# HCS™

TWSC Module

# USER GUIDE

UF Transportation Institute UNIVERSITY of FLORIDA | McTrans

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# Introduction

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# Getting Started

## System Requirements

HCS is designed for standard Windows installations. For optimal performance, the system should be Windows 10 or newer. While HCS may be compatible with older versions of Windows, any installation and operational issues arising from using these older versions will be the sole responsibility of the end user.

## Getting Started

To begin, click on File then New (or the "New File…" from the Start screen). Normal Windows keyboard and mouse functions are available. In Full View, the PgUp and PgDn keys will scroll the entry screen up and down respectively. Tabbing, clicking to a new field, or pressing the Enter key will trigger a recalculation and update the Report pane in Full View.

**Two-Way Stop-Controlled (TWSC) Analysis**

Two-Way Stop-Controlled (TWSC) intersection analyses will estimate Capacity and Level of Service (LOS) for a given set of traffic and geometric conditions. This type of analysis is oriented toward the evaluation of an existing or planned facility. The methodology and procedures of application use the HCM Chapter 20 procedures.

# General Controls

## Menu Items

**New** – Creates a new TWSC file (*.xtw) and starts a new analysis project; shortcut is Ctrl+N

**Open** – Opens an existing TWSC file (*.xhu, *.xtw); shortcut is Ctrl+O

**Example Folder** – Opens folder with all HCS examples in File Explorer

**Save** – Saves an open TWSC file (*.xtw) using the current file name; shortcut is Ctrl+S

**Save As…** – Saves an open TWSC file (*.xtw) using a specified file name; shortcut is F12

**Close** – Closes an existing TWSC file (*.xtw); shortcut is Ctrl+W

**Units**

- **USC Units** – Changes the units of the current file to U.S. Customary
- **Metric Units** – Changes the units of the current file to Metric

**Print** – Brings up printer selection and prints a TWSC report to the printer or specified file type; shortcut is Ctrl+P

**Print Preview** – Displays preview of current report before printing; shortcut is Ctrl+F2

**View**

- **Page View** – Changes the view to display inputs and reports by pages; shortcut is F9
- **Full View**
  - **Report -> Right** – Changes the view to display both the input screen and report simultaneously; the report is displayed on the right portion of the screen; shortcut is F10
  - **Report -> Bottom** – Changes the view to display both the input screen and report simultaneously; the report is displayed on the bottom portion of the screen; shortcut is F11

**Report**

- **Formatted Report** – Displays formatted report including the most important values; shortcut is F4
- **Text Report** – Displays text report with all input, intermediary, and final results; shortcut is F6
- **RCUT Report** – Displays formatted report for an RCUT analysis; shortcut is F7

**Default Settings** – Opens a dialog box for the user to input defaults for Analyst, Agency, and Jurisdiction, which will be applied to all new files; also allows selection of USC or SI units, which will be applied to all new files; shortcut is Alt+F

**Help**

**Contents** – Provides access to glossary, acknowledgements, copyrights, and information on the HCM procedure; shortcut is Ctrl+F1

**Index** – Allows user to search for keywords within the glossary

**Search** – Allows user to search for any word within the glossary

**User Guide** – Opens a comprehensive user guide in PDF format; shortcut is Ctrl+G

**HCM Reference Guide** – Opens a reference guide for the HCM in PDF format

**HCS Updates** – Sends the HCS version number anonymously without any personally identifiable information to McTrans to check for a newer version

**HCM/HCS Training** – Opens the McTrans Training Page in the default web browser to view the latest training opportunities

**HCQS Web Page** – Opens the TRB Highway Capacity and Quality of Service Committee page in the default web browser

**Support**

**Frequently Asked Questions** – Opens the McTrans support page for HCS in the default web browser

**HCS Overview** – Opens the McTrans HCS Overview page in the default web browser

**McTrans Website** – Opens the McTrans home page in the default web browser

**E-mail McTrans** – Composes a new e-mail addressed to McTrans in the default e-mail client with registration number, serial key, module, and version number already populated in the Subject field

**About HCS** – Opens an about window with software version information, EULA, general acknowledgements, contact information, and other relevant links

**CORSIM**

**View Animation** – Sends data to the TSIS-CORSIM program for simulation and/or animation purposes, TRAFVU can be opened within TSIS-CORSIM to allow user to view animation; shortcut is Ctrl+Shift+A

**Generate TRF File** – Saves an open TWSC file (*.xtw) as a CORSIM file (*.trf), which is a file that contains the input data used to define a CORSIM network and to drive the CORSIM simulation for a single simulation; shortcut is Ctrl+Shift+T

**Exit** – Exits the *HCS* TWSC module; shortcut is Alt+F4

# Two-Way STOP Control (TWSC) Intersections

## HCM Chapter 20

Two-way STOP-controlled (TWSC) intersections are common in the United States. One typical configuration is a four-leg intersection, where one street—the *major street*—is uncontrolled, while the other street—the *minor street*—is controlled by STOP signs. The other typical configuration is a three-leg intersection, where the single minor-street approach (i.e., the stem of the T configuration) is controlled by a STOP sign. Minor street approaches can be public streets or private driveways. **Chapter 20, Two-Way STOP-Controlled Intersections,** presents concepts and procedures for analyzing these types of intersections.

#### LIMITATIONS OF THE METHODOLOGY

The methodologies in this chapter apply to TWSC intersections with up to three through lanes (either shared or exclusive) on the major-street approaches and up to three lanes on the minor-street approaches (with no more than one exclusive lane for each movement on the minor-street approach). Effects from other intersections are accounted for only in situations in which a TWSC intersection is located on an urban street segment between coordinated signalized intersections. In this situation, the intersection can be analyzed by using the procedures in Chapter 18, Urban Street Segments. The methodologies do not apply to TWSC intersections with more than four approaches.

The methodologies do not include a detailed method for estimating delay at YIELD-controlled intersections; however, with appropriate changes in the values of key parameters (e.g., critical headway and follow-up headway), the analyst could apply the TWSC method to YIELD-controlled intersections.

All the methods are for steady-state conditions (i.e., the demand and capacity conditions are constant during the analysis period); the methods are not designed to evaluate how fast or how often the facility transitions from one demand or capacity state to another. Analysts interested in that kind of information should consider applying alternative tools.

