

Survey Manual

Chapter 1

General

Colorado Department of Transportation

2021

TABLE OF CONTENTS

Chapter 1 – General

1.1	General	4
1.1.1	CDOT Mission	4
1.1.2	CDOT Vision	4
1.1.3	CDOT Values	4
1.1.4	Survey Manual History	4
1.1.5	Survey Manual Revisions	6
1.1.6	Survey Advisory Committee	7
1.1.7	Purpose of Manual	7
1.1.8	Scope of Manual	7
1.1.9	Local Public Agencies	8
1.1.10	Importance of Surveying	8
1.1.11	23 CFR, Chapter I, Part 630 – Plans, Specifications, and Estimates (PS&E)	8
1.1.12	Federal Authority (23 CFR 710.201)	8
1.1.13	State Authority (Colorado Revised Statutes)	9
1.1.14	FHWA / CDOT Stewardship and Oversight Agreement (SOA)	9
1.1.15	Colorado State Board of Licensure Memorandum of Understanding	9
1.1.16	CDOT Standard Specifications for Road and Bridge Construction – Section 625 & 629	9
1.1.17	Land Surveys	10
1.1.18	Right of Way (ROW) Monuments	10
1.1.19	Relationship to the PLSS	10
1.1.20	Quality Review / Assurance	11
1.2	Preservation of Survey Monuments	11
1.2.1	Perpetuation of Land Survey Monuments	11
1.2.2	Agency / Region Survey Coordinator Notification	11
1.2.3	Referencing and Replacing of Monumentation	11
1.2.4	Public Land Survey System (PLSS) Monumentation	12
1.2.5	CDOT Contact Information	12
1.2.6	Region Map	15
1.2.7	NOAA / NGS	15
1.2.8	Monumentation Information to be furnished	15
1.3	Public Relations	16
1.3.1	General	16
1.3.2	Business Cards	16
1.3.3	Public Relations with Property Owners	16
1.3.4	Written Consent for Property Damage	16
1.3.5	Surveying on Public Lands	17
1.3.6	Surveying on Wilderness Property	17
1.3.7	Surveying on Railroad Property	17
1.3.8	Surveying on Utility Property	17
1.3.9	Surveying on CDOT Property	17
1.3.10	Survey Crew’s Conduct and Care of Property	18
1.4	Administration, Organization and Control	18
1.4.1	General	18

1.4.2	Surveying Safety	18
1.4.3	Technical Control of the Survey	19
1.4.4	Cooperation Between Survey Crew Members and Internal Customers	19
1.5	Cost Control for Surveying	19
1.5.1	General	19
1.5.2	Responsibility of the Survey Coordinator	19
1.5.3	Cost Control	19
1.5.4	Cost or Budget Estimate	20
1.5.5	Ability to Act	20
1.5.6	Schedule and Quality Control	20
1.5.7	Documentation	20
1.5.8	Cost Considerations	20
1.6	References	21

1.1 General

The Colorado Department of Transportation (CDOT) Survey Manual is intended to be used as a guide for Surveyors working on all projects administered by CDOT, to ensure minimum accuracies and data quality standards are met. It is not the intent of this Manual to supersede the use of Professional judgement or conduct. If the Professional Land Surveyor in responsible charge of work performed for a CDOT project would like to propose methods which deviate from procedures as outlined in this manual without sacrificing accuracy or quality, those deviations will **only** be accepted with prior documented approval from the CDOT Regional Professional Land Survey Coordinator who has direct oversight responsibility for the project.

1.1.1 CDOT Mission

To provide the best multi-modal transportation system for Colorado that most effectively moves people, goods, and information.

1.1.2 CDOT Vision

To enhance the quality of life and the environment of the citizens of Colorado by creating an integrated transportation system that focuses on safely moving people and goods by offering convenient linkages among modal choices.

1.1.3 CDOT Values

Safety—We work together to achieve a high-performing safety culture. We promote and apply consistent and sustainable safe work behaviors in everything we do.

People—We value our team. We acknowledge and recognize the skills and abilities of our co-workers and draw strength from our diversity and commitment to equal opportunity.

Integrity—We earn Colorado's trust! We are honest and responsible in all that we do and hold ourselves to the highest moral and ethical standards.

Customer service—We strive to provide the highest level of customer satisfaction and experience. With a can-do attitude, we work together and with others to respond effectively to our customers' needs.

Excellence—We are committed to quality. We are leaders and problem solvers, continuously improving our products and services in support of our commitment to provide the best transportation systems for Colorado

Respect—We treat everyone with respect. We are kind and civil with everyone, and we act with courage and humility.

1.1.4 Survey Manual History

The history of CDOT's Survey Manual is easily traced back to the 1960s. Prior to this date information is scarce, difficult to verify, and those individuals who worked as surveyors have long since retired.

