at breaks in terrain for each cross section but at least every 15 ft unless otherwise approved by the Engineer.
 - f. Measure and record points to at least the anticipated slopes and reference locations.
 - g. Reduce all cross section distances to horizontal distances from centerline.
 - h. Take cross sections at right angles to tangents and normal to curves.
 - i. Include in cross sections all grades, locations, and existing ground line profiles.
 3. May develop cross sections from digital terrain models provided if:
 - a. Ground survey locations do not exceed 50 ft in any direction.
 - b. Major horizontal and vertical breaks in terrain are also included.
 - c. Horizontal and vertical control for the project is used.
 - d. DTM is verified accurate to required tolerances as indicated in the UDOT Survey & Geomatics Standards manual by spot checking throughout the length of the project. Refer to <http://www.udot.utah.gov/go/standardsreferences> to view this manual.
- B. The Engineer may approve alternate methods of calculating quantities.

3.4 STAKE MAINTENANCE AND MARKINGS

- A. Provide and maintain reference/location stakes that identify stationing at least every 200 ft until all work has been completed and accepted by the Engineer for each alignment.
 - 1. Provide reference/location stakes at whole station intervals such as 1032+00.
- B. Maintain ALL staking necessary for the work until the construction has been completed and accepted by the Engineer.
 - 1. Legibly mark all survey stakes with station and offset referenced to their respective control line.
 - 2. Mark slope, reference, and guard stakes with station.
 - 3. Renew illegible or damaged stakes at no additional cost to the Department.

3.5 CONTROL POINTS AND SURVEY TOLERANCES

- A. Survey using the guidelines set in the UDOT Survey & Geomatics Standards manual.
 - 1. Refer to <http://www.udot.utah.gov/go/standardsreferences> to view this manual.
- B. Amend the survey control diagram as requested for the project.
 - 1. Have the amended diagram sealed, signed, and dated by a licensed surveyor in accordance with UC 58-22-601, 602, 603, and Utah Administrative Code R156-22-601.
 - 2. Refer to <http://www.udot.utah.gov/go/standardsreferences> for Utah Code and Utah Administrative Code.
- C. Relocate initial horizontal and vertical control points in conflict with construction to areas that will not be disturbed by construction operations.
 - 1. Furnish the coordinates and elevations for the relocated points before the initial points are disturbed.
 - 2. Furnish to the Region Surveyor or Engineer the coordinates and elevations for the relocated points before the initial points are disturbed.
- D. Protect benchmarks from construction activities.
 - 1. Position all benchmarks to allow a level rod to stand vertically and squarely on the mark.

- E. Reference benchmarks to centerline and horizontal measurements. The surveyor should, to the extent necessary to achieve the standards contained herein:
 - 1. Compensate or correct for systematic errors, including those associated with instrument calibration
 - 2. Select the appropriate equipment and methods, and use trained personnel.
 - 3. Use appropriate error propagation and other measurement design theory to select the proper instruments, field procedures, geometric layouts and computational procedures to control random errors.

- F. The surveyor will apply appropriate procedures in order to assure that the allowable positional tolerance of such points is not exceeded if radial survey methods, GPS or other acceptable technologies or procedures are used to locate or establish points on the survey.

- G. The positional tolerance may be tested by:
 - 1. Comparing the relative location of points in a survey as measured by an independent survey of equal or higher accuracy or,
 - 2. The results of a minimally constrained, correctly weighted least squares adjustment of the points on the survey.

- H. The surveyor will employ, in his judgment, proper field procedures, instrumentation and adequate survey personnel in order to achieve a precision of 0.02 feet (or 6 mm) + 20 ppm.
1. See Table 1 for construction staking tolerances.

Table 1

CONSTRUCTION STAKING TOLERANCES		
Description	Horizontal Vertical	
	Decimals of a foot	
Box Culverts	± 0.02	± 0.02
Bridge Superstructures	± 0.02	± 0.02
Bridge Substructures	± 0.02	± 0.02
Clearing and Grubbing Stakes	± 1.00	-----
Construction Centerline Control	± 0.05	-----
Construction Centerline Station	± 0.10	-----
Curbs, Walks, and Bike Paths	± 0.03	± 0.02
Grade Stakes – Roadway Subgrade	± 0.20	± 0.05
Grade Stakes – Top of Rock	± 0.20	± 0.03
Grade Stakes – Roadway Finish	± 0.10	± 0.02
Luminaire and Signal Poles (incl.	± 0.20	± 0.20
Manholes, Inlets, and Culverts	± 0.10	± 0.03
PCC Pavement	± 0.10	± 0.02
Slope Stakes and References	± 0.30	± 0.10
Traffic Markings	± 0.20	-----
Walls – Retaining, MSE, Sound, etc.	± 0.05	± 0.05
Wetland Mitigation Control Stakes	± 0.20	± 0.20