## Operational Data

#### GENERAL

First, the user enters the General Information into the respective fields: Analyst, Agency, Date, and Time Analyzed, as well as site information for Jurisdiction, Analysis Year, Project Description, Intersection and Street Names.

The Major Street Direction is selected as either East-West or North-South form the drop-down menu options.

Analysis Time Period is the length of time (T) the peak flow remains constant (usually 0.25 hr) and is used in the delay equations. If v/c exceeds 0.90, control delay may be significantly affected by the value of T.

The Peak Hour Factor (PHF) for the intersection is coded under the Intersection Data. The HCM no longer permits PHF by movement.

The Median Type is coded for the major street, either Undivided, Thru & Left, or Left Only. A raised, striped or two-way left-turn lane (TWLTL), often causes a special gap acceptance phenomenon known as two-stage gap acceptance where a significant proportion of the minor-street drivers cross part of the major-street then pause in the median to wait for a gap on the other approach.

Undivided is selected when there is no median storage, disabling that field. Thru & Left is selected if the geometry permits both thrus and lefts from the minor street to store in the median for two-stage movements. Left Only is selected if only left turns (not thrus) can be stored, in a TWLTL for example.

If a median type other than Undivided is selected, the Median Storage field will enable coding the number of vehicles able to be stored.

In Page View, the Back and Next arrows on the left and right margins allow navigation between screens. This can also be done by selecting screens from the menu bar at the top among Start, General, Lanes, Traffic Headway, Adjustment, and Report.

**LANES**

Lanes is a graphic data entry screen for coding lane configuration data. Lane combinations can be selected by clicking on the appropriate arrows to place them on the central diagram for each approach. Clicking on an arrow on the central diagram will remove it. As arrows are selected, others may become disabled.

*Note: As stipulated in the HCM methodology, each major-street approach can have up to three thru lanes and one exclusive right- and/or left-turn lane (five lanes maximum). Each minor-street approach can have up to three lanes, a maximum of one exclusive lane for each movement.*

Enter the Percent Grade for each approach with positive values for upgrades and negative values for downgrades. These values are used to compute adjustment factors used in the computation of critical headway and follow-up headway.

The Right Turn Channelized box is checked when the right-turning traffic from the major road is separated by a triangular island and has to comply with a stop or yield sign. This is a special case of an exclusive right-turn lane, which is coded in Lanes.

The Flared Minor-Street Approaches box is checked when two vehicles may occupy or depart from the stop line simultaneously as a result of a large curb radius, a tapered curb, or a parking prohibition. This geometry may result in a greater capacity than if turning and through movement share only one lane. The magnitude of this effect depends in part on the turning-movement flow rates and the resultant probability of there being two vehicles simultaneously at the stop line, and in part on the storage length available to feed the second position at the stop line. The Flared Minor-Street Storage is the number of spaces for right turning passenger cars that can queue at the stop line without obstructing the access to the stop line for other movements.

**TRAFFIC**

The Volume for each movement of the intersection is coded in vehicles per hour. An hourly volume is required for any movement to be included in the analysis. Note that U-turns off the major street are now analyzed.

Enter the Percent Heavy Vehicles for each movement. These values are used to compute adjustment factors used in the computation of critical headway and follow-up headway.

The Short Left-Turn Pocket box is checked if present and the Left-Turn Storage is coded for computing the delay to Rank 1 vehicles if the estimated queue exceeds the storage.

If no exclusive left-turn lane is provided on the major street, it is possible for major-street thru (and possibly right-turning) traffic to be delayed by left-turning vehicles waiting for an acceptable gap. In this situation, the Saturation Flow Rate and Percent Thrus Using Shared Lane for the appropriate major street thru and right turn movements are required to compute the probability that there will be no queue in the respective major-street shared lanes.

For queue length calculations, the Stored Passenger Car Length and Stored Heavy Vehicle Length are provided.

For calibration needs, a conflicting flow factor table is provided to adjust conflicting flow calculations.

**HEADWAY**

The Critical Headway is defined as the minimum time interval in the major-street traffic stream that allows intersection entry to one minor-street vehicle. The Base Critical Headway is obtained from HCM defaults for each movement for two-lane, four-lane, or six-lane major roads. Adjustments are made to account for the presence of heavy vehicles, approach grade, T-intersections and two-stage gap acceptance.

Follow-Up Headway is the time span between the departure of one vehicle from the minor street and the departure of the next vehicle using the same major-street headway under a condition of continuous queuing on the minor street. The Base Follow-Up Headway is obtained from HCM defaults for each movement for either two-lane, four-lane, or six-lane major roads.

Calibration of these values for local condition is strongly advised. If smaller values are observed, capacity will be increased. If larger values are used, capacity will be decreased.

**ADJUSTMENT**

Pedestrian Flows are the pedestrians crossing each approach (i.e., "Eastbound" pedestrians are those crossing the Eastbound vehicular approach) and are counted somewhat differently than vehicle flows. If a pedestrian crosses the intersection individually, then each pedestrian should be counted individually in the pedestrian flows. If pedestrians tend to cross in the groups, the number of groups should be counted in the pedestrian flow. The pedestrian volume is the sum of pedestrians crossing individually and groups of pedestrians crossing together during the time period of study. Minor-street traffic streams must yield to pedestrian streams.

The Lane Width is entered as the average width for all lanes in the approach.

The Pedestrian Walking Speed is entered to calculate the pedestrian blockage factor, or proportion of time that one lane on an approach is blocked during the analysis period.

The Pedestrian Blockage Factor is automatically computed on the basis of the pedestrian flow rate, pedestrian walking speed, and the lane width.

The Upstream Signal box is checked for the existence of a nearby upstream signalized intersection. An upstream signalized intersection usually causes vehicles to arrive at the subject intersection in platoons, which may cause an increase in the minor-street capacity compared with the case of random arrivals. The greater the number of vehicles traveling in platoons, the higher the minor-street capacity for a given opposing flow because there is a greater proportion of large gap sizes that can be used by more than one minor-street vehicle.

To evaluate the impact of coordinated upstream signals, the urban street segments methodology is used to estimate the proportion of time that each Rank 2 or lower movement will be effectively blocked by a platoon. With these values, the proportion of the analysis period that is blocked for each minor movement can be computed.