Surveying Training Aid

The Surveying Training Aid was prepared in the early 1960's, and served as one of the earlier manuals for surveying within the Department of Highways. The manual consists of the following chapters consisting of approximately 240 pages:

1. Introduction
2. Field Notes; Hard copy and Electronic
3. Trigonometry
4. Measurement of Distances
5. Vertical Control – Leveling
6. Determination of Direction
7. The Magnetic Compass
8. Measurement of Angles
9. Plane Coordinate Systems
10. Traverse Computations
11. Area Computations
12. Stadia
13. Horizontal Curves
14. Compound Curves
15. Spirals
16. Vertical Curves
17. Earthwork
18. Adjustment of Instrument
19. Appendix

Survey Manual 1966

The Survey Manual of 1966 supersedes the Surveying Training Aid, and was prepared in part by a group of engineers, mostly by two resident engineers from what was then the Colorado Department of Highways (CDOH) District IV, and VI. The manual consists of the following chapters consisting of approximately 140 pages:

1. Objects and Purpose, Public Relations
2. General Survey Procedures and Techniques
3. Reconnaissance, Preliminary and Location Survey
4. The Survey
5. Construction Surveys
6. Glossary and Standard Abbreviations

Survey Manual 1984

The Survey Manual of 1984 supersedes the manual of 1966. The manual consists of the following chapters consisting of approximately 170 pages:

1. General
2. General Procedures
3. Preliminary Surveys
4. Construction Surveys
5. Incidental
6. Useful Information
7. Appendix

Survey Manual 1992

The Survey Manual of 1992 supersedes the manual of 1984, and was prepared by the Survey Activities Committee (SAC). Each CDOT region participated in authoring the chapters. The manual is comprised of the following chapters consisting of approximately 400 pages:

1. General
2. General Procedures
3. Preconstruction Surveys
4. Photogrammetry
5. Construction Surveying
6. Geodetic Control
7. Surveying Safety
8. Appendix

Survey Manual 2003

The Survey Manual of 2003 supersedes the manual of 1992. CDOT Project Development, Right of Way Survey and Plans prepared it, under the direction, review, and approval of the Survey Activities Committee. The manual is comprised of the following chapters consisting of approximately 570 pages:

1. General
2. General Procedures
3. GPS Surveys
4. Aerial Surveys
5. Preliminary Surveys
6. Construction Surveys
7. Safety
8. Appendix

Survey Manual 2021

The Survey Manual of 2021 supersedes earlier Survey manuals from 2003 - 2017. CDOT Project Development, Right of Way Survey and Plans organized the updates with the direction, review, and approval of the Survey Advisory Committee. The manual is comprised of the following chapters:

1. General
2. General Procedures
3. GPS/GNSS Surveys
4. Aerial Surveys
5. Preliminary Surveys
6. Construction Surveys
7. Safety
8. Resources
9. Open Roads, CDOT Best Practices

This manual is not distributed in hard print; rather it is available for downloading and printing from the following:

Survey Manual

www.codot.gov/business/manuals/survey

1.1.5 Survey Manual Revisions

Manual revisions will be updated annually, as advances in technology are developed and implemented in survey procedures, hardware, and processing software. As advancements that prove a higher degree of accuracy are more easily attained, new specifications for CDOT shall be developed and sections of this manual shall be revised to stay current with those advances. As such, it is recommended that users of this manual check for revisions and replace those sections that have been revised.

Suggestions and/or comments for improvement, clarification, corrections, and/or inclusion of material in this manual are welcome. Please forward your comments to the following:

CDOT Statewide Survey Coordinator
HQ Project Support,
Right of Way/Survey Program
2829 W. Howard Place
Denver, Colorado 80204
phone: 303-757-9923

1.1.6 Survey Advisory Committee

The Chief Engineer granted authority on March 22, 1991, establishing the Survey Advisory Committee (SAC) as a standing committee. The name changed to the Survey Advisory Committee in 2015. The Chief Engineer in P.D. 1305.1 (January 28, 1998, incorporated into the Survey Manual, October 24, 2003) grants further authority. The committee membership consists of voting members made up of two region professional land surveyors or their designees from each of the five CDOT Regions and the Project Development section of HQ Project Support/ ROW/Survey Department.

Survey Advisory Committee meeting summaries are shared with the Survey Committee members and are available to anyone upon request to the HQ Survey coordinator or any Regional PLS-II. CDOT SAC members can view and retrieve meeting summaries from the CDOT Google Survey Advisory Committee share drive.

