

SECTION 4

TRAFFIC

4.01 TRAFFIC DATA

The Form 463, Design Data, provides a section for information on traffic data for both the current and future (usually 20 years, but can be less) average daily traffic, design hourly volume, and the percentage of trucks. This information, along with the highway functional classification, is used to determine the appropriate design standards (e.g., typical sections or travel lanes) for a project.

The Resident Engineer is responsible for obtaining the latest traffic data. Traffic data is available from the Division of Transportation Development (DTD) or is accessible at <http://apps.coloradodot.info/dataaccess/>. For non-CDOT controlled roadways, the local transportation planning region (TPR) or metropolitan planning organization (MPO), such as the Denver Regional Council of Governments, may furnish traffic data.

The Resident Engineer will usually request any turning movement volumes from the Division of Transportation Development.

The following items consist of traffic information that should appear on the Form 463, the Title Sheet, or elsewhere on the plans as appropriate:

1. Traffic data - includes average daily traffic, design hourly volume, percentage of trucks and directional traffic distribution [Form 463, Title Sheet, Traffic Movement Diagram plan sheet].
2. Roadway functional classification - such as interstate, freeway, collector, or arterial can be obtained from the DTD web page referenced above [Form 463].
3. Terrain type -- obtained from the same web page [Form 463].
4. Number of lanes - geometric design type or typical section, can be determined from the *CDOT Design Guide*, the *Transportation Research Board (TRB) Highway Capacity Manual*, or associated software [Form 463, Typical Sections, Plan & Profiles].

Additional References:

1. *AASHTO Policy on Geometric Design of Highways and Streets*
2. CDOT Procedural Directive 512.1, *Project Scoping and the Design Scoping Review (DSR)*
3. State Highway Access Code
4. For forms, see CDOT on-line forms library
<http://www.coloradodot.info/library/forms>

4.02 REQUEST AND ANALYZE CRASH DATA

The Safety and Traffic Engineering Branch periodically reviews the safety performance of all roads on the state highway system and identifies locations that have the potential for accident reduction. This data is available to the designer.

Under the Federal-aid Highway Act, each state is to maintain the Hazard Elimination Program by surveillance and identification of accident locations on all federal aid roads and streets. This program is part of the state's overall Statewide Safety Program and is administered by the Safety and Traffic Engineering Branch.

In the Colorado Highway Safety Improvement Plan developed by CDOT, a program is described to reduce the number and severity of traffic accidents and to decrease the potential for accidents. All crash data is supplied to the Department of Revenue by the Colorado State Patrol and other local law enforcement agencies. The Department of Revenue, in turn, provides information and makes accident reports available to CDOT for analysis.

The Safety and Traffic Engineering Branch, with crash data supplied by the Department of Revenue, is responsible for identifying locations that have the potential for accident reduction. Some of the methods of identifying highway and traffic safety issues are:

1. Accident frequency distribution
2. Accident rate
3. Accident severity
4. Pattern Recognition
5. Roadway Diagnostics
6. Safety Performance Functions

The *Accidents and Rates on State Highways* book (<http://staging.coloradodot.info/library/traffic/traffic-manuals-guidelines/safety-crash-data/accident-rates-books-coding>) is another important tool used in the analysis and selection of locations for traffic accidents and associated rates. The two sources for producing this report are the electronic traffic volume data bank from the Division of Transportation Development and the electronic crash data gathered and maintained by the Safety and Traffic Engineering Branch.

Safety Assessment Reports are provided by the Safety and Traffic Engineering Branch on all highway type projects, such as rail-highway, non-interstate routes, interstate, "safety enhancement" type and 3R type. When requested, the accident summaries are

provided by either the Region Traffic Engineer or the Safety and Traffic Engineering Branch. Use the Safety Engineering and Analysis website <http://internal/stafftraffic/safety_engineering_group/index.html> to: submit requests for new Safety Assessment Reports, accident information, and graphs; view completed reports and studies; or get information on accidents and rates.

Additional References:

1. 23 CFR Part 655F, Traffic Control Devices on Federal-Aid and Other Streets and Highways; Part 924, Highway Safety Improvement Program; Part 1205, Highway Safety Programs; Determinations of Effectiveness
2. CDOT Procedural Directive 548.1, *Safety Considerations on Resurfacing & 3R Type Projects*
3. 23 USC Section 109(e), Standards; Section 152, Hazard Elimination Program
4. *Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD)*

4.03 TURNING MOVEMENTS REQUEST

Traffic volume data are used to analyze the level of service of proposed designs as described in Section 4.01. Average daily traffic volumes and design hourly volumes are usually projected for 20 years for each traffic movement at an at-grade intersection or interchange.

The Resident Engineer will initiate a request to the Division of Transportation Development for turning movement volumes prior to designing the intersection or interchange. The request will be in e-mail or letter form adequately describing the location and type of data needed.

