	STANDARD OPERATING PROCEDURE	
	Survey Control Procedures	
Document Owner: Eduardo Garcia IV	Revision: 1	Review Date: 3/29/2024
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1. Purpose

The purpose of this procedure is to standardize the setting of survey control points and ensure that they meet the needs of our projects. These needs include accuracy to establish consistency across the department, precise so that they ensure projects can be designed correctly, and long-lasting so that they can be utilized on later projects. This will reduce errors in material quantity estimation, redesigns, and allow data to be used for multiple projects.

2. References

[TxDOT Surveyors' Toolkit](#)


[Monument Specifications](#)

[TxDOT Levels of Accuracy](#)

3. Acronyms and Definitions

ACRONYM	TERM
NGS	National Geodetic Survey
PM	Project Manager
PPCP	Primary Project Control Point
PS&E	Plan Specifications and Estimates
TxDOT RTN	The TxDOT Real-Time Network
RRP	Regional Reference Point

TERM	DEFINITION
<i>Control Status Definition and Protocol:</i>	
Missing Control	Any control that can no longer be found. Should be reset according to the standards of the funding entity under a unique control name. Recommendation is to use a suffix. Use a naming convention agreed upon by the District Survey Coordinator
Recovered	Control monument that has been previously sealed by a surveyor and/or engineer. Control originally set for a different entity (whether county or city or other department of the State or Feds, etc.). These shall be checked in the field for condition, current position and or elevation. Any missing or out of compliance control shall be reset using the process in this document, the TxDOT Monument Specifications, and according to the standards in the TxDOT Survey Manual.
Set	Control monument set under TxDOT funding and shall be installed according to the process in this document and according to the standards in the TxDOT Survey Manual. Primary control shall always follow TxDOT standards or be installed new.

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TERM	DEFINITION
<i>Project Mapping Plane Definition and Protocol:</i>	
Legacy Mapping Plane	Control coordinates of record; Substantial design efforts that have been performed on a project previously mapped. A table of the primary control points is required showing: control coordinates of record, current TxDOT RTN control coordinates, and differential between the two mapping planes at the primary control points. All metadata shall be reported as required.
New Mapping Plane	Current TxDOT RTN Data
Survey Level One	RRP Network Stations, Cooperative CORS sites; See TxDOT Levels of Accuracy for precision tolerances
Survey Level Two	Primary project control (GPS), Control for airborne GPS or LiDAR; See TxDOT Levels of Accuracy for precision tolerances.
Survey Level Three	Photogrammetric control panels, boundary corners, Right-of-Way, and local control; See TxDOT Levels of Accuracy for precision tolerances.


4. Responsibilities

- 4.1. District Survey Coordinator – The District Survey Coordinator is responsible for determining if any deviations from this document are needed for a single project and to supply control caps.
- 4.2. Surveyor – The Surveyor is responsible for setting control according to these standards and certifying all applicable deliverables.
- 4.3. TxDOT Project Manager (PM) – The TxDOT designated survey PM is responsible for communication and enforcement of these standards.

5. Flowchart N/A

6. Procedure

- 6.1. The Surveyor shall contact the TxDOT Project Manager (PM) and request TxDOT RTN accounts. These are good for a single data collector per account. These will need to be used to make sure the control is tied to the TxDOT RTN.

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6.2. The Surveyor shall determine a control layout per the District Survey Coordinator’s guidance and provide it to the TxDOT PM for approval. It’s understood that this layout may be field adjusted to avoid utilities and maintain intervisibility. It is the responsibility of the Surveyor to provide a final layout if the approved layout has been modified.

6.3. The Surveyor shall confirm with the TxDOT PM the number of primary control points that they will be setting and which CSJs and/or Project IDs they pertain to. TxDOT PM will request control point numbers/names for the primary control from the District Survey Coordinator. This request shall include the CSJ and/or Project ID, number of primary control points, as well as control sheets for nearby control points that will be checked as direct by the District Survey Coordinator. The TxDOT PM will provide the point numbers, control sheets for existing monuments, and appropriate TxDOT caps to the Surveyor.

6.4. The Surveyor shall submit a [Texas811](#) ticket as an excavator on all primary control points to be set. TxDOT is not responsible for surveyor damage to utilities. The District Survey Coordinator may request a copy of the Texas811 ticket at any time.

6.5. The Surveyor shall set the primary control via the methods provided below: Note: See [Monument Specifications](#) in [Surveyors’ Toolkit](#) for monument detail.


6.5.1. Prior to setting, stamp the TxDOT aluminum cap with control point number, as applicable.

6.5.2. Control Construction *Method 1* for areas with soil.

- Use earth auger or post hole digger and form to create a 3-foot deep by 18-inch diameter circular hole or as directed by the District Survey Coordinator. Fill with wet concrete.
- 5/8-inch-diameter iron rebar (3 feet in length unless obstructed) with aluminum cap and set into wet concrete. Use wire or twine to anchor rebar to nearby lathes. Push rebar into concrete until the edge of the convex cap is just slightly below wet concrete. This minimizes exposure of the edge of the cap. Once concrete is set, clip twine/wire.
- The use of delineator/witness posts shall be determined by the TxDOT District Survey Coordinator.

6.5.3. Control Construction *Method 2* for areas with exposed bedrock.

- Drill a hole into exposed rock wide enough to accommodate control cap.
- Grind a countersink depression wide enough for the top of the cap.
- Epoxy control cap into the hole.
- Allow epoxy to cure according to epoxy manufacturer’s specifications.

