Chapter 3 Presentation Script

Welcome to the Manual on Uniform Traffic Studies, also called MUTS, computer-based training!
This training module will cover Chapter 3 - Traffic Signal Warrant Summary.

This training contains audio, so please adjust your speakers accordingly.
An alternate version is available on the Resources page.
To begin select the start button or press Shift + N on your keyboard.

During this training module, we will refer to one form in excel format stored on the MUTS online library through the FDOT's Traffic Engineering and Operations Office website.

Before continuing the training, consider scanning the Q-R code using your phone camera which directs you to the online library pictured.
When conducting these studies,
make sure to download the latest excel form available through the website.

The link to the forms is also provided in the resources page to this training.
Please open Form number 750-020-01 as we will refer to this form later in the module.

The information in this chapter has been adopted from the Federal Highway Administration or FHWA Manual on Uniform Traffic Control Devices also known as MUTCD.

MUTS Chapter 3 presents a detailed guide of the procedure to complete a Traffic Signal Warrant analysis.

The chapter content covers what data is necessary to complete the analysis and how to use the summary spreadsheet for analysis documentation.

Traffic signals should not be installed unless one or more of the nine warrants are satisfied.
Meeting one of the nine warrants is a minimum requirement and does not necessarily justify or mandate a traffic signal, engineering judgement should be applied.

A warrant is only effective when combined with knowledgeable judgement considering all pertinent facts. This is discussed in greater detail in MUTS Chapter 2, Traffic Signal Study Procedure.

The Traffic Signal Warrant Summary form provides a procedure to determine input into the decision of whether conditions at an intersection warrant the installation or the continued operation of a traffic signal.

A traffic signal warrant is a set of criteria used to define the relative need for, and appropriateness of a particular traffic control device.
Warrants are usually expressed in the form of numerical requirements, such as the volume of vehicular or pedestrian traffic.
A warrant normally carries with it a means of assigning priorities.

There are two fundamental concepts involved in this determination.
The first concept is that the most effective control device is the least restrictive while still accomplishing the intended purpose.
The second concept is that driver response to the influences of a traffic control device has been previously identified by observation, field experience, and laboratory tests under a variety of traffic and driver conditions.

A traffic signal warrant is a guideline and engineering judgement should be applied when determining if a traffic signal should be installed.
Refer to Section 1A.09 of the MUTCD for further detail.

Next, we will look at the Traffic Signal Warrant Summary, a tool developed to aid practitioners in completing a signal warrant analysis.

The nine traffic signal warrants include: Warrant 1 - Eight-Hour Vehicular Volume,
Warrant 2 - Four-Hour Vehicular Volume, Warrant 3 - Peak Hour,
Warrant 4 - Pedestrian Volume, Warrant 5 - School Crossing,
Warrant 6 - Coordinated Signal System, Warrant 7 - Crash Experience,
Warrant 8 - Roadway Network, and Warrant 9 - Intersection near a Grade Crossing.
We will discuss each of these warrants in greater detail during this training.

Form number 750-020-01 is recommended to be used to complete a traffic signal warrant analysis.
The first tab of the form is the Instructions & Input tab.

Throughout the form, two color cells are used to denote the following:
orange highlighted cells and checkboxes must be filled in by the user when highlighted in this color.
And blue highlighted cells denote user input has been completed
either manually filled in by the user or automatically populated from earlier data input by the user.

The Traffic Signal Warrant Summary updated form **includes** a column to input up to eight hours
of pedestrian crossing data, used for consideration in Warrant 7.

Throughout this training, we will use the unsignalized intersection of Main Street and 5th Avenue
as an example to work through the Traffic Signal Warrant Summary form.
The intersection of Main Street and 5th Avenue along with the associated intersection characteristics
have been generated for the purposes of this analysis as a hypothetical case.

For this example, we will assume there is a nearby school with students crossing Main Street
on the north leg of the intersection.
There is also an at grade railroad crossing on 5th Avenue on the east leg of the intersection.