It is important that the request properly describes the proposed improvement so that any new traffic patterns can be predicted. The request should also include a list of alternative design concepts, if applicable. If the current project is part of a corridor, then the overall corridor traffic should be used in the prediction.

In urban locations it is desirable to have peak hour traffic counts both in the morning and in the evening, so that the design hourly volume is properly selected.

It may be necessary for the Division of Transportation Development to conduct a current traffic count at the site prior to applying an expansion factor. In some areas, the local agency may have a current count and may have a planning model predicting traffic.

The Division of Transportation Development may provide a traffic diagram (see Section 4.04) to the designer showing the requested traffic information.

On larger projects or corridor projects, a traffic model may be prepared, based on future growth and land uses, to forecast the expected volumes. The Resident Engineer may include this modeling need in the design engineer's scope of work.

The turning movement volumes should be documented in the project file, or in the intersection or interchange report, as supporting documentation for the chosen design.

Additional References:

1. *AASHTO Policy on Geometric Design of Highways and Streets*
2. *CDOT Roadway Design Guide*
3. *CDOT Procedure Directive 512.1, Project Scoping and the Design Scoping Review (DSR)*

4.04 TRAFFIC MOVEMENT DIAGRAM

The traffic movement diagram illustrates, in the plans, the design traffic volume predicted for each movement within an intersection or interchange. It is used as data to confirm acceptable levels of service and to justify design features such as turning lanes and storage lengths.

The traffic movement diagram is a graphic representation of the data received from the request that is described in Section 4.03. The diagram is placed on the plan sheet showing the proposed intersection or interchange design and provides a permanent record, in the plans, of the data that justified the design features of the intersection or interchange.

The diagram will show the design hourly volume for each movement within the intersection or interchange. The diagram may also show the current average daily traffic and the current hourly volume. The diagram will show the current year and the 20-year projection of traffic movements. Signal project movements may be projected for 10 years.

The Resident Engineer is responsible for assuring that the traffic movement diagram and data are placed on the appropriate plan sheet, as needed. Placing the diagram on the plan sheet provides permanent documentation of the traffic data used for design of the project.

If the turning movement data will be more than two years old at the time of advertisement, the Division of Transportation Development should be contacted for updated information, and the design assumptions for the new traffic predictions should be verified.

Additional References:

1. *AASHTO Policy on Geometric Design of Highways and Streets*
2. *CDOT Roadway Design Guide*
3. *Transportation Research Board (TRB) Highway Capacity Manual*

4.05 SIGNAL WARRANTS

A thorough investigation of traffic conditions, accident history, and physical characteristics of the location is necessary to establish warrants for the installation of a traffic signal. Warrants should be established prior to any engineering work, since the design criteria for a signalized intersection will be different from that of a stop-controlled intersection.

The Region Traffic Engineer will conduct the signal warrant study for the roadway intersection together with all the necessary calculations, documentation and traffic signal warrant justification for each location.

The Region Traffic Engineer shall certify that warrants have been met by documenting them in the form of a letter justifying the need for traffic control signals. Traffic Control Signals can be justified when warrants are met as indicated in the *Manual of Uniform Traffic Control Devices for Streets and Highways (MUTCD)*, Part IV. The letter should state which of the warrants as shown in the *MUTCD* are applicable. It is important to note that a location meeting signal warrants does not automatically mean that installation of a traffic signal is the solution. Engineering judgment should be exercised before making a final decision.

Additional References:

1. 23 CFR Part 655F
2. 23 USC 109(d), Standards
3. *AASHTO Policy on Geometric Design of Highways and Streets*

4.06 INTERSECTION AND INTERCHANGE DESIGN

Project design should efficiently and safely move traffic through various conflict points arising at the crossing of highways.

The crossing of two or more highways can be accomplished in three manners: at-grade intersections, grade separations, and interchanges. The most common at-grade intersection configurations are “4-leg,” “T,” and “Y,” with or without separate auxiliary lanes or channelization. At-grade intersections require some form of traffic control, which could range from stop signs or traffic signals to a modern roundabout. Grade separations allow one roadway to pass over another with no provision for turning movements. Interchange design allows for one roadway to pass over another with turning movements. Common interchange types are “diamond,” “cloverleaf,” “directional,” “urban,” “Y,” and “trumpet.” The decision to use interchanges depends on traffic counts, highway classification, and access requirements.

Concepts, including signal warrants and truck-turn templates, for use in intersection design can be found in the References listed at the end of this Section. Truck-turn templates account for the off-tracking of large vehicles as they turn through at-grade intersections,

The Resident Engineer is responsible for the justification and design of new or modified intersections or interchanges. Turning movements are discussed in Section 4.03 and signal warrants in Section 4.05 of this manual.