Notes:

1. Stakes for miscellaneous items not listed above will have a horizontal and vertical tolerance of 0.20 ft, unless otherwise directed.
2. Features that are to be constructed flush to another surface should take on the same tolerance as that surface.
3. Staking tolerances for special circumstances will be discussed at the pre-survey meeting.
4. Meet the appropriate construction tolerances for the material as specified in the special provisions or standard specifications, regardless of the construction staking tolerances, specific to the work item.
5. Use bridge control once established, independent of other project controls for the duration of the bridge construction. Refer to Survey & Geomatics Standards manual for bridge control methodology. Refer to <http://www.udot.utah.gov/go/standardsreferences>.
6. Tolerances stated for each type of construction stake in this table indicates the acceptable deviation of the position of each reference point from its computed position relative to the given alignment and grade. Staked positions are generally checked using electronic stakeout reports and, if within tolerances, the stated position is accepted. Reference points may also have an accuracy relative to each other for precise measurements such as structures.

2. Survey Staking Methods:
 - a. Furnish reference stakes for all slope stakes and stakes used for setting items for work.
 - b. Furnish the following for projects using Conventional Survey Methods:
 - 1) Maintain the reference stakes for the duration of the project until the Engineer approves removal.
 - 2) Establish and set slope stakes and references on both sides of centerline at cross section locations.
 - a) Place slope stakes at a maximum centerline spacing of 25 ft when the centerline curve radius is less than or equal to 500 ft.
 - b) Place slope stakes at a maximum spacing of 50 ft when the centerline curve radius is greater than 500 ft.
 - c) Place reference stakes at a maximum centerline spacing of 100 ft on tangents.
 - 3) Establish slope stakes in the field as the actual point of intersections of the design slope with the natural ground line.
 - 4) Set slope stake references outside the clearing limits.
 - 5) Include all reference point and slope stake information on the reference stakes.
3. Furnish the following for projects using Machine Control Guidance Methods:
 - a. Maintain the reference stakes for the duration of the project until the Engineer approves removal.
 - b. Establish and set location stakes and references on one side of centerline at cross section locations.
 - 1) Place cross section stakes at a maximum spacing of 300 ft. (Cross-section stakes reference physical points in the proposed cross-section, such as edge of pavement or top back of curb)
 - c. Place slope stakes at a maximum spacing of 300 ft.
 - d. Establish slope stakes in the field at the actual point of intersections of the design slope with the natural ground line.
 - e. Set slope stake references outside the clearing limits.
 - f. Include all reference point information on the reference stakes.
 - g. Provide adequate bench marks throughout the project for construction equipment equipped with MCG to check setup and tolerances.
 - 1) Perform equipment checks at least once per day.
 - 2) Record equipment checks in a log for verification by the Engineer.

4. Staking limits – Reference/Location stakes can serve the purpose of the following staking requirements as long as all required information for both purposes can be written on the stake.
 - a. Stake clearing limits on both sides of centerline at each established station.
 - 1) Locate the clearing limit on the ground as shown by the cut and fill limits on the plans.
 - b. Stake right of way limits, or temporary construction easement (TCE) if one exists, every 500 ft maximum on tangents, every 250 ft maximum on curves where ROW is not delineated by existing fence lines or other obvious boundaries.
 - 1) Stake Right of Way limits at all right of way break/angle points along the right of way lines.
 - 2) Reduce the distance if staking distance is affected by line of sight.
 - c. Stake environmental control limits on both sides of centerline at each established station.
 - 1) Locate the environmental control limits on the ground as shown by the slope rounding contours and environmental and silt fence locations as shown on the Plans.
 - 2) Stake environmental control limits every 25 ft in environmentally sensitive areas.
 - 3) Provide staking as needed to guarantee the silt fence is located inside of right of way in standard silt fence installations where stations/locations are not called out on the environmental control plan sheets,.
- I. Furnish reference stakes for all slope stakes and stakes used for setting items for work.
 1. Accomplish the following for projects using ground based total stations, robotics, and levels. (Conventional Survey):
 - a. Maintain the reference stakes for the duration of the project until the Engineer approves removal.
 - b. Establish and set slope stakes and references on both sides of centerline at cross section locations.
 - c. Place reference stakes at a maximum centerline spacing of 100 ft on tangents.
 - 1) Place slope stakes at a maximum centerline spacing of 25 ft when the centerline curve radius is less than or equal to 500 ft.
 - 2) Place slope stakes at a maximum spacing of 50 ft when the centerline curve radius is greater than 500 ft.