**Results**

Level of Service (LOS) criteria for TWSC intersections in control delay (s/veh):

| Control Delay (s/veh) | LOS by Volume-to-Capacity Ratio | |
|---|---|---|
| | $v/c \leq 1.0$ | $v/c > 1.0$ |
| 0–10 | A | F |
| >10–15 | B | F |
| >15–25 | C | F |
| >25–35 | D | F |
| >35–50 | E | F |
| >50 | F | F |

Note: The LOS criteria apply to each lane on a given approach and to each approach on the minor street. LOS is not calculated for major-street approaches or for the intersection as a whole.

Control Delay and LOS are computed for each movement and approach.

# TWSC Report

The report can be displayed in either Page or Full View. If displayed in Page View, the results will automatically update when the user switches to the Report page. From the Report page, the user can then switch between the formatted report and the text report using the button found at the bottom of the page. The formatted report shows the most important results in a presentable format, while the text report shows a detailed step-by-step analysis in plain text.

If displayed in Full View, the report can be displayed along with the input screen. The user has the choice of displaying the report to the right of the input screen or below the input screen. The report is dynamic and reacts to changes in the input screen. Like the Report page in Page View, the user can switch between the formatted report and the text report using the button found at the bottom of the report.

All or a portion of the reports can be copied to the Windows clipboard for insertion into other files by right-clicking into the Report pane and selecting Copy. The user can also change the display of the report through File Menu or with the use of shortcuts. See *General Controls*.

# Pedestrian Mode

## HCM Chapter 20

This methodology applies to TWSC intersections and midblock crossings at which pedestrians cross up to four through lanes on the major street. It is applied through a series of steps requiring input data related to vehicle and pedestrian volumes, geometric conditions, and motorist yield rates to pedestrians.

**LIMITATIONS OF THE METHODOLOGY**

The pedestrian methodology's limitations differ from the limitations of the motorized vehicle mode because the methods were developed in separate research efforts. The pedestrian methodology does not apply to undivided streets with more than four lanes, although it can accommodate up to four lanes in each direction separated by a median. It does not account for interaction effects of upstream signalized intersections, and it assumes random arrivals on the major street and equal directional and lane distribution on the major street.

The methodology does not take into account pedestrian cross flows (i.e., pedestrian flows approximately perpendicular to and crossing another pedestrian stream), and it assumes the pedestrian will reach the crossing without delay from pedestrians traveling parallel to the major street. Under high pedestrian volumes, this assumption may not be reasonable.

The method is for steady state conditions (i.e., the demand and capacity conditions are constant during the analysis period); it is not designed to evaluate how fast or how often the facility transitions from one demand or capacity state to another.

## Operational Data

**ADJUSTMENT**

In addition to the inputs mentioned for the motorized procedure, the following inputs are available for the pedestrian mode procedure: Crosswalk Length, Median Refuge, Start-Up and End Clearance Time, Crosswalk Markings, Crossing Treatment, Motorist Yield Rate, Rectangular Rapid-Flashing Beacon, Pedestrian Platooning, and Crosswalk Width. These inputs along with the lane configuration, traffic volume, pedestrian flow, lane width, and walking speed, are used in determining the average pedestrian delay and level of service. There is also a checkbox provided to indicate whether or not to show pedestrian delay and LOS. Checking this will add pedestrian mode related results to both the formatted and text reports.

**Results**

Level of Service (LOS) criteria for TWSC intersections:

| LOS | Condition | Comments |
|---|---|---|
| A | $P_D < 0.05$ | Nearly all pedestrians would be satisfied |
| B | $0.05 \leq P_D < 0.15$ | At least 85% of pedestrians would be satisfied |
| C | $0.15 \leq P_D < 0.25$ | Fewer than one-quarter of pedestrians would be dissatisfied |
| D | $0.25 \leq P_D < 0.33$ | Fewer than one-third of pedestrians would be dissatisfied |
| E | $0.33 \leq P_D < 0.50$ | Fewer than one-half of pedestrians would be dissatisfied |
| F | $P_D \geq 0.50$ | The majority of pedestrians would be dissatisfied |

Note: $P_D$ = proportion of pedestrians giving a "dissatisfied" rating or worse.

# TWSC Pedestrian Report

The report can be displayed in either Page or Full View. If displayed in Page View, the results will automatically update when the user switches to the Report page. From the Report page, the user can then switch between the formatted report and the text report using the button found at the bottom of the page. The formatted report shows the most important results in a presentable format, while the text report shows a detailed step-by-step analysis in plain text.

If displayed in Full View, the report can be displayed along with the input screen. The user has the choice of displaying the report to the right of the input screen or below the input screen. The report is dynamic and reacts to changes in the input screen. Like the Report page in Page View, the user can switch between the formatted report and the text report using the button found at the bottom of the report.

On the input screen, checking 'Show Pedestrian Delay and LOS' will add pedestrian mode related results to both the formatted and text reports.

All or a portion of the reports can be copied to the Windows clipboard for insertion into other files by right-clicking into the Report pane and selecting Copy. The user can also change the display of the report through File Menu or with the use of shortcuts. See *General Controls*.

# Alternative Intersections

## HCM Chapter 23

The procedure in this chapter can be used to estimate the capacity and level of service (LOS) of interchange ramp terminals and alternative intersections. Alternative intersection LOS is dictated by the experienced travel time (ETT) of origin-destination movements.

**Restricted Crossing U-Turn (RCUT) Intersections**

RCUTs can be controlled by traffic signals, STOP control on the minor-street approach, or merges and diverges. The core computational methodology in Section 3 of the chapter can evaluate all three types of control, at RCUTs and MUTs with three or four approaches. RCUTs and MUTs with signals are typically built in urban or suburban areas with higher traffic demands, while those with STOP signs or merges are typically built in rural areas on high-speed roadways with lower minor-street traffic demands. RCUTs with signals or stop signs typically have 450 to 800 feet (or 137.2 to 243.8 meters in metric) from the main junction to a U-turn crossover. RCUTs with merges typically have more than 800 feet (or 243.8 meters in metric) from the main junction to a U-turn crossover, to make the weaving maneuvers easier.