1.1.7 Purpose of Manual

The purpose of this manual is to define the minimum specifications that shall be followed while performing surveys by CDOT surveyors, contractor or consultant surveyors in order to secure an optimum degree of statewide uniformity in surveying, to establish and maintain survey standards and to improve the overall efficiency of CDOT's survey program. This manual is not intended as a textbook on surveying, rather it provides a reference source for statewide surveying policies, procedures, and information. The specifications as defined by this manual shall include the entire Survey Manual; not each chapter separately. Throughout this manual, Federal Regulations, Colorado Revised Statutes and Board Rules are included for reference only; readers are instructed to check the latest regulations, statutes and rules to ensure there have not been any repeals, revisions or amendments. Any variation from the specifications shall have the prior approval of the Region Survey Coordinator.

1.1.8 Scope of Manual

This manual covers CDOT's surveying policies, procedures, and appropriate reference material. These policies and procedures shall be considered specifications, and are referenced to in the Standard Specifications for Road and Bridge Construction, Section 625 - Construction Surveying, and Revision of Section 629 - Survey Monumentation, as well as in contracts securing the professional services for engineering, Right of Way mapping, Topographic Surveys and Utility surveys by consultants which require survey control.

Please see the latest publications for Sections 625 and revision of 629 on the CDOT Public website:

<https://www.codot.gov/business/designsupport/cdot-construction-specifications/2019-construction-specifications/2019-specs-book>

The Region Survey Coordinator should be contacted for specific information not included within this Survey Manual. In cases of unique project concerns, the CDOT Project Manager and CDOT PLS-II's can approve a "Project Specials" provision.

1.1.9 Local Public Agencies

This manual covers the department's surveying policies, procedures and appropriate reference material for Local Public Agency projects that fall under CDOT oversight in accordance with the FHWA Stewardship Guide.

www.codot.gov/business/localagency

See ROW Manual Chapter 8 – Local Public Agencies for additional information.

1.1.10 Importance of Surveying

Surveying is a prerequisite to civil engineering design and Right of Way acquisition. In transportation engineering, surveying provides the foundation and continuity for route control, location, photogrammetry, design, Right of Way mapping, land acquisition, access issues, Geographic Information Systems (GIS), and all other preliminary engineering including traffic, hydraulics and bridge. Surveyors also set a basic "framework" of stakes in which are used by contractors and state engineers in building and inspecting highway projects. Surveying is the single function that ties all the elements of a project together. From conception through design, Right of Way mapping, land acquisition, and construction to final Right of Way monumentation and Geographic Information Systems, to a large degree, the acceptability and cost effectiveness of planning, Right of Way mapping, land acquisition, design and construction is dependent upon properly performed surveys.

1.1.11 23 CFR, Chapter I, Part 630 – Plans, Specifications, and Estimates (PS&E)

630.201 - Purpose

The purpose of this subpart is to prescribe Federal Highway Administration (FHWA) procedures relating to the preparation, submission, and approval of plans, specifications and estimates (PS&E), and supporting documents for Federal-aid projects.

630.203 - Applicability

The provisions of this regulation apply to all highway construction projects financed in whole or in part with Federal-aid highway funds and to be undertaken by a State or political subdivision, except for projects carried out pursuant to 23 U.S.C. 117 relative to certification acceptance or a secondary road plan.

630.205 - Preparation, submission, and approval

- (a) The contents and number of copies of the PS&E assembly shall be determined by the FHWA.
- (b) Plans and specifications shall describe the location and design features and the construction requirements in sufficient detail to facilitate the construction, the contract control and the estimation of construction costs of the project. The estimate shall reflect the anticipated cost of the project in sufficient detail to provide an initial prediction of the financial obligations to be incurred by the State and FHWA and to permit an effective review and comparison of the bids received.
- (c) PS&E assemblies for Federal-aid highway projects shall be submitted to the FHWA for approval.
- (d) The State Highway Agency (SHA) shall be advised of approval of the PS&E by the FHWA.
- (e) No project or part thereof for actual construction shall be advertised for contract nor work commenced by force account until the PS&E has been approved by the FHWA and the SHA has been so notified.

1.1.12 Federal Authority (23 CFR 710.201)

(b) Program oversight. The SDOT (State Department of Transportation) shall have overall responsibility for the acquisition, management, and disposal of real property on Federal-aid projects. This responsibility shall include assuring that acquisitions and disposals by a State agency are made in compliance with legal requirements of State and Federal laws and regulations.

1.1.13 State Authority (Colorado Revised Statutes)

The provisions of Articles 50, 51, 52 and 53 of Title 38, and Article 25, Part 2 of Title 12, of the Colorado Revised Statutes, as amended, are just some of the Colorado Revised Statutes that apply to CDOT's practice of Land Surveying and Right of Way plans.