- c. Establish slope stakes in the field as the actual point of intersections of the design slope with the natural ground line.
 - d. Set slope stake references outside the clearing limits.
 - e. Include all reference point and slope stake information on the reference stakes.
2. Accomplish the following for projects using Machine Control Guidance Methods:
- a. Maintain the reference stakes for the duration of the project Survey until the Engineer approves removal.
 - b. Establish and set location stakes and references on one side of centerline at cross section locations.
 - 1) Place cross section stakes at a maximum spacing of 300 ft.
 - a) Cross-section stakes reference physical points in the proposed cross-section, such as edge of pavement or top back of curb.
 - c. Place slope stakes at a maximum spacing of 300 ft.
 - d. Establish slope stakes in the field as the actual point of intersections of the design slope with the natural ground line.
 - e. Set slope stake references outside the clearing limits.
 - f. Include all reference point information on the reference stakes.
 - g. Provide adequate bench marks throughout the project for construction equipment equipped with MCG to check setup and tolerances.
 - 1) Perform equipment checks at least once per day.
 - 2) Record equipment checks in a log for verification by the Engineer.
- J. Setting grade finishing stakes (Conventional Survey or RTK):
- 1. Grade elevations and horizontal alignment:
 - a. On centerline.
 - b. On each shoulder at roadway cross section locations and between centerline and shoulder with a maximum spacing of 25 ft.
 - c. At the top of sub grade and the top of each aggregate course.
 - 2. Locations:
 - a. Set stakes on centerline, on each normal shoulder, and on the shoulder of the turnout where turnouts are constructed.
 - b. Set hubs at the center and along the edges of parking areas.
 - c. Set stakes in all ditches to be paved.
 - 3. Maximum spacing between stakes along the alignment is 50 ft.
 - 4. Use brushes or guard stakes at each grade finishing stake.
 - 5. Reset grade finishing stakes as many times as necessary to construct the sub grade and each aggregate course.

- K. Grade Verification (Machine Control Guidance)
1. The following procedure will only be applicable for verification of roadway layers for grade elevations and horizontal alignment.
 - a. The Department will use the Contractor provided survey equipment listed above.
 - b. The Department will verify elevations at the following locations:
 - 1) On centerline.
 - 2) On each shoulder at roadway cross section locations and between centerline and shoulder with a maximum spacing of 25 ft.
 - 3) At the top of sub grade and the top of each aggregate course.
 2. Locations:
 - a. On centerline, on each normal shoulder, and on the shoulder of the turnout where turnouts are constructed.
 - b. At the center and along the edges of parking areas.
 - c. At the top of subgrade and the top of each aggregate course.
 - d. In all ditches to be paved.
 3. The Department will verify and document elevations at a 300 ft maximum spacing between locations along the alignment.
 - a. The Department reserves the right to increase the spacing between grade verification locations up to, but not to exceed, 1000 ft if a level of confidence can be attained by the Engineer.

3.6 CONCRETE PAVING

- A. Develop a method of horizontal and vertical control for the placement of concrete pavement.
1. Use laser, wire, or string line, for example, to maintain horizontal and vertical control.
 2. Maximum spacing, 50 ft Set control on both sides of roadway.
- B. 3D Paving, Machine Control Guidance, Wireless Paver
1. Survey control should be staggered on either side of the highway to provide a good strength of figure.
 - a. Typically the distance between control points set for MCG should be no farther than 650 ft. The actual distance may vary by the type of equipment used by the Contractor.
 - b. The instrument setup must obtain vertical accuracies within ± 0.02 ft of the existing control.
- C. Stake concrete joint and station stamp locations if requested by the Engineer.

3.7 DRAINAGE STRUCTURES

- A. Stake drainage structures to fit field conditions and in coordination with the Engineer. The location of the structures may differ from the plans.
 - 1. Survey and record the ground profile along the centerline of the structure.
 - 2. Determine the slope catch points at inlets and outlets.
 - 3. Set reference points and record information necessary to determine structure length and end treatments.
 - 4. Stake ditches or grade to make the structure functional.
 - 5. Plot the profile along centerline of the structure to show the natural ground, the flow line, the roadway section, and the structure.
 - 6. Mark guard stakes with the following, when applicable:
 - a. Diameter, length, and type of culvert such as 18 inch x 35 ft corrugated metal pipe (cmp)
 - b. The vertical and horizontal distance from the hub to the invert at the end of the culvert or any intermediate point as needed or directed
 - c. Flow line grade of the pipe
 - d. Station
 - 7. Provide a reference at a maximum spacing of 50 ft for storm sewers and waterlines. Reference inverts of pipe at all manholes.

3.8 BRIDGES

- A. Based upon the Projects Primary Control points, set at least 4 horizontal and vertical control reference points to be used for surveying all bridge substructure and superstructure components including but not limited to pile locations and cutoffs, line and grade for abutments, bents, beam seats, anchor bolts, and screed grades.
- B. Set intermediate slope stakes at bridge abutments to establish transitions.
 - 1. Place finish grade stakes on the centerline of abutment bearing and at the top of slope of all bridge berms.
 - 2. Place finish grade stakes on each side at top, mid-point, or slope and toe of fill.