To complete the signal warrant analysis, we begin with filling out the Instructions & Input tab.
Intersection general input data should be recorded at the top of the form
including location, number of major and minor street lanes,
and major and minor approach speeds with either the posted speed limit
or 85th percentile speeds.
Considering our intersection for today's training,
Main Street is the major street and 5th Avenue is the minor Street.

Main Street is a four-lane roadway with two through lanes in each direction.
5th Avenue is a two-lane two-way roadway with one through lane in each direction.
The posted speed limit on Main Street is 45 miles per hour and the posted speed limit
on 5th Avenue is 30 miles per hour.

The traffic volumes recorded on the form should be the actual Turning Movement Counts
taken for the highest 8 to 12 hours in an average day.
Data collection and time periods used will be discussed in further detail later in the presentation.
The highest eight hours of vehicle volume data should be recorded for Eight Hour Volumes,
Condition A, as well as Eight Hour Volumes, Condition B tables.
The 8 hours recorded in Condition A are not required
to be the same 8 hours recorded in Condition B.
On the minor street, the higher-volume minor street is not required to be the same approach
during each of the 8 hours.

The highest four-hour vehicle volume data should be recorded
in the Highest Four-Hour Vehicular Volumes table.
The highest one-hour of vehicle volume data should be recorded
in the Vehicular Peak Hour Volumes table.

The highest eight hours of pedestrian volume data should be recorded for Warrant 7
under the Condition A table.
The peak period of pedestrian volumes should be the highest four-hour pedestrian volume data
rather than vehicular peak period,
which should be recorded in the Highest Four Hour Pedestrian Volumes table.
The highest one-hour of pedestrian volume data should be recorded
in the Pedestrian Peak Hour Volumes table.

Let's take a closer look at how approach lanes should be considered in a signal warrant analysis.

The effects of the right-turn vehicles from the minor-street approaches
should be carefully considered in the study.
Engineering judgement should be applied to determine what,
if any, portion of the right-turn traffic should be deducted from the minor street traffic count
when evaluating the count against the traffic signal warrants.

Intersections with approaches consisting of one lane plus one right-turn or left-turn lane
should be analyzed with the application of engineering judgement.
Site-specific traffic characteristics will dictate whether an approach
should be considered as a one lane approach or a two-lane approach.
The following slides will review two examples.
Refer to the MUTCD Section 4C.01, paragraphs 8, 9, and 10
for additional guidance on these considerations in addition to the following slides.

Site specific characteristics will dictate whether an approach
should be considered as a one lane approach or a two-lane approach.
For example, let’s take a look at a minor street approach with one shared through / right-turn lane
and an exclusive left-turn lane with minor left-turning volume.
In this case, engineering judgement would indicate that it should be considered
as a one-lane approach.

In addition, engineering judgement would also indicate that only the volume
in the shared through / right-turn lane should be considered for the minor street volume
against the warrants.

In contrast, if the left-turn lane has sufficient length
to accommodate left-turn vehicles and approximately half of the traffic on the approach turns left,
the approach should be considered as a two-lane approach.

In another example, for a minor street approach with one shared through / left-turn lane
and an exclusive right-turn lane with a heavy right turn volume,
engineering judgement would indicate that the minor street
should be considered as a two-lane approach.

In this case, engineering judgement would also indicate that the left-turn, through,
and right-turn volume should be considered for the minor street volume in the warrant analysis.

The following factors should be considered when applying engineering judgement
to determine the portion of right-turn volumes to include in the minor street volume:
Number of lanes on the minor street approach, presence or absence of exclusive right-turn lane,
presence or absence of free flow right turn, availability of gaps in major street traffic,
sight distance available to right turning vehicles,
percentage of minor street traffic which turns right, and pedestrian and bicyclist volumes.

Note that MUTS Chapter 8 - Gap Study and its corresponding computer-based training module
provides detailed information on the data collection requirements and how to conduct gap studies.

In this section, we will discuss what traffic volume data is needed
and how it should be used to complete a signal warrant analysis.

Traffic volumes are needed for evaluation of most signal warrants.
The traffic volumes used should be the actual turning movement counts
taken for the highest 8 to 12 hours in a typical weekday.
Turning movement counts are needed when the engineer is unsure if the right turning volume
from the minor street approach should be included in the total volume.