LexisNexis CRS

www.lexisnexis.com/hottopic/colorado/

1.1.14 FHWA / CDOT Stewardship and Oversight Agreement (SOA)

In 1994, the Federal Highway Administration (FHWA) and CDOT jointly established a Stewardship Agreement to define how they will work together to provide project and program oversight. The Stewardship Agreement was last updated March 2019. Under the Stewardship Agreement, FHWA and CDOT will share the responsibility for oversight of projects using Federal-aid funds.

The Stewardship Agreement between FHWA and CDOT is intended to be a document that is under continual review. Each organization has the opportunity to make a change to the document when there is mutual agreement that the change is necessary. The document will also be modified to reflect changes in authorization or regulations.

www.codot.gov/business/designsupport/cdot-fhwa-stewardship-agreement

1.1.15 Colorado State Board of Licensure Memorandum of Understanding

It is CDOT's intent to comply fully with Federal Regulations, Colorado Revised Statutes and Board Rules as they relate to the practice of land surveying. On July 1, 1985, CDOT entered into a Memorandum of Understanding (MOU) with the Colorado State Board of Licensure for Architects Professional Engineers and Professional Land Surveyors, which addresses the legal aspects of surveying for Right of Way plans and clarifies the responsibility of the CDOT and consultant surveyors.

The MOU shall be adhered to by CDOT, local public agencies, contractors and consultants working on Federal-Aid and state funded projects at all times.

The MOU was last updated and approved by CDOT and the State Board in September of 2020.

1.1.16 CDOT Standard Specifications for Road and Bridge Construction – Section 625 & 629

CDOT Standard Specifications for Road and Bridge Construction are to be used on contract work awarded by CDOT. These may be supplemented or modified to suit specific contracts.

<https://www.codot.gov/business/designsupport/cdot-construction-specifications/2019-construction-specifications/2019-specs-book>

Specific project requirements under Sections 625 and 629, can be required using the Survey Tabulation Sheet contained in the Project Final Plans Ad set. It is recommended that project requirements for construction listed on the Survey Tabulation sheet, are discussed at the FOR (Final Office Review) and Pre-Survey Conference-Construction Survey Meeting.

1.1.17 Land Surveys

Land surveys, including the monumentation of land corners and the preparation and recording of Plats and Right of Way plans, are to be completed by persons licensed in the State of Colorado to perform such surveys. CDOT's policy is to comply with all applicable Federal Regulations, Colorado Revised Statutes and Board Rules as stated in the Memorandum of Understanding between CDOT and the Colorado State Board of Licensure for Architects and Professional Engineers and Professional Land Surveyors.

<https://dpo.colorado.gov/AES/Laws>

1.1.18 Right of Way (ROW) Monuments

Right of Way monuments are physical points set on the ground by CDOT or its contracted consultants to define Rights of Ways in the field. They are set per current statute requirements, currently at angle points and at distances of 1400 feet or less. They are intended to accurately monument property acquired by CDOT within the state of Colorado. These monumented Right of Way points shall be set within the Minimum Horizontal Accuracy Tolerance stated for a CDOT Class B – Secondary survey as stated in Chapter 5 – Preliminary Surveys of this manual. Right of Way monuments are used to delineate both existing and newly acquired Right of Way.

Neither CDOT nor its consultant surveyors perform complete surveys of properties adjacent to a state-owned Right of Way. Any gaps or overlaps between the Right of Way and adjacent properties are noted on the plans and in the Right of Way Authorization Memo, as determined by the Professional Land Surveyor (PLS) in responsible charge of the project. Boundaries are not adjusted unless CDOT ROW goes through the proper legal process to acquire such property for a CDOT project. Right of Way monuments are not to be set on adjacent property lines and should be avoided at all times.

Whenever a property owner requests to have their private property corner monuments replaced due to a partial acquisition of their property, CDOT's Right of Way Manual Chapter 4 – Acquisition, Section 4.13 – Land Survey in Memorandum of Agreement, shall be followed.

SECTION 4.13 – Land Survey Memorandum of Agreement

Items included in the agreement requesting monument replacement by CDOT's surveyor are not appropriate due to the liability associated with the monument placement. If the landowner requires that certain monumentation be performed as part of the negotiations, a private land surveyor must perform the work. If CDOT would hire the surveyor, it must be done through the consultant agreement process. The hiring cannot be done through purchasing with a purchase order.

If surveying is required, the negotiator should get an estimate from a reputable surveying company for the required work. The estimate shall be reviewed and approved by the Region Survey Coordinator for reasonableness. The amount of the estimate shall be included on the agreement as expenses incidental to conveying the real property. When the agreement is sent to the Project Development Branch, Headquarters ROW, for the ordering of the warrant, a separate warrant shall be issued for these incidental expenses unless the warrant is issued to a title company for closing.