For a new or modified intersection justification, factors usually addressed are:

1. Traffic factors include: capacity, turning movements, signal warrants, cause of accidents and their type and frequency, the needs of pedestrians and bicycle users when justified in urban or rural areas.
2. Physical factors include: topography, improvements, physical requirements, and physical constraints.
3. Economic factors include: the cost of the improvements and economic effects on abutting businesses.
4. Human factors include: driving habits, decision and reaction times, driver expectations, and natural paths of movement.

When signal warrants are not initially met but are expected to be met in the future, the Region Traffic Engineer should specify the requirements that must be met to justify signalization of the intersection.

For interchange design, the above factors also apply, along with addressing highway classification, character and composition of traffic, design speed, and degree of access control. For the interchange design and approval process, see *CDOT Policy Directive 1601.0, Interchange Approval Process*.

For new or modified intersection design, the following data is required for initiating a final design:

1. Basic data – relative to traffic, physical and economic factors.
2. Preliminary design – aerial photos (when available), topographic maps, preliminary sketches of plan and profiles for alternative designs. Preferred alternative should be determined no later than the Field Inspection Review stage.
3. Comparative costs – cost estimates of alternative designs.
4. Selection of suitable design – from the standpoint of traffic adequacy and economy and safety considerations.
5. Final plans – design approval of intersection configuration, complete calculations, plan and profiles, traffic flow diagrams showing the design hourly volume and the design year of all anticipated traffic movements, and proposed construction Traffic Control Plan.

Additional References:

1. 23 CFR Part 771
2. *AASHTO Policy on Geometric Design of Highways and Streets*
3. *Bicycle and Pedestrian Facilities* (see Section 2.10 of this manual)
4. *CDOT Roadway Design Guide*
5. *Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD)*
6. *Transportation Research Board (TRB) Highway Capacity Manual*
7. For forms, see CDOT on-line forms library
<http://www.coloradodot.info/library/forms>

4.07 TRAFFIC SIGNAL PLAN

A traffic signal plan is used to establish control of vehicular and pedestrian traffic flow at intersections, consistent with the assumptions used in Section 4.06 Intersection and Interchange Design. Prior to design of signal plans, the Resident Engineer confirms that the signals are warranted and that documentation is in the project file.

Traffic signal plans will include a complete geometric layout of the intersection showing the location of the traffic signal poles, conduit, signal cabinet, power source, and existing utilities. A sketch of the signal faces, a phasing diagram, a legend, general notes pertaining to the signalization, and a summary of approximate quantities will be included.

The Project Traffic Engineer or a consultant prepares the signal plan according to the decisions made at the Design Scoping Review and the Field Inspection Review meetings. The Region Traffic Engineer reviews and approves signal plans.

The Resident Engineer will be responsible for providing an updated intersection layout to the Project Traffic Engineer to use in designing the signal plan.

The Project Traffic Engineer completes all the necessary calculations for documentation of the signal warrant study, prepares the traffic signal design, computes quantities, drafts specifications, and completes drawings for the final signal plans. The Project Traffic Engineer also certifies that all traffic plans conform to the *Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD)* and *CDOT S Standard Plans*. Some signal installations may need to conform to the local entity specifications, if they are a part of an integrated signal system.

Additional References:

1. 23 CFR Part 655
2. AASHTO Policy on Geometric Design of Highways and Streets
3. FHWA 23 USC 120
4. Transportation Research Board (TRB) Highway Capacity Manual

4.08 LIGHTING PLAN

A lighting plan is prepared by a qualified engineer to provide roadway lighting for improved driver vision at night and to enhance the safety of pedestrian and vehicular traffic.

The purpose of roadway lighting is to improve nighttime highway safety by reducing the possibility of motor vehicle collisions with pedestrians, fixed objects, or obstructions on the roadway. The quantity of light does not necessarily indicate a good lighting system. What's important is to provide effective lighting. Effective lighting refers to the ability of the light to provide contrast between objects and background so that motorists can detect conflicts in sufficient time to take evasive action. Many interrelated factors contribute to effective lighting, such as reducing glare to help improve driver performance.

The CDOT *Roadway Design Guide* provides a description of illumination, including design guides, methods, and types. Design software may be available through the Region.

Warrants for lighting are outlined in The AASHTO *Informational Guide for Roadway Lighting*. Warrants are not required for minimum interchange lighting.

The CDOT *Lighting Design Guide* should be used when preparing lighting plans or determining lighting warrants. The CDOT *Lighting Design Guide* is based on the Illuminating Engineering Society of North America (IESNA) *Lighting Handbook Ninth Edition* and the American Association of State Highway and Transportation Officials (AASHTO) *2005 Roadway Lighting Design Guide*. It represents the current recommended practice for roadway lighting and includes criteria for typical applications found in the state of Colorado. The CDOT *Lighting Design Guide* should be used in conjunction with the latest version of these two references. Exceptions to these guidelines should be thoroughly evaluated and documented in accordance with CDOT's design exception policies.

All projects that include lighting installation or modification require plans and specifications that show the type and locations of the lighting equipment and a summary of quantities. The lighting design will be incorporated into the final plan set by the Resident Engineer.