## Modeling Capability in HCS

HCS has the capability of modeling five types of alternative intersections supported by HCM:

- Restricted Crossing U-Turn Intersections (RCUT) with Signals
- Restricted Crossing U-Turn Intersections (RCUT) with Stop Signs
- Restricted Crossing U-Turn Intersections (RCUT) with Merges
- Median U-Turn Intersections (MUT) with Stop Signs
- Partial Displaced Left-Turn Intersections (DLT)

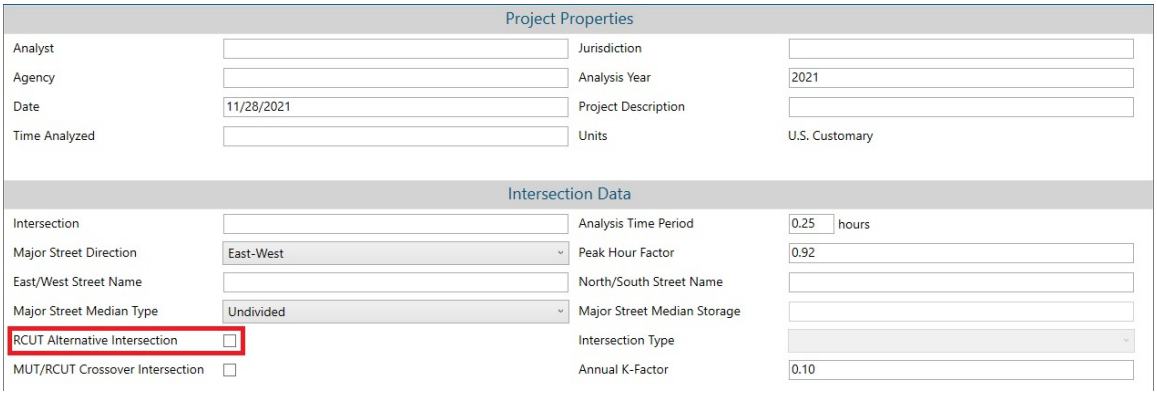
The computations procedure for each type of alternative intersection can be used to estimate the control delay, extra distance travel time (EDTT), and experienced travel time (ETT) per origin-destination (O-D) demand movement. The level of service (LOS) for alternative intersections is dictated by the ETT value. RCUT with Stop Signs and RCUT with Merges are applicable to the TWSC module. MUT with Stop Signs requires both the use of the Streets module and the TWSC module.

# Creating New Alternative Intersection Datasets

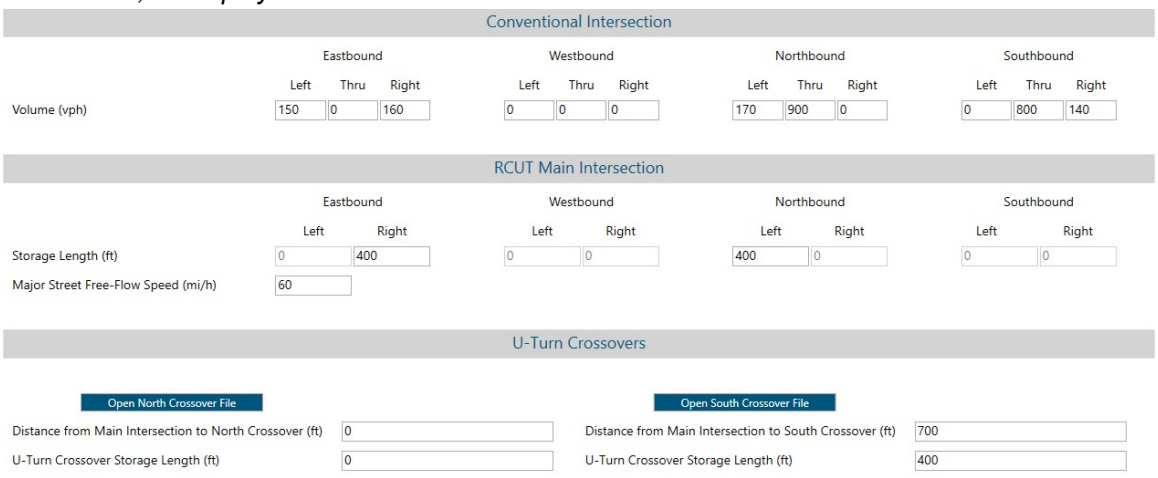
## Steps to Build an RCUT with Stop Signs

To conduct an RCUT with stop signs analysis, the Two-Way Stop Control module is used. One TWSC (.xtw) file is necessary to serve as the main intersection file, and one or two separate TWSC (.xtw) files to serve as the upstream/downstream junctions. The upstream/downstream junctions will be attached in the main intersection file. HCS supports three-legged and four-legged RCUT intersections with stop signs. *Note: TWSC does not redistribute conventional volumes. These values must be determined prior to input.*

1. Create a new TWSC (.xtw) file and check the RCUT Alternative Intersection checkbox found in Intersection Data. This file will serve as the main intersection.



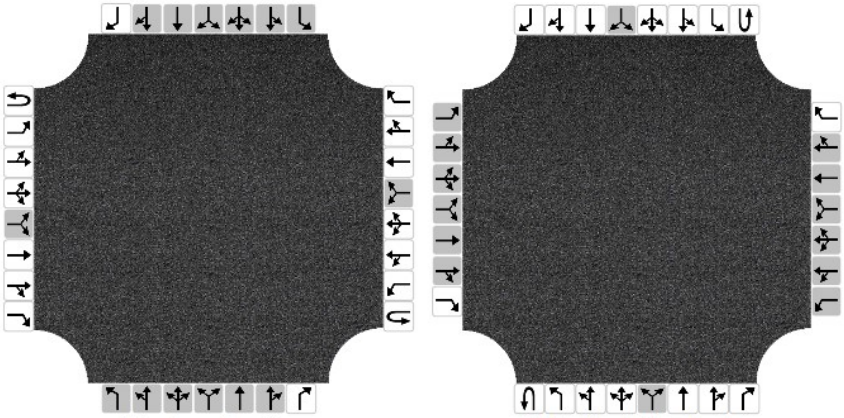

2. The Intersection Type dropdown will now become editable. The default selection is RCUT with Stop Signs. *Note: Activating the RCUT Alternative Intersection checkbox adds three new input sections to TWSC titled Conventional Intersection, RCUT Main Intersection, and U-Turn Crossovers, as displayed below.*




   a. In Page View, these fields may be found in the newly enabled RCUT tab.