All monies shall be paid directly to the property owner. It shall be the property owner's responsibility to hire a survey company to perform the work. The property owner shall be reimbursed after the work has been completed.

1.1.19 Relationship to the PLSS

Whenever necessary, or when additional Right of Way may be acquired, the control network will be tied

to all found and identified PLSS monuments lying along a length of highway to a degree that will enable a surveyor to locate said monuments from the control monuments. Distances between incidental land monuments and angles from control lines to intercepted land lines will not be verified unless such verification is required to initially establish control for physical Right of Way. All found property corners shall be tied to the control survey.

1.1.20 Quality Review / Assurance

Region and/or consultant surveyors shall complete quality and assurance reviews for all surveying done by CDOT or consultant surveyors. All surveys shall be checked for accuracy and compliance with State and Federal laws and/or rules. A professional land surveyor shall be assigned to verify that a reasonable portion of each survey activity has been checked and found to be in accordance with CDOT specifications and applicable federal and state laws.

1.2 Preservation of Survey Monuments

1.2.1 Perpetuation of Land Survey Monuments

Colorado Revised Statutes Title 38, Article §§ 38-53-101 — 38-53-110, Perpetuation of Land Survey Monuments declares it to be a public policy of the state to encourage the establishment and preservation of accurate land boundaries, including durable monuments and complete public records, and to minimize the occurrence of land boundary disputes and discrepancies. This article shall be adhered to by all agencies of the state, counties, and local governments as well as individuals, corporations, and partnerships engaged in the private practice of land surveying.

The provisions of this article requires that if a professional land surveyor conducts a survey that uses any monument representing a public land survey system corner monument location, quarter section corner, sixteenth section corner, government land office or bureau of land management (government) lot corner as defined by the nomenclature of the United States Public Land Survey System (PLSS), or any United States Geological Survey (USGS), United States coast and geodetic survey, or National Oceanic and Atmospheric Administration (NOAA) monument, as a control corner, such professional land surveyor shall file a monument record describing said monument with the Board if the monument and its accessories are not substantially described in an existing monument record previously filed pursuant to this section or its predecessor.

If a professional land surveyor establishes, restores, or rehabilitates any public land survey monument corner location or section corner, quarter section corner, or sixteenth section corner as defined by the nomenclature of the United States public land survey system, said Professional Land Surveyor shall file a monument record.

1.2.2 Agency / Region Survey Coordinator Notification

The preservation of survey monuments is mandatory and affects all governmental agencies including CDOT. Once a survey monument is destroyed, the cost of replacing the monument is significantly increased and the accuracy of re-establishing the monument back to its original position is degraded. Due to this fact, the Region Survey Coordinator and the agency affected shall be notified as soon as it becomes known that a monument is in a position that is, or will be, in danger of being destroyed by construction or maintenance operations. The monument datum must be preserved.

1.2.3 Referencing and Replacing of Monumentation

When any monument is identified for replacement, the monument shall be referenced prior to being disturbed in accordance with Federal Regulations, Colorado Revised Statutes and Board Rules.

Referencing of monuments for replacement requires the use of correct replacement methods so the stated precision of the monument is not degraded. At a minimum, the monument being replaced shall be replaced in a position that will meet the Minimum Horizontal Accuracy Tolerance for the particular monument unless a higher level of accuracy is required by the monuments owner.

The replacement monument shall bear the license number of the PLS responsible for setting the monument along with any other required monument stamping. All appropriate survey diagrams, maps, and plans such as Project Control Diagrams, Land Survey Control Diagrams and Right of Way Plans shall be completed and filed in accordance with this Survey Manual.

In many cases, county engineering offices will work with CDOT personnel in a joint effort to protect and restore monuments. Their assistance should be solicited whenever possible.

(See Chapter 5 – Preliminary Surveys for additional information.)

1.2.4 Public Land Survey System (PLSS) Monumentation

It is imperative that every effort be made to protect, restore and reestablish Public Land Survey System (PLSS) monuments such as Township, Range, and section corners, whenever they are affected by construction or maintenance operations in accordance with the applicable laws of the state of Colorado. PLSS monumentation must be carefully referenced in order that they may be re-established at such time as they are safe from construction and/or maintenance operations in accordance with the Federal Regulations, Bureau of Land Management Manual of Surveying Instructions, Colorado Revised Statutes and Board Rules.

(See Chapter 5 - Preliminary Surveys for additional information.)