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- The use of delineator/witness posts shall be determined by the TxDOT District Survey Coordinator.

6.5.4. Control Construction *Method 3* for areas with sand.

- Start by digging a hole with an auger or shovel, 1-foot deep by 18-inch diameter circular hole.
- Drive the first section of rod in the center of the hole with the driving point tip on the first rod.
- Make sure it remains plumb while driving. Couple another section of rod with lock washers tightly to the first and continue to drive the assembly. To obtain tight joints, hand tighten the sections and then apply another one-quarter turn with a wrench or wrenches. Repeat this procedure until the driving rate is near refusal.
- When refusal or prescribed driving rate is reached. The last rod section is driven such that its top is up to 3 inches below the surface. Use a grinder or comparable tool to cut off the rod and leave the top of rod shaped smooth to have a good surface adding a “Dimple” in the center.
- Stamp aluminum lid with the control point name and year of installation.
- Install required size #5 PVC sleeve and epoxy the Aluminum cap/lid to it which will isolate the rod from soil movements that may occur. Ensure that the top of the monument is at least 3” from the closed lid.
- Backfill around the outside of the sleeve with sand or surrounding material.
- Install, per the witness posts, and signs for the PPCP. This post should be (6 feet) in length and be set to a minimum of (3 feet) above the ground surface. The post should have the standard witness post sign attached or painted. Leave the area as close to undisturbed as possible. Clean up any trash or unused material in the area.
- The use of delineator/witness posts shall be determined by the TxDOT District Survey Coordinator. *Note: See [Monument Specifications](#) in [Surveyors’ Toolkit](#) for detail of delineator/witness posts.*

6.5.5. The Surveyor shall perform two four-hour sessions on different days with at least 3 hours between start times of static observations on control to develop a good average of control value coordinates. The District Survey Coordinator will determine the Control Level Precision requirements.

6.5.5.1. Level between all primary control points to develop an adjustment for balanced elevations. The District Survey Coordinator will determine the Control Level Precision's requirements.

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6.5.5.2. Perform least-squares adjustment or its equivalent commercially available software to create a unified control network.

6.5.5.3. [TxDOT Levels of Accuracy](#) can be found on the [TxDOT Surveyors' Toolkit](#) web page.

6.6. The Surveyor shall tie adjacent Control Tie into adjacent TxDOT, NGS, city, and/or Flood Control District Control as directed by District Survey Coordinator based on the requirements below.

6.6.1. At the discretion of the District Survey Coordinator and subject to needs of Design Team, the minimum requirement is at least 2 adjacent control monuments for Flood Control District (if any) and 2 adjacent control monuments for any dataset or plan set that the Design Team will be using (City, County, etc., as available).

6.6.2. Perform at least two 180 second epochs VRS observations on adjacent control monument within the acceptable accuracy tolerance. Perform the same process with the project control monument.

6.6.3. Wait four hours for satellite geometry and atmospheric conditions to change before repetition.

6.6.4. Level between one project control monument and adjacent control monument as directed by the District Survey Coordinator.

6.6.5. Report the average values of observations as a product of the Least-Squares adjustment, then illustrate on the PS&E Data Sheets.


6.7. The Surveyor shall create a Control Index Sheet suitable for the PS&E using the [Primary Survey Control Checklist \(Form ROW-S-2462Check\)](#) as approved by the District Survey Coordinator.

6.8. The Surveyor shall create a Horizontal & Vertical Control Sketch Sheet suitable for the PS&E using the [Primary Survey Control Checklist \(Form ROW-S-2462Check\)](#) as approved by the District Survey Coordinator.

6.9. The Surveyor shall create [Primary Survey Control \(Form ROW-S-2462\)](#) suitable for Public Information Requests.

6.10. The Surveyor shall complete a [Primary Survey Control Checklist](#) on all deliverables.

6.11. The Surveyor shall submit the Control Index Sheet (Section 6.7), Horizontal & Vertical Control Sketch Sheet (Section 6.8), [Primary Survey Control](#) (Section 6.9), and [Primary Survey Control Checklist](#) (Section 6.10) to the TxDOT PM for checking **prior** to seal and signature. TxDOT PM will return redlined copy or approval in writing to the Surveyor for revision.

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6.12. After redlines are addressed by the Surveyor, the Surveyor shall sign and seal the Control Index Sheet (Section 6.7), Horizontal & Vertical Control Sketch Sheet (Section 6.8), and [Primary Survey Control](#) (Section 6.9).

6.13. The Surveyor shall submit signed & sealed copies to the TxDOT PM. The TxDOT PM will give them to the District Survey Coordinator for archiving and public information requests. The TxDOT PM shall maintain copies within the project records.

6.14. In the absence of clear understanding of the procedures outside this document, it is the responsibility of the TxDOT PM and/or District Survey Coordinator to provide a practical example.

7. Forms/Records

FORM NUMBER	FORM NAME	RECORD ADMINISTRATOR	STORAGE LOCATION	RETENTION PERIOD
ROW-S-2462	Primary Survey Control	Leia Golden		
ROW-S-2462Check	Primary Survey Control Checklist	Leia Golden		

8. Revision History

REVISION	ORIGINATOR	REVISION DATE	DESCRIPTION OF CHANGE
1	Ronny Lackey	3/29/2023	Original release

9. Training

TRAINING DATE	TRAINER	TRAINING LOCATION (insert link)