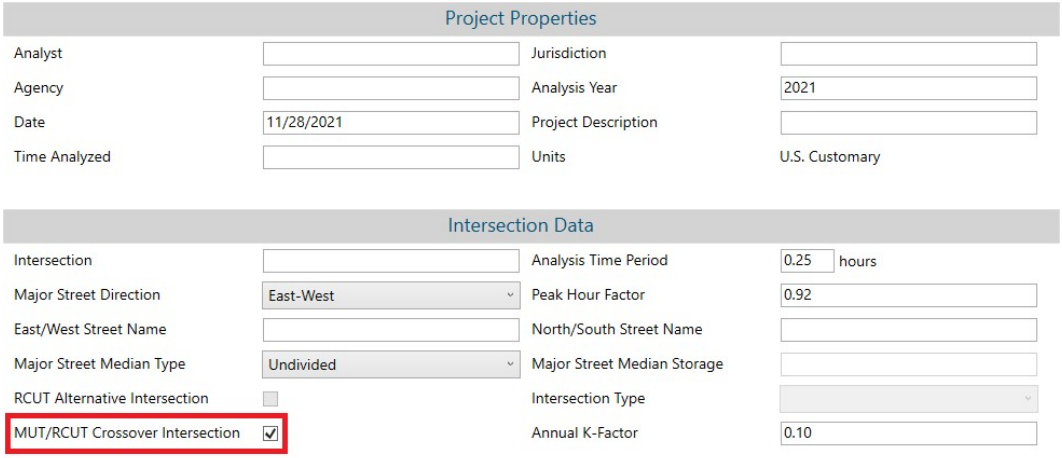
   b. In Full View, these fields may be found by scrolling midway down the page.

3. Code the inputs for Quick Lanes, Vehicle Volume and Adjustments, Critical Headway and Follow-Up Headway, and Pedestrian Volumes and Adjustments as would typically be done.
   a. Quick Lanes will disable the restricted side-street left-turn and through movements.

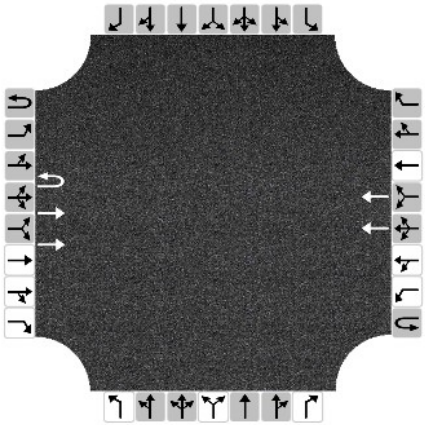



b. The volume entered in the Vehicle Volumes and Adjustments section should be the redistributed conventional volume. As previously mentioned, this must be determined manually. TWSC does not currently automate volume redistribution.

4. Code the RCUT specific inputs in the sections Conventional Intersection, RCUT Main Intersection, and U-Turn Crossovers. *Note: The conventional intersection volume is only used for final ETT calculations.*
5. If the crossover junctions have already been coded, skip ahead to Step 6. If not, the upstream and downstream TWSC files will be coded in this step. These files will then be attached in the U-Turn Crossovers section of the main intersection file.
   a. Open a new TWSC module. There is no need to check the RCUT Alternative Intersection checkbox for the U-Turn crossover files. However, the MUT/RCUT Crossover Intersection checkbox must be checked to indicate the intersection is an MUT/RCUT crossover. Code the crossover junction as would be done for a typical TWSC file.

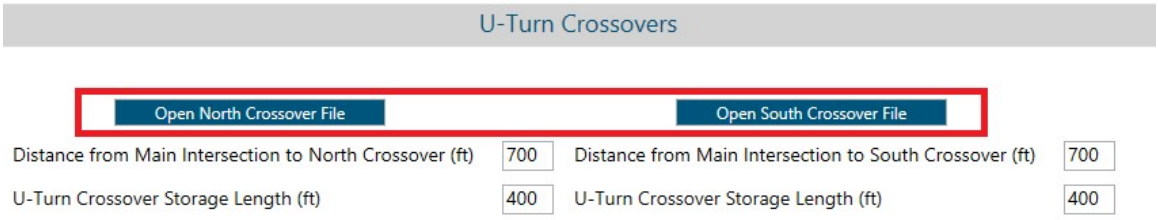



*Note: It is however necessary that the crossover junction only has major street through movements and one major street U-Turn movement. The main intersection attachment will not accept the file otherwise. A sample configuration of an East-West major street crossover file is presented in the image below.*




b. Repeat Step 5a to create a second crossover file if a four-legged RCUT intersection is being constructed.

6. Return to the main intersection file and navigate to the U-Turn Crossovers section. To attach the crossover files, click the buttons in blue.

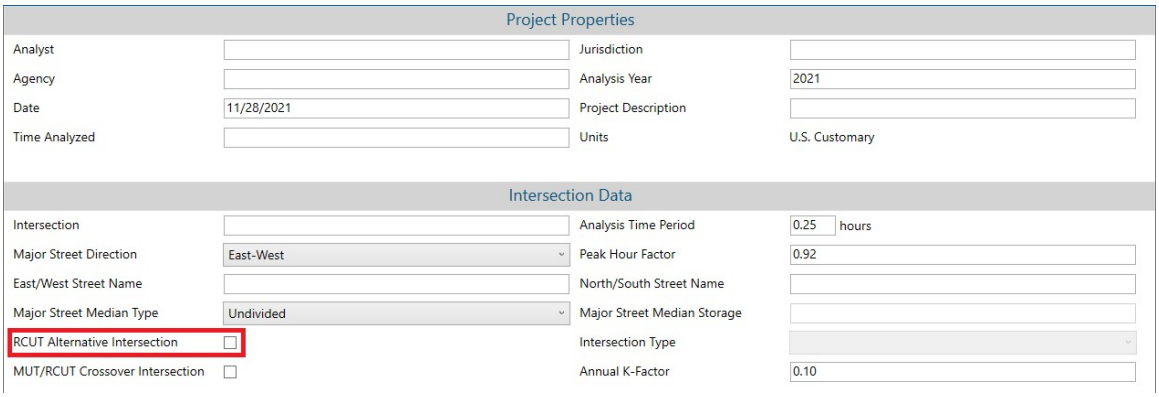



7. To view the RCUT report, press the F7 key. Alternatively, use the menu icon and navigate to Report > RCUT Report. *Note: The RCUT report is only accessible after at least one crossover file has been attached.*