3.9 BOX CULVERTS

- A. Set horizontal and vertical control and reference points.
 - 1. Establish and reference the centerline, back of parapet or barrier, skew, and flow line elevations at inlet, outlet, and breaks.

3.10 CURB AND GUTTER

- A. Set curb and gutter staking at 25 ft intervals on tangent and 10 ft intervals on curve radii.
- B. Set line and grade for curb and gutter within 0.02 ft of the proposed or established grade line.

3.11 GUARDRAIL

- A. Stake guardrail vertical and horizontal control at a maximum spacing of 25 ft on tangent sections and 10 ft on curved sections unless otherwise approved.
- B. Obtain the Engineer's approval and field verification of staking before installation.

3.12 EXISTING SURVEY MONUMENTS

- A. Locate and reference all private and public land survey monuments that may be destroyed by project construction activities before disturbing those existing monuments and under the direction of a Professional Land Surveyor licensed in the State of Utah.
- B. Complete referencing and reestablishing those existing monuments at no cost to the Department and before project completion.
- C. Reference and reestablish the monuments created by the county surveyor.
 - 1. Notify the county surveyor at least 30 days before the destruction of any monument.
 - 2. Coordinate the reestablishment of section corner and quarter corner monuments with the county surveyor.
 - 3. Prepare a corner record to be filed in the office of the County Surveyor's Office per Utah State Code 17-23-17.5 unless prepared by the County Surveyor's Office.
 - 4. Submit a certified supplement to the Survey Control Sheet with notes to the Engineer showing references to section corners and quarter corners.
- D. The Department pays for the additional work under the Directed Survey item if a monument is found during construction but is not shown on the contract plans and must be reset.

3.13 RETAINING WALLS

- A. Set horizontal and vertical control and reference points based upon the Projects Primary and Secondary control.
 - 1. Establish and reference the centerline offsets for the walls, radius points, and the beginning and ending wall locations as shown on the plans.
- B. Stake retaining wall vertical and horizontal control at a maximum spacing of 25 ft on tangent sections and 10 ft on curved sections unless otherwise approved.

3.14 PAVEMENT MARKING

- A. Layout all temporary and permanent pavement markings according to Section 02765.
 - 1. Place references for traffic striping at least 150 ft apart on tangents and at least 50 ft on curves.

3.15 CLEANUP

- A. Remove and dispose of all flagging, lath, stakes, and other staking material after the project is complete.

3.16 UTILITIES

- A. Stake control lines as needed in cooperation with the utility companies so their facilities can be relocated to their proper final position.
- B. Stake crossings or potential points of conflict between facilities to give proper horizontal and vertical control for the relocation.
- C. Schedule this survey work with the utility companies to minimize delays and disruption of survey stakes.
- D. Replace all disturbed stakes as necessary to facilitate the relocations.
- E. The Contractor is responsible for costs incurred to relocate any utility more than once due to inaccurate or incomplete staking.
- F. Collect survey grade coordinate data for all exposed, relocated, and new utilities during construction.
 - 1. Collect data in one foot intervals unless otherwise directed in the UDOT Survey & Geomatics Standards manual. Refer to <http://www.udot.utah.gov/go/standardsreferences>.

3.17 EXISTING MILEPOST SIGNS

- A. Locate all existing milepost sign stations within the project limits.
 - 1. Contact the Engineer to determine any locations where a milepost sign was placed at a point other than the actual mile point due to prior physical limitations such as driveways, intersections, or bridge parapets, in coordination with Highway Referencing Specialist of the Asset Management Division.

- B. Reestablish location of milepost signs before project completion if construction activities required removal of any existing milepost signs.
 - 1. Reset sign location at original station of existing sign.
 - a. Exceptions
 - 1) Any prior physical limitations listed in this Section, Article 3.17, paragraph A were removed during construction and no longer prevent installation of a sign at the actual mile point.
 - 2) Roadside conditions or newly constructed physical limitations would prevent reestablishment of any milepost sign within 3 ft of its original station.
 - b. Contact the Engineer to determine how to proceed in either of these special cases in this Section, Article 3.17, paragraph B1a, in consultation with the Highway Referencing Specialist.
 - 2. Establish an appropriate offset for each milepost sign to meet installation and clear zone requirements.

- C. Contact the Highway Referencing Specialist through the Engineer to determine the preferred action for reestablishing the milepost signs where the alignment of the roadway was modified during construction to the extent that the new measured mile point locations of any milepost signs were shifted more than 10 ft from their original location.

END OF SECTION