1.2.5 CDOT Contact Information

CDOT Survey / ROW Plans correspondence should be directed to the following:

REGION 1 Denver, CO

Vacant

303-757-9921 • Work

[2829 W Howard Pl Denver CO 80204](#) • Work

Region 1 - Denver Metro (Central)

Dane Courville

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[425 A Corporate Cir Golden CO 80401](#) • Work

Region 1 - Denver Metro (West)

Shannon Hart

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Region 1 - Denver Metro (South)

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[303-398-6726](tel:303-398-6726) • Work
[4670 Holly St, Denver CO 80216](https://www.colorado.gov/government/locations/4670-holly-st-denver-co-80216) • Work
Region 1 – Denver Metro (North)

REGION 2 Pueblo, CO

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gregory.a.jones@state.co.us
[719-546-5746](tel:719-546-5746) • Work
[5615 Wills Blvd Pueblo CO 81008 US](https://www.colorado.gov/government/locations/5615-wills-blvd-pueblo-co-81008-us) • Work

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[5615 Wills Blvd Pueblo CO 81008 US](https://www.colorado.gov/government/locations/5615-wills-blvd-pueblo-co-81008-us) • Work

REGION 3 Grand Junction, CO

Brian Bowker
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[970-683-6240](tel:970-683-6240) • Work
[222 S 6th St 317 Grand Jct CO 81501 US](https://www.colorado.gov/government/locations/222-s-6th-st-317-grand-jct-co-81501-us) • Work

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REGION 4 Greeley, CO

Mark Guerrero
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[970-350-2173](tel:970-350-2173) • Work
[10601 10th St Greeley CO 80634 US](https://www.colorado.gov/government/locations/10601-10th-st-greeley-co-80634-us)
Region 4 - Greeley

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Region 4 - Greeley

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Region 5 - Durango

HEADQUARTERS

vacant

Statewide Survey Program Coordinator

2829 West Howard Place, Denver, CO 80204

Office: 303-757-9923

Andrea Griner

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Acquisition-Relocation-Records Supervisor

2829 W. Howard Pl., 3rd Floor, Denver, CO 80204

P 303.727-9141

- monument)
- 3. The date by which the monument must be moved
- 4. The necessity for moving the monument
- 5. Digital photos if available
- 6. If the agency involved is the U.S. Geological Survey, a copy of "Request to Disturb" must be sent to the NOAA/NGS Contact above, for their records.

In most instances the agency affected will send a new monument marker that has been properly stamped together with instructions for establishment of the new monument. Contact each agency directly for specific procedures and information.

1.3 Public Relations

1.3.1 General

Public relations are an important duty of any surveyor, and are the responsibility of all CDOT and contracted consultant surveyors. It is imperative to remember that common sense and courtesy are necessary in any form of public relations. Each employee and contracted consultant is a representative of CDOT. The Department is often judged by our behavior as well as our work. The nature of surveying keeps surveyors out in the public eye much of the time. First impressions, whether good or bad, are often lasting. The impression you create thereby will be a credit or liability to you, your profession, and CDOT.

Maintain a pleasant, businesslike attitude at all times and be informed about our job. This includes answering questions, taking criticism (right or wrong), and listening to suggestions. Questions from the general public concerning the work should be answered promptly or referred to the appropriate party.

1.3.2 Business Cards

All survey crew chiefs shall carry and make use of business cards that include the crew chief's name, title, business address, and phone number while engaged in performing any field work. These cards can be given to property owners, park rangers, other surveyors, etc. as a means of introduction and contact information.

1.3.3 Public Relations with Property Owners

Dealing with property owners is an important aspect of a surveyor's public relations. The property owner is the one who will be directly affected by the survey and possible subsequent construction. He/she will naturally take an interest in any possible intrusion on his/her property regardless of the purpose. Written Permission to Entry Property Forms should be obtained from the property owner before CDOT or a contract consultant survey crew enters the property (See Chapter 2 - General Procedures for additional information). A property owner or occupant shall be contacted before CDOT or a contract consultant survey crew enters the property. The purpose of this contact is to:

1. Inform the owner or occupant that an entry is required
2. Explain what survey activities are to be performed
3. Indicate the duration of the survey
4. Obtain Permission to Entry Property Forms if not previously obtained

1.3.4 Written Consent for Property Damage

If damage to the property is anticipated, a written consent from the property owner shall be obtained prior to the damage. Examples of activities that require the property owner's written consent are:

1. Digging large holes
2. Cutting trees
3. Clearing land areas
4. Setting of survey monuments
5. Using vehicles or equipment not normally used on the property

1.3.5 Surveying on Public Lands

Public lands should be treated as though it were private property, especially where extra care and attention to regulations are required. Some types of public land that may be encountered are state and national parks, municipal parks, national forests, federal wilderness areas and historical sites.

