

# **Survey Manual**

## **Chapter 1**

### **General**

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## **1.1 General**

### **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**

Is that transportation is the safe, practical, and efficient movement of people, goods, and information (not just vehicles). This should be done at the lowest possible cost (to demonstrate our accountability to spend tax dollars wisely) and should protect the environment (to enhance the quality of life for the citizens of Colorado).

### **1.1.3 CDOT Values**

The Values that will guide the Colorado Department of Transportation and its employees are:

**SAFETY** – We work and live safely!

We protect human life, preserve property, and put employee safety before production.

**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.

**PEOPLE** – We value our employees!

We acknowledge and recognize the skills and abilities of our coworkers and draw strength from our diversity and commitment to equal opportunity.

**CUSTOMER SERVICE** – We satisfy our customers!

With a can-do attitude we work together and with others to respond effectively customer’s needs.

**EXCELLENCE** – We are committed to quality!

We are leaders and problem solvers, continuously improving our products and support of our commitment to provide the best transportation systems for Colorado.

**RESPECT** – We respect each other!

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 is comprised of the following chapters consisting of approximately 240 pages:

1. Introduction
2. Field Notes

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 supercedes 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 is comprised 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 supercedes the manual of 1966. The manual is comprised 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 supercedes 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 supercedes 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

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](http://www.codot.gov/business/manuals/survey)

### **1.1.5 Survey Manual Revisions**

This manual shall have quarterly revision periods. As advances in technology are made in survey procedures, hardware, and processing software that prove a higher degree of accuracy is 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 Project Development, Right of Way Survey/Plans  
4201 East Arkansas Avenue, 4<sup>th</sup> Floor  
Denver, Colorado 80222  
phone: 303-512-4401  
fax: 303-757-9868  
cell: 303-514-2692  
[daniel.a.smith@dot.state.co.us](mailto:daniel.a.smith@dot.state.co.us)

### **1.1.6 Survey Activities Committee**

The Chief Engineer granted authority on March 22, 1991, establishing the Survey Activities Committee (SAC) as a standing committee. 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 consist of voting members made up of two region professional land surveyors or their designees from each of the six CDOT Regions and the Project Development section of HQ Project Development.

SAC Committee meeting minutes are archived and shared on a server for all internal CDOT personnel to view and retrieve.

The name was changed for the Survey Activities Committee to the Survey Advisory Committee in 2015.

### **1.1.7 Purpose of Manual**

This manual supersedes the Survey Manual of 1992, and any revision made thereof.

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 instruction 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 Section 629 - Survey Monumentation, as well as in contracts securing the professional services for engineering, Right of Way mapping and photogrammetry surveys by consultants which require survey control.

The Region Survey Coordinator should be contacted for specific information not included within this Survey Manual.

### **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](http://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, Geographical Information Systems (GIS), and all other preliminary engineering including traffic, hydraulics and bridge. Surveys 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, from conception through design, Right of Way mapping, land acquisition, and construction to final Right of Way monumentation and Geographical Information Systems data. 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 STD 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.

[www.gpo.gov/fdsys/granule/CFR-2010-title23-voll/CFR-2010-title23-voll-sec710-201](http://www.gpo.gov/fdsys/granule/CFR-2010-title23-voll/CFR-2010-title23-voll-sec710-201)

### **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/hottopics/colorado/](http://www.lexisnexis.com/hottopics/colorado/)

### **1.1.14 FHWA / CDOT Stewardship Agreement**

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 July 19, 2007. 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](http://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 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 has been updated at various times. It was last updated in 2011.

[www.colorado.gov/pacific/dora/AES\\_Publications\\_Docs](http://www.colorado.gov/pacific/dora/AES_Publications_Docs)

### **1.1.16 Procedural Directive for Performing Land Surveys**

The Department's Procedural Directive 1305.1 – Land Surveys, was implemented on 11/20/1986 to further strengthen the Memorandum of Understanding. On 3/5/1997 CDOT Central Offices, Staff Right of Way Services completed a Pre-construction Quality Assurance Review for Preliminary Surveys. The intent of this QAR was to find out how preliminary surveys may be the source of inconsistencies in design, such as Right of Way, utility, construction, etc, that may result in project delays or additional expenses (a copy of the findings of this QAR is on record with Central Offices Right of Way Services). Following this QAR, Procedural Directive 1305.1 was revised and implemented on 1/28/98. In November of 2002, Central Offices began a program to update, revise and identify any Procedural Directives that could be enforced by being included into a CDOT Operations Manual, and then deleting the Procedural Directive. In January of 2003, Procedural Directive 1305.1 – Land Survey was reviewed, updated, revised, and then included in this chapter for enforcement, and subsequently deleted as a

procedural directive.