Approach counts should be conducted first to determine the need for turning movement counts
and the appropriate time periods for collecting turning movement counts.
If the volume from the approach counts is considered to be low,
then turning movement counts are not needed and approach counts
can be used in place of turning movement counts to complete a signal warrant analysis.
In all warrants where hourly volumes are entered, an hourly period may begin on any quarter hour
as long as there is no overlap among warranted hours.
Refer to MUTS Chapter 4, Intersection Turning Movements Counts,
for further details on the procedures for this data collection.

This slide will cover criteria to the volume warrants or Warrants 1, 2, 3 and 4.
If the posted, statutory, or 85th percentile speed on the major street exceeds 40 miles per hour,
or if the intersection lies within the built-up area of an isolated community having a population
of less than 10,000 people, the 70 percent volume thresholds may be used.

The form allows the engineer to document if these criteria are met,
and automatically checks the 70 percent threshold option when either criterion is marked as “Yes.”
When using the electronic form, the MAY checkbox must be checked
to use the 70 percent reduced volumes, this action will auto-populate the corresponding input
from the Instructions & Input tab.

The engineer should use engineering judgement to determine if it is appropriate to use the 70 percent volume threshold even when the criteria is met. Consider the situation when the posted speed on the major road is 45 miles per hour, but a target speed of 35 miles per hour has been set for the corridor. The engineer may choose to not use the 70 percent volume threshold given the unique conditions of the location.

Note that the speed threshold for Warrants 1, 2, and 3 is greater than 40 miles per hour.
While for Warrant 4, the criteria to use the 70 percent volume threshold
should be based on the posted, statutory, or 85th percentile speed on the major street
exceeding 35 miles per hour instead of 40 miles per hour.

We will now walk through how to complete each of the nine traffic signal warrants
using the example intersection of Main Street and 5th Avenue.

Warrant 1 is the Eight-Hour Vehicular Volume warrant.
The Minimum Vehicular Volume, Condition A is intended where large volume of intersecting traffic
is the principal reason to consider installing a traffic signal.
Refer to Section 4C.02 of the MUTCD for further detail.

If the posted speed, statutory, or 85th percentile speed on the major street exceeds 40 miles per hour,
or if the intersection lies within the built-up area of an isolated community
having a population of less than 10,000 people, the 70 percent volume threshold may be used.

For our example, a target speed has not been established for Main Street and it has a posted speed
of 45 miles per hour.

As a result, we can use the 70 percent volume threshold or volume reduction
due to the posted speed exceeding the 40 mile per hour criterion.
The MAY checkbox must be checked to use the 70 percent volume threshold.

This is an overview of the application of Warrant 1, Condition A.
The eight-hour vehicular volume data is auto-populated from the Instructions & Input tab.
As noted in the previous slide, the MAY checkbox must be checked
to use the 70 percent reduced volumes.

Warrant 1, Condition A is met if the major and minor street traffic volumes
meet the corresponding volume thresholds for eight hours based on number of approach lanes.
In our example there are two through lanes on Main Street and one shared left-right on 5th Avenue.
Warrant 1, Condition A is met based on the 70 percent volume thresholds
since all eight hours of major street volumes are greater than 420 vehicles per hour
and the minor street volumes are greater than 105 vehicles per hour.

The Interruption of Continuous Traffic, Condition B is intended where the traffic volume
on a major street is so heavy that traffic on a minor intersecting street suffers excessive delay,
as determined by a gap study or conflict in entering or crossing the major street.
The information for Warrant 1, Condition B is available on Page 2 of the Warrant 1 tab
while Condition A is available on Page 1.
Refer to MUTS Chapter 8 - Gap Study for further details on gap studies.

This is an overview of the application of Warrant 1, Condition B.
The eight-hour vehicular volume data is auto-populated from the Instructions & Input tab.
The MAY checkbox must be checked to use the 70 percent reduced volumes.
Warrant 1, Condition B is met if the major and minor street traffic volumes
meet the appropriate thresholds for eight hours based on the corresponding number of approach lanes.