## Steps to Build an RCUT with Merges

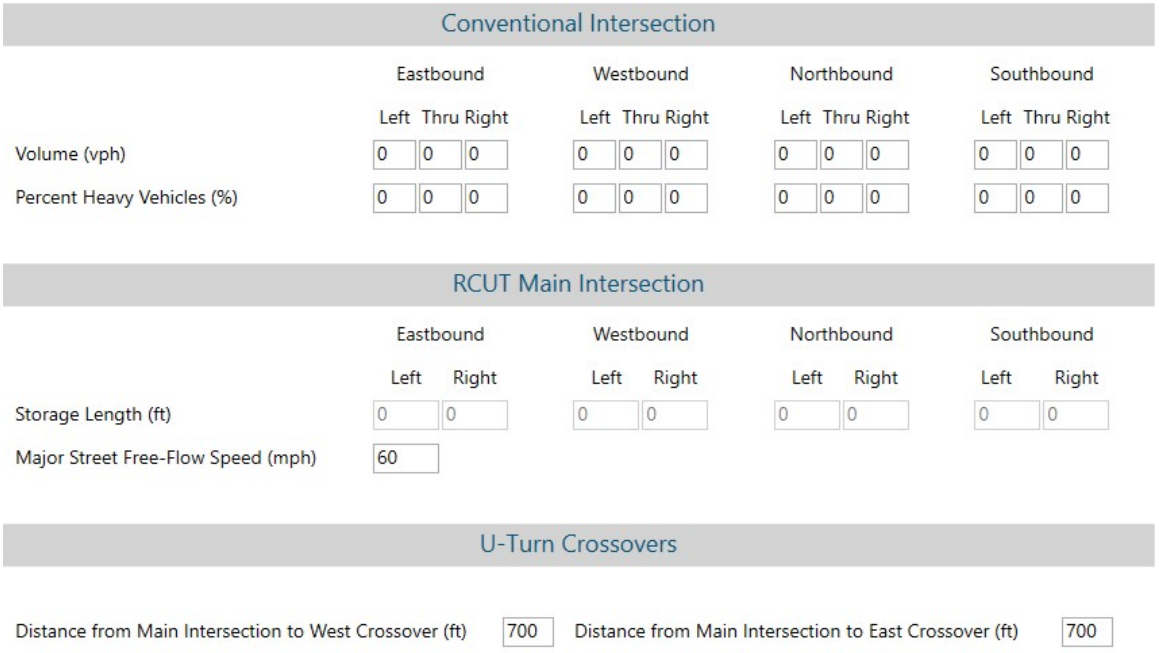
To conduct an RCUT with merges analysis, the Two-Way Stop Control module is used. One TWSC (.xtw) file is necessary to serve as the main intersection file. The minor street movements will be treated as merges and therefore the only movements experiencing control delay are the major street left-turns. *Note: TWSC does not redistribute conventional input volumes. These values must be determined prior to input. The RCUT with Merges engine will however calculate upstream and downstream junction demands, which are displayed in the Demand section of the RCUT Report.*

1. Create a new TWSC (.xtw) file and check the RCUT Alternative Intersection checkbox found in Intersection Data.




2. The Intersection Type dropdown will now become editable. Select RCUT with Merges.

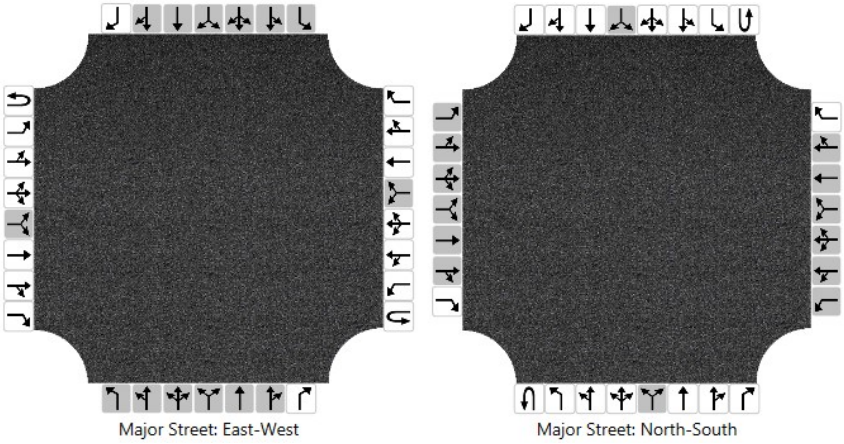
*Note: Activating the RCUT Alternative Intersection checkbox adds three new input sections to TWSC titled Conventional Intersection, RCUT Main Intersection, and U-Turn Crossovers, as displayed below.*




   a. In Page View, these fields may be found in the newly enabled RCUT tab.

   b. In Full View, these fields may be found by scrolling midway down the page.

3. Code the inputs for Quick Lanes, Vehicle Volume and Adjustments, Critical Headway and Follow-Up Headway, and Pedestrian Volumes and Adjustments as would typically be done.
   a. Quick Lanes will disable the restricted side-street left-turn and through movements.




   b. The volume entered in the Vehicle Volumes and Adjustments section should be the redistributed conventional volume. As previously mentioned, this must be determined manually. TWSC does not currently automate volume redistribution.

4. Code the RCUT specific inputs in the sections Conventional Intersection, RCUT Main Intersection, and U-Turn Crossovers. *Note: The conventional intersection volume is used to check the zero merging delay assumption, and to calculate ETT values.*
   a. If the demand combinations do not fall within the 'insignificant delay' constraints, an input error message will appear.
5. To view the RCUT report, press the F7 key. Alternatively, use the menu icon and navigate to Report > RCUT Report.
   a. If changing the conventional input volumes is necessary, first navigate away from the RCUT report. Since the zero delay assumption is checked after each volume input, failing to do so may result in an input error message appearing before editing is finished with the volume fields.