The following documentation and procedures are to be followed for the design of highway lighting:

1. The Resident Engineer, through the Region Utility Engineer, will coordinate with the utility company to ensure proposed materials are compatible with utility inventories. If applicable, a lighting agreement will be negotiated between CDOT and the local agency.
2. The Region Utility Engineer will designate the power source locations and negotiate with the utility company to supply the power.
3. In special lighting situations (e.g., use of ornamental or decorative lighting), the state and federal shares of costs shall not substantially exceed the estimated cost of conventional highway lighting, unless such special lighting is within the scope of the project (such as enhancement projects or historical areas) or is otherwise justified by the public interest. The Resident Engineer will negotiate the local share, if any, of special lighting costs.

The following information will be shown on the lighting plan:

1. Circuit type, voltage, and location of power source.
2. Luminaire type, lumens, and locations.
3. Light standard type, mounting height, bracket arm type and length, and foundation details.
4. Size and location of electrical conduit, conductor size, location of direct burial cable, and locations of pullboxes and junction boxes.

All final plans for lighting should be reviewed by a qualified lighting or electrical engineer for proper wiring or other electrical details.

Additional References:

1. *CDOT Roadway Design Guide*
2. *AASHTO Policy on Geometric Design of Highways and Streets*
3. *IESNA Lighting Handbook*
4. *AASHTO Lighting Guide*
5. *CDOT Lighting Design Guide*

4.09 PERMANENT SIGNING AND PAVEMENT MARKING

The proposed final signing and pavement marking plan will be included in the project Plans, Specifications, and Estimate package.

The Project Traffic Engineer or a consultant is responsible for the design of the signing and pavement marking plans for the construction project.

The preparation of permanent signing and pavement marking plans includes the following activities:

1. Plan sheets showing the roadway, edge of traveled way, shoulders, structures, and topography are drafted for traffic engineering plans by the Designer, and electronic files provided to the Project Traffic Engineer or consultant, when required.
2. The Project Traffic Engineer or consultant collects and tabulates the field inventory of existing traffic controls.
3. The Project Traffic Engineer or consultant draws existing signs on the plan sheets.
4. The Project Traffic Engineer or consultant locates and places the required traffic controls, such as pavement markings or guide signs, on the plans.
5. The Project Traffic Engineer or consultant prepares the traffic plan that includes the tabulations of signing and striping quantities.
6. The Project Traffic Engineer or consultant prepares required specifications and special provisions.

The Project Traffic Engineer or consultant submits the traffic plans and specifications to the Resident Engineer for incorporation into the final plan set .

Additional References:

1. 23 CFR Part 655F
2. *AASHTO Policy on Geometric Design of Highways and Streets*
3. *CDOT S Standard Plans*
4. *CDOT Roadway Design Guide*
5. *CDOT Standard Specifications for Road and Bridge Construction*
6. *Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD)*

4.10 CONSTRUCTION TRANSPORTATION MANAGEMENT PLANS

A Transportation Management Plan (TMP) lays out a set of coordinated strategies and describes how these strategies will be used to manage the work zone impacts of a project. The scope, content, and degree of detail of a TMP may vary based on the expected work zone impacts of the project. All projects must comply with the Region's Lane Closure Strategies. The Region Traffic Engineer must approve all work that does not comply with the Region's Lane Closure Strategies

(<http://www.coloradodot.info/library/traffic/traffic-manuals-guidelines/lane-close-work-zone-safety/lane-closure-strategies>).

The components of the TMP will depend on whether it is a "significant project." A significant project is defined as one that, alone or in combination with other concurrent projects nearby, is anticipated to cause sustained work zone impacts at a location for three or more consecutive days with either intermittent or continuous lane closures. A significant project impacts the traveling public at the metropolitan, regional or the Interstate level and has a moderate to very high level of public interest. It will directly impact a moderate to very large number of travelers and will have moderate to very high user cost impacts. A TMP may consist of the following components:

1. Traffic Control Plan (TCP) – **Required Component**

Traffic control devices are all types of signs, signals, and temporary or permanent pavement marking that are used on streets or highways to regulate, warn, or guide traffic during the construction phase of a project. Traffic control is also required for maintenance, utility, and emergency operations. The safety of all forms of transportation such as cars, trucks, pedestrians, and bicycles should be considered throughout the construction phases of the project.

All construction plans that require temporary signing, signals, and pavement marking shall have a Traffic Control Plan layout sheet (which may be a reference to one or more of the cases illustrated in the CDOT S Standard Plans) showing the different phases of construction and the locations of signs, signals, and pavement marking. The TCP shall be consistent with the provisions of the CDOT Standard Specifications for Road and Bridge Construction, CDOT M&S Standard Plans, Manual on Uniform Traffic Control Devices (MUTCD), and any applicable incident management plans. A tabulation of pavement markings, signing quantities, schedule of construction traffic control devices, and project specifications are also required.