Warrant 1, Condition B would not be met based on the 70 percent volume thresholds
since not all eight hours of major street volumes are greater than 630 vehicles per hour.
The minor street volumes are greater than 53 vehicles per hour,
but the intersection should also meet the major street volume thresholds in order to meet the warrant.

Nonetheless, in our training example, Condition B is not applicable
due to already meeting Condition A.

Under circumstances where Conditions A or B for the 100 percent volumes are not satisfied,
the application of the Conditions A and B combination can be explored.
Both volume thresholds must be met by meeting the required vehicles per hour 80 percent thresholds,
total of both approaches for the major street and higher-volume approach for the minor street.
All other alternatives should be tried prior to using the 80 percent threshold.
Note that the 80 percent threshold influences the criteria under Warrant 7,
which will be discussed later in the training.

Warrant 2 is the **Four**-Hour Vehicular Volume warrant.
This warrant is intended to be applied where the volume of intersecting traffic
is the principal reason to consider installing a traffic control signal.
Refer to Section 4C.03 of the MUTCD for further details on completing Warrant 2.

This slide provides an overview of Warrant 2.
The 100 percent checkbox must be selected to auto populate the volumes
in the 100 percent volume level table and plotted on the chart.
Warrant 2 is met when the major and minor street traffic volumes meet the appropriate thresholds
on the 100 percent volume level chart for four hours.
If all four plotted points fell above the appropriate curve, the warrant would be met.

For our example, all four plotted points fall below the curve
for two or more lanes on the major street and one lane on the minor street.
Therefore, the 100 percent threshold is not met.
The next step is to check the 70 percent volume threshold.
The 70 percent checkbox as well as the MAY checkbox must be checked
to use the 70 percent reduced volumes.

Once we click the MAY checkbox to use the 70 percent reduced volumes
the spreadsheet auto populates the volumes in the 70 percent volume level table
and plots the volumes in the chart.
Warrant 2 is met when the major and minor street traffic volumes fall above the curve
in the 70 percent volume level chart for four hours.
In our example, all four points fall above the appropriate curve
for two or more lanes on the major street and one lane on the minor street,
therefore Warrant 2 is met.

Warrant 3 is the Peak Hour warrant.
The warrant is intended to be applied at a location where traffic conditions are such
that for a minimum of one hour of an average day,
the minor street suffers undue delay when entering or crossing the major street.
This warrant should only be applied in unusual cases,
such as office complexes, manufacturing plants, industrial complexes,
or high-occupancy vehicle facilities attracting or discharging large numbers of vehicles
over a short time.

If Warrant 3 is met, the location can operate in flashing mode
during the hours that the warrant is not met.
Refer to Section 4C.04 of the MUTCD for further detail on Warrant 3.

The following is an overview of how to complete Warrant 3.
Before applying Warrant 3, the unusual condition justification box
should be filled in to explain the circumstances justifying the use of the warrant.

The 100 percent checkbox must be selected to auto populate the volumes
in the 100 percent volume level table and chart.
Warrant 3 is met if the major and minor street traffic volumes meet the appropriate thresholds
on the 100 percent volume level chart for the peak-hour.
For our example, the peak hour volumes do not meet the 100 percent threshold
as the plotted points fall below the curve for two or more lanes on the major street
and one lane on the minor street.

Warrant 3 is also met if all three criteria are fulfilled for the same one hour of an average day.
The three criteria that must be met are delay on the minor approach,
volume on the minor approach, and total intersection entering volume.
A delay study must be completed to evaluate the delay on the minor approach.
Refer to MUTS Chapter 7 - Intersection Delay Study
for the procedure to conduct an intersection delay study.
To meet the delay criteria, the minor approach must experience 4 vehicle-hours of delay
for a one-lane approach or 5 vehicle-hours for a two-lane approach.

The MAY checkbox must be checked to use the 70 percent reduced volumes.
Warrant 3 is met if the major and minor street traffic volumes meet the appropriate thresholds on the 70 percent volume level chart.
For our example, the plotted point falls below the appropriate curve for two or more lanes on the major street and one lane on the minor street, therefore Warrant 3 is not met.