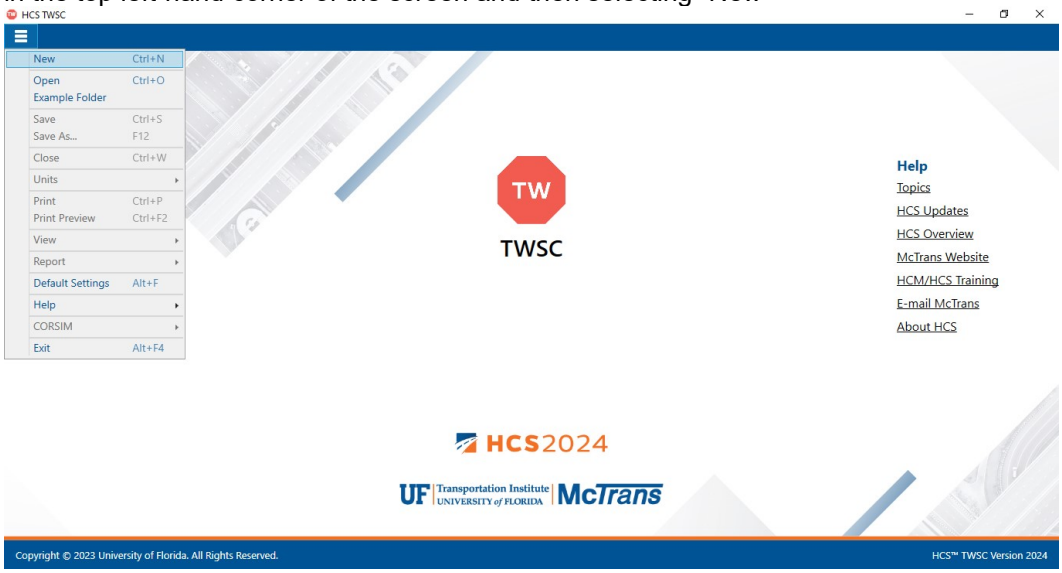
# How To

## Create a New File

1. From the Start screen, there are three options for creating a new file:

*Note: A new file can be created if an existing file is already open; you do not need to start from the Start screen.*

a. Selecting *File* > *New* from the main menu; this can be found by selecting the three lines in the top left-hand corner of the screen and then selecting “New”

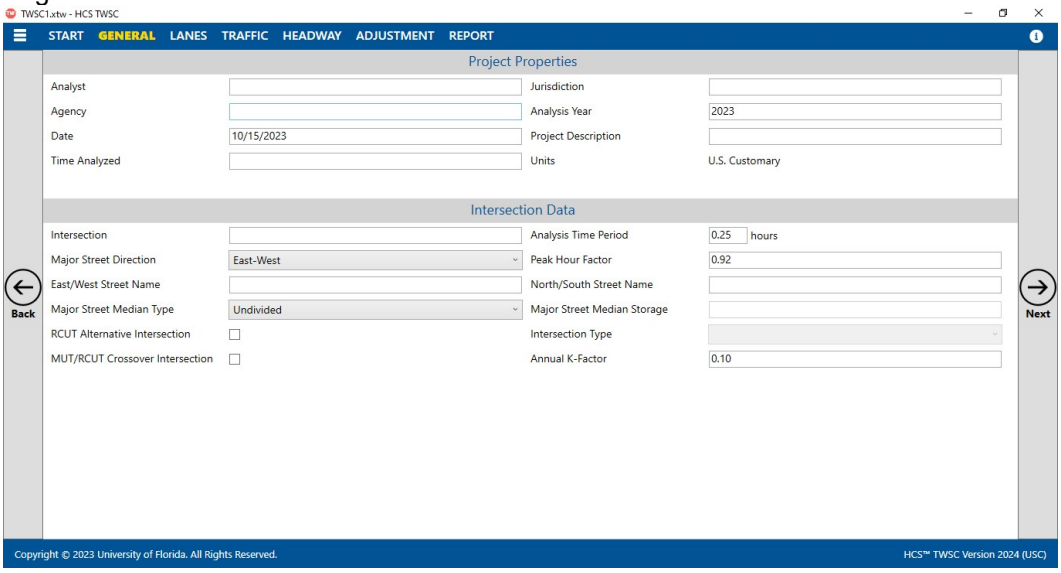



b. Selecting “New File…” from the Start screen; this can be found below in the red box

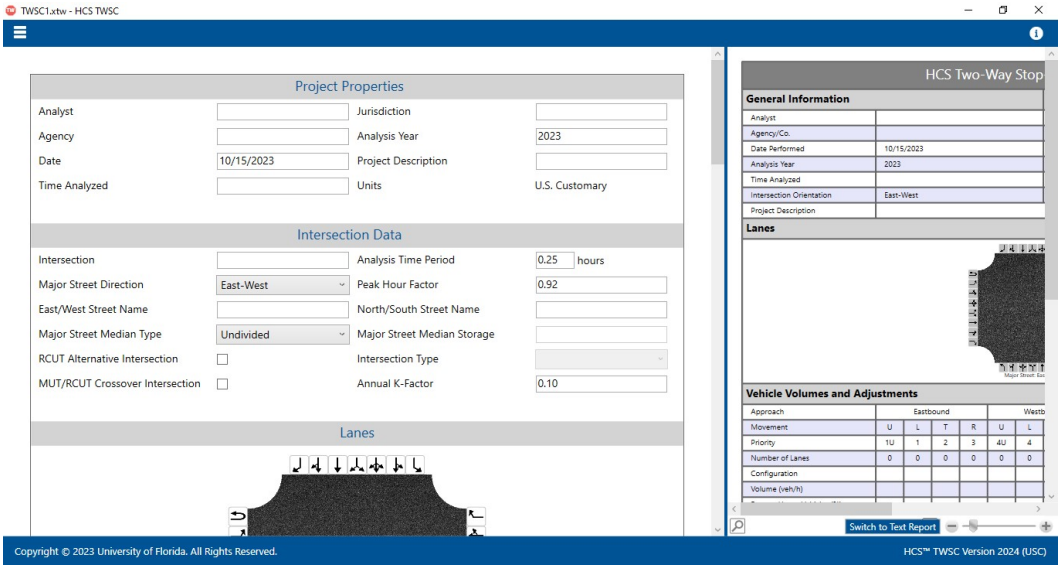
c. Using the keyboard shortcut “Ctrl+N”