The Traffic Control Plan may be developed by the Region Traffic Unit or a consultant. Coordination with the region, local agencies, utility companies,

railroads, and entities is essential during project development. The Region Traffic Engineer or designee is responsible for reviewing Traffic Control Plans. The Resident Engineer is responsible for providing the construction phasing plan and ensuring that a Traffic Control Plan is included in the final plan set.

2. **Transportation Operations (TO) – Required Component**

The TO component of the TMP consists of compliance with the Region's Lane Closure Strategies. (The Region Traffic Engineer must approve all work that does not comply with the Region's Lane Closure Policy.) In addition, TO strategies should be identified that will be used to mitigate impacts of the work zone on the operation and management of the transportation system within the work zone impact area. Typical TO strategies may include, but are not limited to, demand management, corridor/network management, work zone safety management, and Traffic/Incident Management and enforcement. More strategies are listed in the "Work Zone Safety and Mobility Procedures" document (http://www.coloradodot.info/library/traffic/traffic-manuals-guidelines/lane-close-work-zone-safety/work-zone-safety-mobility/WZSM_Procedures.pdf/view). The scope of the TO component should be determined by the project characteristics, and the identified transportation operations and safety strategies.

3. **Public Information (PI) – Required Component for Significant Projects**

The PI component of the TMP includes communications strategies that inform affected road users, the general public, area residences and businesses, and appropriate public entities about the project, the expected work zone impacts, and the changing conditions on the project. The PI component may be customized by use of the "Public Information Services" project special provision worksheet (<http://www.coloradodot.info/business/designsupport/construction-specifications/2011-Specs/project-special-provision-work-sheets/626pis.docx/view>). This may include motorist information strategies. The scope of the PI component should be determined by the project characteristics and the identified public information and outreach strategies. Public information should be provided through methods best suited for the project and may include, but not be limited to, information on the project characteristics, expected impacts, closure details, and commuter alternatives.

Preparation and implementation of a TMP for a highway project includes:

1. The Project Traffic Engineer will prepare a TCP, TO, and PI (optional for non-significant projects) to be included in the Plans, Specifications, and Estimate package, including project special provisions for traffic control, general notes, and pay items for all traffic control devices, when requested by the Resident Engineer. TO strategies must be specified in the general notes and include all contract language, plan sheets, and specifications required to implement the

selected strategies. Projects requiring a PI component must utilize the Public Information Services project special provision worksheet.

2. The Project Traffic Engineer will select traffic control devices that conform to the version of the Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD) adopted by the Transportation Commission and amended by the Colorado Supplement for CDOT use, the CDOT Guidelines on Variable Message Signs, the Standard Specifications, and the CDOT S Standard Plans.
3. Work zone speed limits shall be set in accordance with the procedures established by CDOT Form 0568 <http://www.coloradodot.info/library/forms/cdot0568.pdf/view>, in CDOT's Update on Signing for Double Fines memo, and any others communicated to the Region Transportation Directors and Branch Heads.
4. The Resident Engineer will ensure adherence to all parts of the CDOT Work Zone Safety Guidelines for Engineering and Maintenance:

Additional References:

1. 23 CFR Parts 630J and 655F
2. CDOT S Standard Plans
3. CDOT Guide Signing Practices and Procedures

4.11 ENGINEERING JUDGMENT AND MUTCD REQUEST OPTIONS

The controlling federal document for designing roadway signage is the *Manual on Uniform Traffic Control Devices* (MUTCD), published by the Federal Highway Administration (FHWA). In some cases, deviations from the standards set forth in the MUTCD are allowed on the basis of engineering judgment.

The MUTCD contains two basic types of statements, Standard statements and Guidance statements. Standard statements contain the word “shall” and are considered mandatory. Guidance statements contain the word “should” and are considered suggestions. Under certain circumstances, a Project Engineer may deviate from a Standard statement based on engineering judgment.

However, deviations may be allowed only if the deviation is location or site-specific. For example, a Project Engineer may use engineering judgment to justify specifying narrower signs in the median of a specific portion of a project where signs of standard width would protrude into the travel lane. The Project Engineer would only need to document the reasons in the project files to justify the decision.

Any deviation using engineering judgment can affect only a specific area of the project; deviations from the MUTCD standard cannot be made on a project, corridor, area, or statewide basis. For example, a Project Engineer cannot use engineering judgment to justify using unique sign layouts on a corridor project, because the decision could have corridor, region, or statewide implications. Instead, to make changes on a project-wide basis, the Project Engineer could make use of one of the MUTCD requests:

1. Request for Interpretation
2. Request for Permission to Experiment
3. Request for Interim Approval
4. Request for Change

A request for interpretation involves asking FHWA to render an official opinion on the application and operation of standard traffic control devices, official meanings of standard traffic control devices, or the variations from standard device designs.