Warrant 4 is the Pedestrian Volume warrant.
The warrant is intended to be applied where the traffic volumes on a major street are so heavy that pedestrians experience excessive delays in crossing the major street,
with determination of excessive delay being based upon a gap study.

Refer to MUTS Chapter 8 for further details on conducting a gap study.
The Warrant 4 Form consists of two pages which will be reviewed in the following slides.

Refer to MUTCD Section 4C.05 for further detail on completing Warrant 4.

The Pedestrian Volume warrant shall only be applied at locations
where the distance to the nearest traffic control signal or stop sign controlling the street that pedestrians desire to cross is greater than 300 feet
unless the proposed traffic control signal will not restrict the progressive movement of traffic.

For additional FDOT guidance on pedestrian crossing treatment selection and placement, refer to the FDOT Traffic Engineering Manual, also known as TEM.
Section 5.2 of the TEM contains information regarding Treatments for Pedestrian Crosswalks at Midblock and Unsignalized Intersections,
Criteria for Beacons and Signals, and **Beacons** and Signals.

Additional elements to be considered while considering the implementation of a traffic signal include signalization plans, pedestrian facilities design criteria, lighting, and speed management.
For guidance on these elements in addition to the TEM provisions,
visit the FDOT Design Manual also referred to as the FDM.

A traffic signal shall be considered using any four hours of an average day
and one hour of an average day.
These are not required to be consecutive hours.
MUTCD Figures 4C-5 and 4C-6, shown in Page 1 of the Warrant 4 tab,
should be used to evaluate the four hours of an average day
and MUTCD Figures 4C-7 and 4C-8, shown in Page 2 of the Warrant 4 tab,
should be used to evaluate the peak pedestrian hour of an average day.

Note that the pedestrian volume may be reduced by 50 percent
if a walking speed study has been conducted and shows that the 15th percentile crossing speed
is less than 3.5 feet per second.

Refer to MUTS Chapter 9 - Non-Motorized Volume Studies for guidance
on how to conduct a walking speed study.

The 100 percent checkbox must be selected to auto populate the volumes
in the 100 percent volume level table and chart or MUTCD Figure 4C-5 or 4C-7.
Warrant 4 is met if the major street traffic volumes and pedestrian crossing volumes
meet the appropriate thresholds for the four-hour or peak hour on the 100 percent volume level charts**.**
The optional checkbox for the 50 percent pedestrian volume reduction is available
and must be checked to plot the reduced pedestrian volume curve.

The total pedestrians crossing the major street along with the major street traffic volume
should be plotted on MUTCD Figure 4C-5 or 4C-7 as explained in the previous slide.
If the posted, statutory, or 85th percentile speed on the major street exceeds 35 miles per hour,
or if the intersection lies withing the built-up area of an isolated community
having a population of less than 10,000 people, Figures 4C-6 and 4C-8 may be used instead.

The MAY checkbox must be checked to use the 70 percent reduced volumes.
Warrant 4 is met if the major street traffic volumes and pedestrian crossing volumes
meet the appropriate thresholds for the four-hour
or peak hour on the 70 percent volume level charts.

For our example, a walking speed study was conducted
resulting in a 15th percentile crossing speed of 3.3 feet per second,
which meets the criteria to use the 50 percent reduction.
Using the 70 percent volume thresholds,
Warrant 4 is not met for either the four-hour or peak-hour volumes.

Warrant 5 is the School Crossing warrant.
The warrant is intended for application where the fact that school children cross the major street
is the principal reason to consider installing a traffic control signal.
Refer to MUTCD Section 4C.06 for further detail on completing Warrant 5.

The following is an overview of how to complete Warrant 5.
The warrant is satisfied if all three criteria are met.
The three criteria that must be met are a minimum number of students crossing the major street, fewer number of adequate gaps in the major street traffic during the period
when children are present than the number of minutes in the same period,
and the nearest traffic signal along the major street is located more than 300 feet away,
or the nearest signal is within 300 feet, but the proposed traffic signal
will not restrict the progressive movement.