Procedural Directive – Land Surveys, Effective date 1/2003.

See Appendix 1.A.5 Procedural Directive – Land Surveys for additional information.

### **1.1.17 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.

[www.codot.gov/business/designsupport/2011-construction-specifications/2011-Specs](http://www.codot.gov/business/designsupport/2011-construction-specifications/2011-Specs)

### **1.1.18 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.

#### **Board of Licensure A/PE/PLS**

[www.colorado.gov/pacific/dora/AES](http://www.colorado.gov/pacific/dora/AES)

### **1.1.19 Right of Way (ROW) Monuments**

Right of Way monuments are points monumented on the ground by CDOT, its contractors or consultants to define the Right of Way boundaries in the field. 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 adjacent property ownerships or remainders. Any discrepancies between adjacent property ownerships are neither determined nor adjusted. Right of Way monuments are not intended to be set on property lines of adjacent property ownership and should be avoided at all times.

Whenever a property owner request to have their private property 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.

#### **CDOT Right of Way Manual**

[www.codot.gov/business/manuals/right-of-way](http://www.codot.gov/business/manuals/right-of-way)

### **1.1.20 Relationship of Land Lines**

Whenever necessary, or when additional Right of Way may be acquired, the control network will be tied to all found and identified PLSS land 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 intercept 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.

#### **1.1.21 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 53, 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 require that if a professional land surveyor conducts a survey that uses any monument representing a public land survey 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, or any United States geological survey or United States coast and geodetic survey (also known as the national ocean service/national geodetic survey) monument as a control corner, such professional land surveyor shall file a monument record describing such 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, such 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 or to interfere with 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 out 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 / RPW Plans correspondence should be directed to the following:

#### **Region 1**

North Program  
Scott Kimminau  
4670 N. Holly  
Denver, CO 80222  
[scott.kimminau@state.co.us](mailto:scott.kimminau@state.co.us)  
(303) 757-9923

South Program  
Kevin Williams  
18500 E. Colfax Avenue  
Aurora, CO 80011  
[kevina.williams@state.co.us](mailto:kevina.williams@state.co.us)  
(303) 365-7410

West Program  
David Stewart  
425 A Corporate Circle  
Golden, CO 80401  
[davida.stewart@state.co.us](mailto:davida.stewart@state.co.us)  
(720) 497-6903

Central Program  
Kathryn Lyon  
2000 S. Holly  
Denver, CO 80222  
[kathryn.lyon@state.co.us](mailto:kathryn.lyon@state.co.us)  
(303) 757-9923

#### **Region 2**

Tom Adams  
905 Erie Avenue  
Pueblo, CO 81001  
[tom.adams@state.co.us](mailto:tom.adams@state.co.us)  
(719) 546-5454

Dennis Pirtle  
905 Erie Avenue  
Pueblo, CO 81001  
[dennis.pirtle@state.co.us](mailto:dennis.pirtle@state.co.us)  
(719) 546-5746

#### **Region 3**

Leslie Doehling  
222 S. 6th Street  
Grand Junction, CO 81501  
[leslie.doehling@state.co.us](mailto:leslie.doehling@state.co.us)  
(970) 683-6234

#### **Region 4**

Mark Guerrero  
1420 2nd Street  
Greeley, CO 80631  
[mark.guerrero@state.co.us](mailto:mark.guerrero@state.co.us)  
(970) 350-2173

Peter Sulmeisters  
1420 2nd Street  
Greeley, CO 80631  
[peter.sulmeisters@state.co.us](mailto:peter.sulmeisters@state.co.us)  
(970) 350-2157