A request for permission to experiment involves asking FHWA's permission to field test or evaluate a new traffic control device, its application or manner of use, or a provision not specifically described in the MUTCD.

A request for interim approval involves asking FHWA for interim use, pending official rulemaking, of a new traffic control device, a revision to the application or manner of use of an existing traffic control device, or a provision not specifically described in the MUTCD. However, any other jurisdiction that desires to use a traffic control device for which FHWA has issued an interim approval must still request permission from FHWA.

A request for change involves asking FHWA to consider use of a new device to replace a present standard device, an additional device to be added to the list of standard devices, or a revision to a traffic control device application or placement criteria.

All requests must be submitted to the FHWA Office of Transportation Operations MUTCD team for consideration (see MUTCD Section 1A.10 for details). All CDOT requests should be developed with the assistance of the appropriate Region Traffic Engineer or the Staff Safety and Traffic Engineering Branch's Traffic Engineering Support / Specs & Standards Unit.

Requests submitted by local entities in Colorado do not require CDOT approval or involvement. However, FHWA does provide the CDOT Traffic Specifications & Standards Engineer with a copy of the local entity's request and FHWA's reply. CDOT Region personnel who become aware of a pending request by a local entity should inform the appropriate Region Traffic Engineer, as well as the State Traffic Engineer, to ensure CDOT is informed of the request.

Should you have any questions, or should you require assistance in submitting a request, contact the Safety and Traffic Engineering Branch.

Additional References:

1. *Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD)*

4.12 Operations Evaluation (formerly TSM&O)

Beginning January 1, 2016, all projects with a Design Scoping Review on or after February 1, 2016, require a Transportation Systems Management and Operations (TSM&O) Evaluation. On January 21, 2021, the TSM&O Evaluation was renamed to the Operations Evaluation and deployed as an OnBase Web Tool. The Operations Evaluation is an evaluation that consists of three parts, a Safety Analysis, and Operations Analysis, and an ITS Analysis. The purpose of the Operations Evaluation is to analyze the project area. This analysis enables the making of project-specific recommendations related to safety and mobility to the project team.

To initiate the Operations Evaluation, the Project Manager will take the following steps.

- Create the TSM&O Evaluation milestone in SAP when a project is initiated. See SAP Workflow 1 in the guidance document on the CDOT website (https://www.codot.gov/business/designsupport/bulletins_manuals/adg). See Design Bulletin 2014-3 Milestone Dates in SAP Project Builder (CJ20N) (https://www.codot.gov/business/designsupport/bulletins_manuals/design-bulletins/db-2014-3) February 10, 2014, for more information on entering milestones in SAP CJ20N.
- Login into OnBase at the Operations Evaluation tool link: <https://oitco.hylandcloud.com>.
- Enter your login name that is a combination of your Windows login and @dot.state.co.us
 - EXAMPLE: Mike Beetles = beetlesm@dot.state.co.us
- Enter your Windows network password (i.e., the same password you use to log into your CDOT computer)
- Click on the three horizontal blue lines at the upper left-hand corner of the window and then select “Open StatusView.”
- Click on the three horizontal blue lines at the upper left-hand corner of the window and then select “Open StatusView.”
- Scroll down until you see the “Forms” box and double click on the “CDOTOPS Evaluation Request.”
- When the new window opens, type in the subaccount of the project you are requesting and click “CLICK HERE TO POPULATE DATA.”
- After the data populates, enter all the project data and scroll to the bottom to click “SUBMIT.” Please note that the “Major Component” is the most critical part of the request and will determine the level of ITS, Traffic Operations, and Safety Analyses.

You only have to submit the form once. If you update the data in PMWeb or SAP, the system will automatically pull the data into the evaluation system during the night.

For more information on how to fill out and use the Operations Evaluation Web Tool:

<https://sites.google.com/state.co.us/learninglane/training-programs/onbase-training/onbase-operational-evaluations>

- Fill out Form 1048 section 4.12, “Transportation Systems Management and Operations Evaluation.”

The Operations Evaluation will be reviewed and coordinated by a Region Traffic Representative Liaison (RTRL) (PE II Traffic Engineer). The RTRL will then assign the evaluations to the appropriate Region, ITS, and headquarters personnel.

The Operations Evaluation has two levels for each analysis for Traffic Operations and Safety. Level 1 Analyses generally take 2-4 weeks and are typically conducted by the region traffic teams.

Level 2 Operations and Level 2 Safety Analyses can be done by consultants or headquarters staff.

The ITS Group conducts the ITS Level 1 Analyses to determine if ITS infrastructure is within the project limits and if there will be a need for new or replacement technology. The analysis will also review if there will be any impacts to the existing ITS infrastructure. If there are project technology needs or impacts to technology resulting in new or replacements, please refer to **4.13 Systems Engineering Technology** for how to proceed.