A gap, as defined in MUTS Chapter 8.2 is the time duration between the rear bumper
and front bumper of two consecutive vehicles.
To simplify measurements in the field, a gap may be measured by the time duration
between consistent reference points of two consecutive vehicles.
A driver or non-motorist can accept or reject gaps.
Gap study procedures are described in further detail in MUTS Chapter 8 - Gap Study.

For our example, there are six students who cross Main Street to get to school during the highest hour, which does not meet the criteria of 20 students.
Knowing one of the three required criteria is not met,
there is no need to check the remaining two criteria.
Therefore, we now know Warrant 5 is not met.

Warrant 6 is the Coordinated Signal System warrant.
The warrant is intended for application where the progressive movement
in a coordinated signal system sometimes necessitates installing traffic signals at intersections
where they are needed to maintain proper platooning.

The Coordinated Signal System warrant should not be applied
where the resultant spacing of traffic control signals would be less than 1,000 feet.
Refer to MUTCD Section 4C.07 for further detail on completing Warrant 6.

The following is an overview of how to complete Warrant 6.
The warrant is satisfied if either of the two criteria are met.
The two criteria are on a one-way street or a street that has traffic predominantly in one direction,
the adjacent signals are so far apart that they do not provide
the necessary degree of vehicle platooning, or on a two-way street,
adjacent signals do not provide the necessary degree of platooning,
and the proposed and adjacent signals will collectively provide a progressive operation.
For our example, Main Street is not part of a coordinated signal system
and so Warrant 6 is not applicable.

Warrant 7 is the Crash Experience warrant.
The warrant is intended for application where the severity and frequency of crashes
are the principal reasons to consider installing a traffic signal.
Refer to MUTCD Section 4C.08 for further detail on completing Warrant 7.

The following is an overview of how to complete Warrant 7.
The warrant is satisfied if all three criteria are met.
The first criterion requires that adequate trial of other remedial measures
to reduce crash frequency must have been tried and failed.

The second criterion requires that a minimum of five reported crashes
of types susceptible to correction by a traffic signal, such as angle, pedestrian, and left turn,
must have occurred within a 12-month period.
Local cities or counties may elect to use within their jurisdiction
MUTCD Interim Approval 19 subject to FHWA approval.
Note interim approval's application should not be done on the state highway system.

The third criterion has been updated in the Signal Warrant Summary Form to reflect Warrant 7
in the MUTCD more accurately.
This criterion requires that either Warrant 1 Condition A be met
for the 80 percent vehicular volume threshold or Warrant 1 Condition B be met
for the 80 percent vehicular volume threshold or requires Warrant 4 be met
for 8 hours for the 80 percent of the pedestrian volume threshold.

Eight hours of pedestrian volume data is needed to complete the pedestrian volume criteria
as part of Warrant 7.

The 8-hour pedestrian volume requirement may impact the level of effort required for data collection
if Warrant 7 is to be used.
For our example, criteria two and three are met,
but criteria one is not met as no remedial measure has been taken to date,
therefore Warrant 7 is not met.

Warrant 8 is the Roadway Network Warrant.
The warrant is intended to be applied where installing a traffic signal is needed
to encourage concentration and organization of traffic flow on a roadway network.
Refer to MUTCD Section 4C.09 for further detail on completing Warrant 8.

The following is an overview of how to complete Warrant 8.
The warrant is satisfied if at least one of the two criteria is fulfilled and if all intersecting routes have one or more of the Major Route characteristics listed.
Criterion one requires that the total entering volume is at least 1,000 vehicles per hour during a typical weekday peak hour and that five-year projected volumes satisfy one or more of Warrants 1, 2, or 3.

Criterion two requires that the total entering volume is at least 1,000 vehicles per hour for each of any five hours of a non-normal business day, such as Saturday or Sunday.

The three major route characteristics are as follows:
part of the street or highway system that serves as the principal roadway network for through traffic,
a rural or suburban highway outside of, entering, or traversing a city,
and if the roadways appear as major routes on an official plan.
For our example, Main Street is not part of a major route, so Warrant 8 is not applicable.