#### **Region 5**

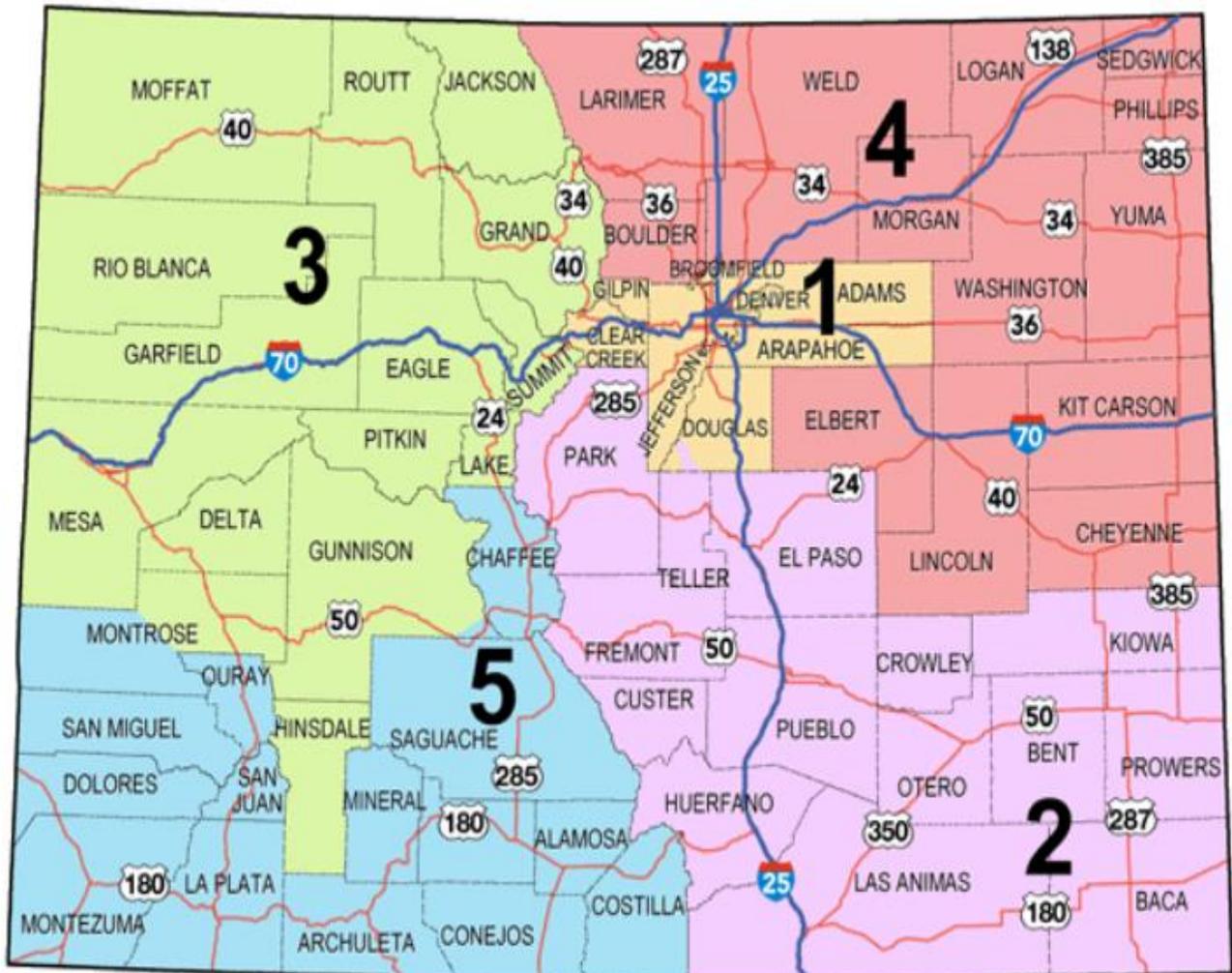
Todd Johnston  
3803 N. Main Avenue  
Durango, CO 81301  
[todd.johnston@state.co.us](mailto:todd.johnston@state.co.us)  
(970) 385-1419

## Headquarters

Daniel Smith  
4201 E Arkansas Ave  
Denver, CO 80222  
[daniel.a.smith@state.co.us](mailto:daniel.a.smith@state.co.us)  
(303) 512-4401

Ian Broussard  
4201 E Arkansas Ave  
Denver, CO 80222  
[ian.broussard@state.co.us](mailto:ian.broussard@state.co.us)  
(303) 757-9305

### 1.2.6 Region Map



### 1.2.7 NOAA / NGS

The National Oceanic and Atmospheric Administration (NOAA) / National Geodetic Survey (NGS) provide guidance for CDOT's geodetic surveying to meet federal standards and specifications in compliance with 23 CFR 630.402.