4.12.01 Background

The TSM&O Reorganization Report of May 2013 recommended that all CDOT projects conduct an operational analysis to ensure improved systematic and integrated delivery of statewide operations. Per federal regulations, the FHWA-CDOT Stewardship Agreement, and CDOT policy, CDOT is required to conduct safety analyses and ITS systems engineering analyses as applicable on CDOT Projects. The Operations Evaluation combines all these analyses – safety, operational, and ITS – into one coordinated process to ensure that every CDOT project considers improvements for the safety and efficiency of the traveling public.

Another purpose of the Operations Evaluation is to enhance regional partnerships that support collaborative investment and implement TSM&O strategies that benefit the Region and its stakeholders. This requires collaboration by Maintenance, Access, Regions, Operations, Safety, ITS, FHWA, and other stakeholders to identify and consider operational strategies for implementation early in the project lifecycle. This will help provide the ability to implement new or additional operational strategies at the opportune time during the project lifecycle. Additionally, the Operations Evaluation creates enhanced opportunities to provide safety improvements, accountability to stakeholders, increased ability to document and reference lessons learned, and streamline business processes while increasing system reliability.

After three years of use, the Operations Evaluation Support Group determined a significant opportunity for automation that would lead to improved tracking, coordination, communication, and documentation. Between 2019 and 2021, The Operations Evaluation Support Group led an initiative to evolve the Operations Evaluation into an OnBase Web Tool. This initiative was completed on January 20, 2021. Now, all new projects or projects on the shelf for more than two years must be entered into the Operations Evaluation Web Tool for analysis or exemption.

4.12.02 Operations Definition

Operations at CDOT refers to several innovations and strategies used to improve the volume and flow of traffic to maximize the efficiency and benefit/cost of our roadways. These strategies include the use of traffic control devices, use of shoulders, narrow lanes, variable speed, traffic incident management, quick clearance, adaptive and efficient signal timing, traffic control, demand management (metering), appropriate and pertinent speeds, alternative and innovative intersections, and coordinated work and response efforts. CDOT is committed to improving system operations and safety and is implementing this formal process, the Operations Evaluation, building these strategies into CDOT's roadway projects.

4.12.03 Roles and Responsibilities

4.12.03.01 Project Manager

To the Project Manager, this process will look somewhat similar to the current process for the Safety Assessment Report, whereby the Project Manager requests an evaluation, receives recommendations, reports, and documents in the OnBase Web Tool when the Evaluation is complete. The Project Manager considers the recommendations that can be integrated into the scope of the project. The Project Manager will be responsible for assuring that an associated milestone is created in SAP CJ20N (Z0001 Operations Evaluation), coordinating with the RTRL for the status of the Operations Evaluation process, and discussing recommendations for implementation with their Resident Engineer.

The Project Manager is also responsible for returning to the OnBase Web Tool to report on what recommendations were integrated into the design of the project and which recommendations were constructed during the Finals process.

4.12.03.02 Region Traffic Representative Liaison

The Region Traffic Representative Liaison (RTRL) referred to in the process is the traffic engineer (PE II) assigned to the project being evaluated. The RTRL is the single point of coordination for the Operations Evaluation for the project. The RTRL reviews the project request, project documentation, and coordinates with the Project Manager in this role. The RTRL then assigns RTRs to complete the Level 1 Safety and Operations Analyses. When the RTRs complete their analyses, the RTRLs review the Level 1 analyses to determine if Level 2 analyses are warranted. The RTRLs will assign region or headquarters staff to conduct the analysis. The RTRLs can also assign a region RTR for Level 2 and hire a consultant to do the analysis coordinating with the Operations Evaluation Support Groups.

4.12.03.03 Region Traffic Representative

The Region Traffic Representative (RTR) referred to in the process is the traffic engineer assigned to the project being evaluated. In this role, the RTR completes the Level 1 Safety and/or Operations Analyses. There could be two or more RTRs assigned to a project evaluation.

The RTR also provides support to the Project Manager and coordinates and consolidates the key recommendations of the Evaluation from the Operations Evaluation support groups, Safety, Operations, and ITS. The RTR will be the lead for documenting recommendations from the Safety, Operations, and ITS and conducting the SEA analysis detailed in **4.13 Systems Engineering Technology**.

4.12.03.03 Operations Evaluation Support Groups

The Operations Evaluation support group consists of HQ Traffic, Safety, Operations, and ITS (Infrastructure). Each specialty is responsible for providing detailed analysis and recommendations for each of its respective disciplines. The Operations Evaluation Support Group will coordinate directly with the RTRL's and RTR's. The Operations Evaluation Support Groups will also be responsible for reviewing and following up with the regions on the overall effectiveness of the process.