Prior to surveying such an area, the survey crew chief should:

1. Contact the person responsible for the property
2. Explain the need for the survey and its anticipated duration
3. Learn the requirements for working in the area, such as fire regulations, brush cutting procedures, and where vehicles may be driven
4. Research information about the location of control points, property monumentation access roads, etc.
5. Distribute property requirements and information gained to each person involved in the survey so that the work can be performed within the requirements.

1.3.6 Surveying on Wilderness Property

Surveys in wilderness areas are subject to very stringent regulations. Absolutely no work can be performed in these areas without the approval of the U.S. Forest Service. A permit is usually required.

Forest and park rangers and supervisors are very cooperative and helpful when all rules are obeyed. Consulting them in advance of a survey will ensure that regulations will not be broken because of a lack of knowledge.

1.3.7 Surveying on Railroad Property

Railroad property which does not carry rails should be treated as any other private property. Railroad property that carries rails is called an "Operating Right of Way". Before entry is made on such property, a Right to Entry Property Form in writing should be obtained from the proper railroad authority. Surveys should not be made before the right to entry property is granted.

1.3.8 Surveying on Utility Property

In regard to utility companies the surveyor is urged to make personal contact with the official in charge of the utility company. Personal contact with these people will acquaint them with the planned operations prior to surveying or construction, enabling them to schedule their work or services to the best advantage of all concerned. To prevent delay of the preliminary survey, the utilities involved should be given sufficient notice to locate underground services as required.

1.3.9 Surveying on CDOT Property

Private surveyors or contract consultant firms working in or near the existing CDOT Right of Way shall obtain a Utility /Special Use Permit with the survey option completed.

1.3.10 Survey Crew's Conduct and Care of Property

The survey crew shall conduct its operation in the following manner:

1. The method chosen for the survey should be the one that will have the least effect on the property.
2. Proper language should be used at all times.
3. Stakes and other markers should be placed where there is little likelihood of their being disturbed or of their causing an accident.
4. The property should be left, as nearly as possible, in the condition that existed prior to the survey.
5. Any damage should be repaired, holes should be filled, and the property restored in the best manner possible.
6. All potentially hazardous items should be removed from the property after their usefulness has ended. Examples of such items are stakes that have been placed in pedestrian areas or in fields that are to be mowed, and photogrammetry ground control panel materials.

1.4 Administration, Organization and Control

1.4.1 General

The Region Survey Coordinator is responsible for the monitoring of all phases of surveying in his/her assigned area. The survey crew chief is responsible to the Region Survey Coordinator for the actions of the survey crew as part of the unit, and for the actions of individuals assigned to him/her. These responsibilities include the safe and efficient completion of the work, harmonious relations within the crew consistent with the objectives, and courteous businesslike relations with the public.

1.4.2 Surveying Safety

Safety should be a prime consideration in all surveying especially when performed in and around traffic. A key planning consideration is to minimize the overall exposure of surveyors to traffic. Carefully selecting the survey method, choosing the time to perform the survey, and employing special survey techniques can accomplish this in part.

Each survey crew member should know how to use all safety equipment and procedures required for the task at hand. The survey crew chief is responsible for ensuring that each member of the survey crew is trained and familiar with safety equipment and procedures. The Region Survey Coordinator is responsible for ensuring that each survey crew chief is trained and familiar with safety equipment and procedures. Survey crews should hold regularly scheduled safety meetings as determined by the Region Survey Coordinator. Requests for additional safety training by the region should be made to Central Offices. Once additional safety training has been requested, Central Offices will coordinate, schedule and provide for the training in accordance with the general training plan.

Although it may not be readily apparent, the public relations aspect of working procedure is a vital element in survey crew safety. Aside from the obvious benefits of avoiding altercations with property owners, information gained from property owners regarding dangerous domestic animals, drinking water supplies, location of nearest medical facilities, etc. can be very valuable in assuring the safe completion of a survey.

See Chapter 7 - Surveying Safety for additional information.

1.4.3 Technical Control of the Survey

Each survey crew chief shall have a thorough knowledge of surveying theory and techniques as they apply to highway route and Right of Way surveying. Each survey crew shall have a professional land surveyor assigned to be in “Responsible Charge” of that particular survey, in accordance with C.R.S. 12-120-304. The professional land surveyor may delegate surveying tasks, but may not delegate “Responsible Charge” of the survey.

1.4.4 Cooperation Between Survey Crew Members and Internal Customers

Proper relationships within a survey crew are necessary if individuals are to work proficiently as a team. In order to produce satisfactory quality and quantity of work, there must be close cooperation between all members of the survey crew. For efficient operation of the crew, all members must be trained in the different skills required of the work and should be instructed before starting work what the task at hand is and what the objectives of the task are. All operations should be performed as concurrently as possible. For instance, when the instrument person has completed the setup, a backsight should be ready. All needs of the work should be anticipated by each crewmember. The supplies and equipment that are required should be available at the time they are needed.