The NGS regional advisor the serves Colorado may be contacted at the following:

NOAA/NGS  
Pamela J. Fromhertz  
4201 E. Arkansas Ave., 4<sup>th</sup> Floor

Denver, Colorado 80222  
[pamela.fromhertz@noaa.gov](mailto:pamela.fromhertz@noaa.gov)  
Cell: 240-988-6363  
Office: 303-202-4580  
[geodesy.noaa.gov](http://geodesy.noaa.gov)

### **1.2.8 Monumentation Information to be furnished**

When requesting information about one of CDOT's monuments the following information should be furnished:

1. Location of monument (e.g. highway, mile post, nearest intersection or town, PLSS location)
2. The designation of monument, (the letters and figures which are stamped on the 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 USGS for their current 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 contract consultant surveyors. It is imperative to remember that common sense and common courtesy are necessary in any form of public relations. Each employee and contract consultant is a representative of CDOT. The Department is often judged by our behavior as well as our work. The outdoors nature of surveying keeps surveyors out in the public eyes 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 land survey. 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 probably the most important phase 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 a close interest in any intrusion on his/her property regardless of the purpose. Permission to Entry Property Forms in writing should be obtained from the property owner before CDOT or 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 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 and any effect it may have on the property
4. Obtain Permission to Entry Property Forms if not previously obtained

### **1.3.4 Written Consent for Property Damage**

If actual 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 of the 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 having responsibility for the property.
2. Explain the need for the survey, its anticipated duration, and any probable effects on the property.
3. Learn the requirements for working in the area, such as fire regulations, brush cutting procedures, and where vehicles may be driven.
4. Gain valuable 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 as a result 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 "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 to the existing CDOT Right of Way shall obtain a Special Use Permit Form 1283a, with the survey option completed.

See Chapter 2 – General Procedures for additional information.

### **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 his survey crew as part of the unit, and for the actions by 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.

For safe operation of the survey crew, each survey crewmember should know and 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. Request for additional safety training by the Regions 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**

The 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 shall have a survey crew chief assigned to be in "Responsible Charge" of that particular survey. The technical control of the survey is under the direction of the survey crew chief.

### **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 sight 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 persons on 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 do the surveying 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:

(Accuracy) 1. Quality Control:

The survey shall be conducted according to CDOT Minimum Horizontal and Vertical Accuracy Tolerances, or FGCC specifications and tolerances.

(Time) 2. Schedule Control:

The survey must be completed on time to ensure project commitments.

(Cost) 3. Cost Control:

The survey should be completed within budget to ensure 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 detected cost overruns before they occur.
2. Enhance cost-consciousness among all project personnel.
3. Encourage a project team cost-reduction perspective.

Along with the above listed objectives components of a survey cost control system include:

1. A structured project plan is required 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 project has gone bad, meaning that you may have to walk away 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:

(Accuracy) 1. What degree of accuracy, reliability, repeatability or what specific laws, standards or specifications must be met when completing the survey project?

(Time) 2. How long does it take to perform the proposed activity or just a small component task within the entire activity?

### **1.5.7 Documentation**

Thus, 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. Knowing the time and accuracy capabilities for your equipment and personnel will help you to control survey project costs.
2. Maintain cost accountability by paying 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 well-educated employees who will easily adapt to new methods and technologies.

## **1.6 References**

*CDOT Survey Manual*

*CDOT Right of Way Manual*

*CDOT Standard Specifications for Road and Bridge Construction*

*CDOT Policies and Procedural Directives*

*CDOT M & S Standards*

*Federal Highway Administration Project Development Manual*

*Federal Highway Administration Stewardship Guide*

*Code of Federal Regulations, Title 23 – Highways, Chapter I – Federal Highway Administration, Department of Transportation*

*Board of Licensure for Architects and Professional Engineers and Professional Land Surveyors*