4.12.04 Additional References:

1. *Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD)*
2. *Design Bulletin DB 2014-3 Milestone Dates in SAP Project Builder (CJ20N)*
3. *Design Bulletin DB 2016-1 TSM&O Evaluation*
4. *DB 2021-2 Operations Evaluation (Formerly TSM&O)*
5. *DB 2021-3 Systems Engineering Analysis Process*

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4.13 Systems Engineering Analysis (SEA)

The SEA is a project delivery process for technology. This includes any technology that impacts the safety or efficiency of the roadway. The SEA process takes project managers step by step through the design of technology using templates. It is structured to prompt and document critical discussions at the proper time in design. It is also intended to reduce risk by facilitating additional planning during the design phase.

Project Managers will take the following steps to initiate the SEA process:

- During pre-scoping, complete the Technology/SEA Assessment template. All projects must complete and submit this form which is in OnTrack. This document can also be found on the ITS & Network Services - SEA Documents Website (<https://www.codot.gov/programs/intelligent-transportation-systems/systems-engineering-analysis-sea/sea-documents>). This template will walk a project manager through determining if a project has technology and therefore requires a SEA. Even if a project does not have technology and no SEA is required, it is still important to document that no additional SEA documentation is required.
- If an SEA is required, the Technology/SEA Assessment template will guide the PM through determining which of the 10 additional required SEA documents already have an existing document that can be modified to be project specific. If there is no previously prepared work, the PM will need to develop the document using the templates which can be found on the ITS & Network Service Branch website <https://www.codot.gov/programs/intelligent-transportation-systems/systems-engineering-analysis-sea/systems-engineering-analysis-sea>
- The remaining 10 SEA documents build on each other. In OnTrack, the SEA deliverables are tied to particular stage gates to ensure the documents are prepared at the correct time. The submission schedule can also be referenced using the ITS & Network Services - Document Submission Website (<https://www.codot.gov/programs/intelligent-transportation-systems/systems-engineering-analysis-sea/sea-document-submission>). For templates of all SEA documents reference the ITS & Network Services - SEA Documents Website <https://www.codot.gov/programs/intelligent-transportation-systems/systems-engineering-analysis-sea/sea-documents>.
- The date of the completion of the SEA process will need to be populated in the Form 1180.

4.13.1 Background

The SEA is required per 23 Code of Federal Regulations (CFR) 940. Historically, it has been housed in the Operations Evaluation Tool. On September 1, 2021 the SEA was removed from the Operations Evaluation Tool and moved to OnTrack.

The SEA is a project delivery process for technology making OnTrack the appropriate tool for the SEA process. The SEA process was revamped in 2021 through the collaborative work of a project team led by the ITS & Network Service Branch involving subject matter experts from all five regions and HQ. This effort was sponsored by the Federal Highway Administration (FHWA) who was another integral component of the team.

The revamp was structured to ensure compliance with 23 CFR 940. Another objective was to ensure consistent technology design at CDOT through the use of the ITS Architecture Plan. The SEA focuses on the design of technology and ensures appropriate planning is in place for the technology to remain useful for its full lifecycle. This is why the SEA prescribes planning maintenance and asset management resources before the technology is implemented. The ultimate goal of the SEA is to ensure money and time spent deploying technology results in successful systems along with the longevity of technology solutions.

4.13.2 Roles and Responsibilities

4.13.2.1 Project Managers

The project managers are responsible for determining the need for an SEA on a project through the use of the Technology/SEA Assessment template. If no SEA is needed, the PM only needs to complete the top portion and submit the form for verification of the correct assessment. No additional SEA documentation will be needed.

Should an SEA be required, the PM is responsible for preparing and submitting all 10 additional SEA documents. If the PM needs additional help, they can reach out to the ITS & Network Services Branch or the SEA Lead for support.

The PM will also be responsible for completing the Form 1180 which documents completion of the SEA process.

4.13.2.2 ITS & Network Services Branch

The Branch will be timely in their reviews of submitted SEA templates. The Branch will also maintain the ITS specifications published on the ITS & Network Services Branch - Specifications website(<https://www.codot.gov/programs/intelligent-transportation-systems/specifications>). These specifications will have to be referenced in completing the SEA documentation.

4.13.2.3 SEA Lead

Be the point of contact in the ITS & Network Services Branch to support PM's going through design. The SEA lead will coordinate all review of SEA documents, compile all comments, and return comments to the PM. This position will also assist PM's as they prepare SEA documents. This includes explaining the templates and the ITS Architecture Plan, coordinating support for the ITS & Network Services Branch, and any other additional support a project may need.

4.13.2.4 FHWA

FHWA will only be required to review the SEA documentation should the project be a project of division interest (PODI). On all federal aid projects, FHWA retains full federal authority and responsibility, and reserves the right to request individual review and/or approval of any SEA action.

4.13.3 Additional References:

1. *DB 2021-3 Systems Engineering Analysis Process*
2. *ITS & Network Services SEA website (<https://www.codot.gov/programs/intelligent-transportation-systems/systems-engineering-analysis-sea/systems-engineering-analysis-sea>) for additional information.*