Warrant 9 is the Intersection Near a Grade Crossing Warrant.
The warrant is intended to be applied at intersections where a grade crossing exists on an intersection approach controlled by a STOP or YIELD sign and none of the other eight traffic signal warrants are met.

This signal warrant should only be applied after evaluating other alternatives and determining that the alternatives do not address safety concerns related to the grade crossing.
Refer to MUTCD Section 4C.10 for further detail on completing Warrant 9.
Warrant 9 consists of two pages.
The following slides provide an overview of how to complete Warrant 9.

Page 1 describes the two criteria which shall be fulfilled in order to meet the warrant.
The first criterion requires having an existing grade crossing on a STOP or YIELD controlled approach and the center of the track nearest to the intersection within 140 feet of the stop or yield line on the approach.

The second criterion requires that during the highest traffic volume hour
during which the rail uses the crossing,
the plotted point falls above the applicable curve for the existing combination of approach lanes over the track and the clear storage distance.
These figures are displayed on Page 2 of the Warrant 9 tab.
The clear storage distance is defined as D in the charts and is one of the inputs required under Page 1.

Percent of high occupancy buses and percentage of tractor-trailer trucks
on approach lane at track crossing as well as rail traffic occurrences per day
should be defined under Page 1.
Before moving to Page 2 of the tab, the analyst should determine which figure is applicable for the study intersection based on the number of approach lanes crossing the track.

As previously noted, Page 2 of the Warrant 9 tab provides MUTCD Figures 4C-9 and 4C-10.
Figure 4C-9 should be used if there is one approach lane at the track crossing
while Figure 4C-10 should be used if there are two or more lanes at the track crossing.
Each figure shows an intersection schematic for the corresponding approach lane configurations.

The final inputs needed to evaluate the warrant are the major and minor road volumes.
These volumes should be recorded in the corresponding cells based on the number of lanes on the minor road.

Note this is the only tab where volumes are a directly coded onto the Warrant analysis tab as opposed to the Instructions & Input tab.
The form will auto-populate the adjusted volumes with the corresponding adjustment factors coded by the engineer on Page 1 of the tab following MUTCD Tables 4C-2, 4C-3, and 4C-4.

Once the volumes have been recorded, the applicable factors will be applied to the volumes and these will be plotted on the figure.
If the plotted point falls above the appropriate curve, the warrant is met.
For our example, Warrants 1 and 2 are met so Warrant 9 is not applicable.

To conclude the procedure, an overview of the Warrant Summary Checklist is provided.
Once all nine warrants have been evaluated and completed the checklist should be the final step.
This tab has been modified to allow the engineer to check boxes for each warrant
marking if the warrant is not applicable or if the warrant is or it is not met.

In our example, Warrants 6, 8, and 9 are not applicable, Warrants 1 and 2 are applicable and met,
and Warrants 3, 4, 5, and 7 are applicable and not met.
The engineer should now be ready to sign and seal the analysis.

This concludes the Manual on Uniform Traffic Studies computer based training,
Chapter 3 - Traffic Signal Warrant Summary.
You will now be directed to a 10-question quiz to test your knowledge and understanding
on the material presented in this computer-based training.

A passing grade of 70% is required to obtain the Certificate of Completion for the training.
If a grade below 70% is obtained, the trainees are required to re-take the full training
until a passing grade of 70% or higher is obtained.

If you do not pass the quiz, please return to the Index page by selecting the Index button below
and re-take this training.

Once you've received your certificate, please continue to the next chapter
by selecting the "NEXT" button below this CBT.
On the next slide, please enter your first and last name before continuing to the quiz.
Thank you for your time and attention.

LMS:

This concludes the Manual on Uniform Traffic Studies computer based training, Chapter 3 - Traffic Signal Warrant Summary.
You will now take a 10-question quiz to test your knowledge and understanding on the material presented in this computer-based training.

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If you do not pass the quiz, please return to the Course Content tab, and re-take this training. Once you've passed the quiz and received your certificate please continue to the next chapter by returning to the MUTS course content tab and selecting the next chapter in the training. Please, continue to the quiz and thank you for your time and attention