Members of the crew should consider each other’s capabilities and work in cooperation with each other to foster each member’s surveying knowledge and understanding of procedures. Each member of the crew should be considerate and try to aid and not hinder the other members of the crew.

A crew chief can help maintain good crew relationships by keeping crew members well informed about individual and crew roles and duties for each job. Field crews must inform their supervisors of important developments and conversely, the supervisors must keep the field crews informed.

Good relations can also be maintained among regional personnel and central offices personnel through good communication and a clear understanding of survey requirements and responsibilities. When in doubt about a survey request, a phone call for clarification will increase efficiency and save time.

1.5 Cost Control for Surveying

1.5.1 General

The Colorado Department of Transportation is committed to Total Quality Management (TQM) as are those who survey for the Department. This section is designed to aid the Region Survey Coordinator in keeping abreast of the total survey function.

1.5.2 Responsibility of the Survey Coordinator

The survey coordinator has three basic responsibilities:

1. (Accuracy) Quality Control:
The survey shall be conducted according to CDOT Minimum Horizontal and Vertical Accuracy Tolerances, or FGCC specifications and tolerances.
2. (Time) Schedule Control:
The survey must be completed on time to ensure project commitments
3. (Cost) Cost Control:
The survey should be completed within budget to ensure the project can be completed.

1.5.3 Cost Control

Cost has always been a major concern of CDOT. The typical surveying costs control program has three

objectives:

1. Focus management's attention on detecting cost overruns before they occur
2. Enhance cost-consciousness among all project personnel
3. Encourage a project team cost-reduction perspective

In addition to the above listed objectives, a survey-specific cost control system includes:

1. A structured project plan that contains detailed timing and methodology criteria
2. A realistic budget estimate (control estimate)
3. Accurate and timely cost forecasts for all phases of the survey project
4. Budget-cost estimate comparisons for all items included
5. Ability to act: To control and forecast budget overruns

1.5.4 Cost or Budget Estimate

A cost (or budget) estimate is a detailed prediction of the project execution plan. This includes the schedule, economic circumstances, and physical project environment. Enough detail must be present to enable you to make item-by-item comparisons (cost) as the project progresses.

See Appendix 1.A.8 Regional Field Survey Cost Estimate for additional information.

1.5.5 Ability to Act

Having the ability to act means that the project may have changes that require timely updates to the budget estimates. You must also know when the project has “gone bad”, meaning that you may have to step back and re-access the project scope of work and budget.

1.5.6 Schedule and Quality Control

The approach described above is only valid if the procedure used to conduct the survey has been optimized and correlated to two factors:

1. (Accuracy) What degree of accuracy, reliability, repeatability or what specific laws, standards or specifications must be met when completing the survey project?
2. (Time) How long does it take to perform the proposed activity or just a small component task within the entire activity?

1.5.7 Documentation

Any mechanism that allows the surveying cost estimator to correctly relate task requirements with probable productivity rates for the personnel performing the task will facilitate effective cost estimation. A simplified listing of all the factors including costs should be documented on a regular basis. These will form the basis for the actual dollar amounts for your estimates.

1.5.8 Cost Considerations

The following considerations shall be taken into account to control project cost:

1. Know the time and accuracy capabilities for your equipment and personnel.
2. Pay attention to costs (that are well documented) during every project.
3. Provide incentives to help collect and update valid cost inputs.
4. Encourage continued cost consciousness through productivity and the use of modern technology.
5. Consider and evaluate the productivity capabilities of new technology.
6. Look to experienced employees who easily adapt to new methods and technologies.

1.6 References

CDOT Right of Way Manual <https://www.codot.gov/business/manuals/right-of-way>
Links to information below:

<https://www.codot.gov/business>

CDOT Standard Specifications for Road and Bridge Construction
<https://www.codot.gov/business/designsupport/cdot-construction-specifications/2019-construction-specifications/2019-specs-book/2019-standard-specifications> CDOT Policies and Procedural Directives

CDOT M & S Standards
<https://www.codot.gov/business/designsupport/2019-and-2012-m-standards/2019-m-standards-plans>

Project Development and Design Manual
<https://highways.dot.gov/federal-lands/pddm>

Federal Highway Administration Risk-Based Stewardship and Oversight Guidances
<https://highways.dot.gov/federal-lands/programs/stewardship-oversight/so-guidance>

Code of Federal Regulations, Title 23 – Highways, Chapter I – Federal Highway Administration, Department of Transportation
<https://ecfr.federalregister.gov/current/title-23/chapter-I>

Board of Licensure for Architects and Professional Engineers and Professional Land Surveyors
<https://dpo.colorado.gov/AES/Laws>