2. Once a new file is created, you will be brought to the General page if in Page View or the input screen split with the report either on the right or the bottom of the screen if in Full View

a. Page View




b. Full View

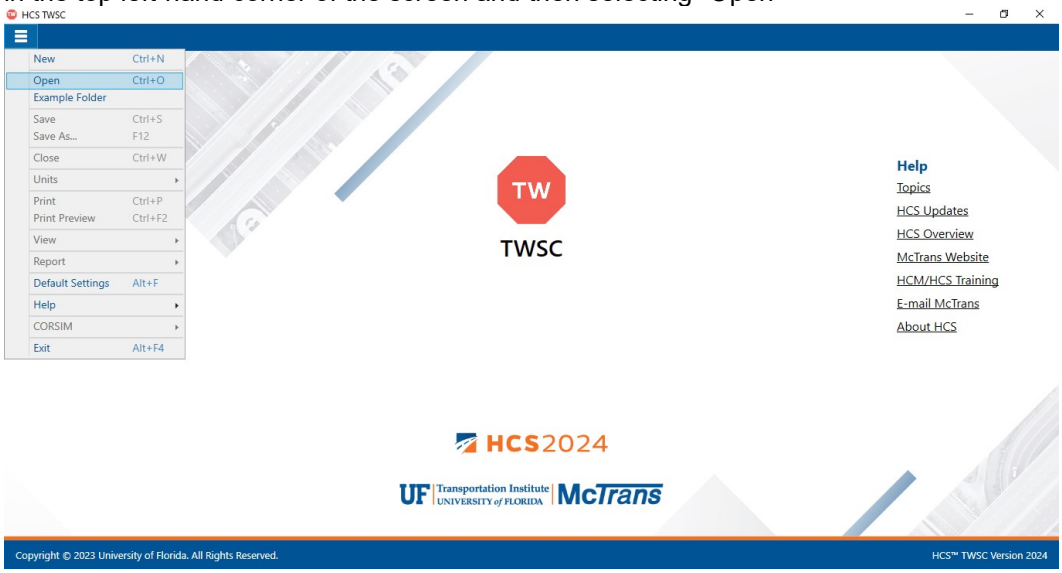


# Open an Existing File

1. From the Start screen, there are six options for opening an existing file:

*Note: A file can be opened even if another file is currently open; you do not need to start from the Start screen.*

   a. Selecting *File* > *Open* from the main menu; this can be found by selecting the three lines in the top left-hand corner of the screen and then selecting “Open”



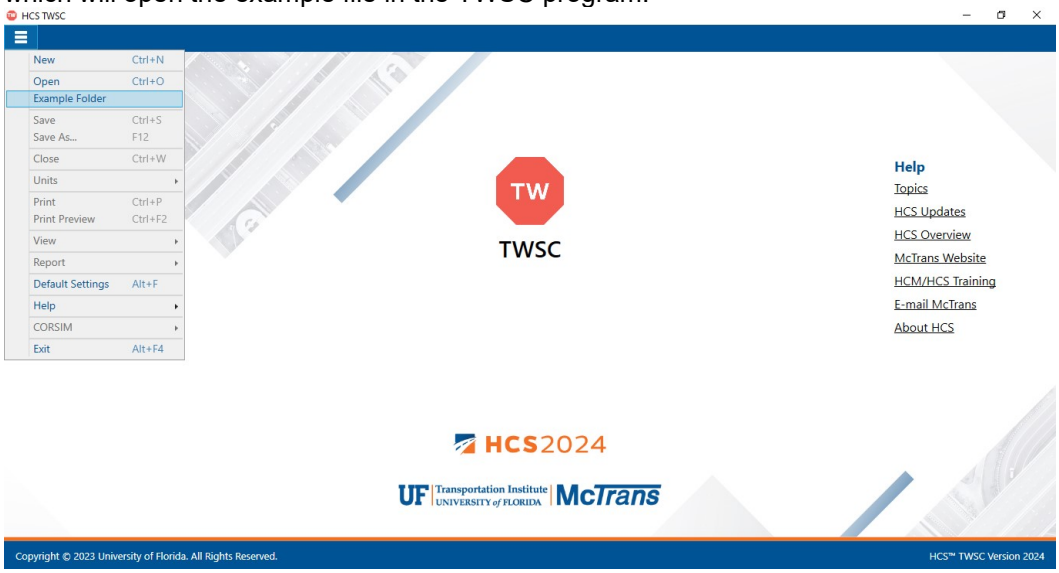
b. Selecting “Open File…” from the Start screen; this can be found below in the red box

c. Using the keyboard shortcut “Ctrl+O”

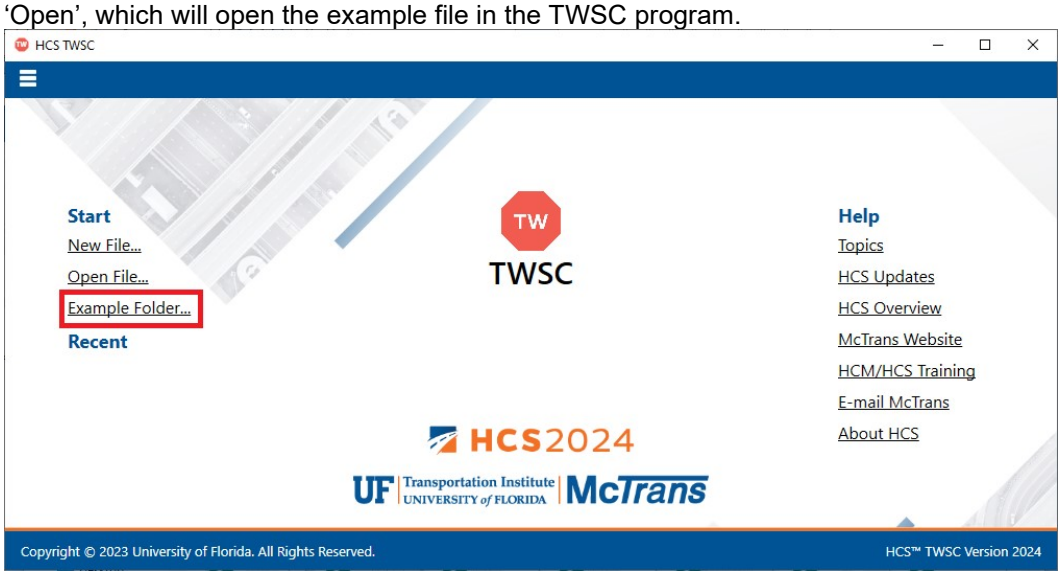
d. Selecting a file under the Recent files list from the Start screen; this can be found below in the red box

e. Selecting *File* > *Example Folder* from the main menu; this can be found by selecting the three lines in the top left-hand corner of the screen and then selecting “Example Folder”. Opening the example folder will open the path of the HCS example files in File Explorer. The desired example file can be double-clicked or right-clicked and selecting ‘Open’,

which will open the example file in the TWSC program.

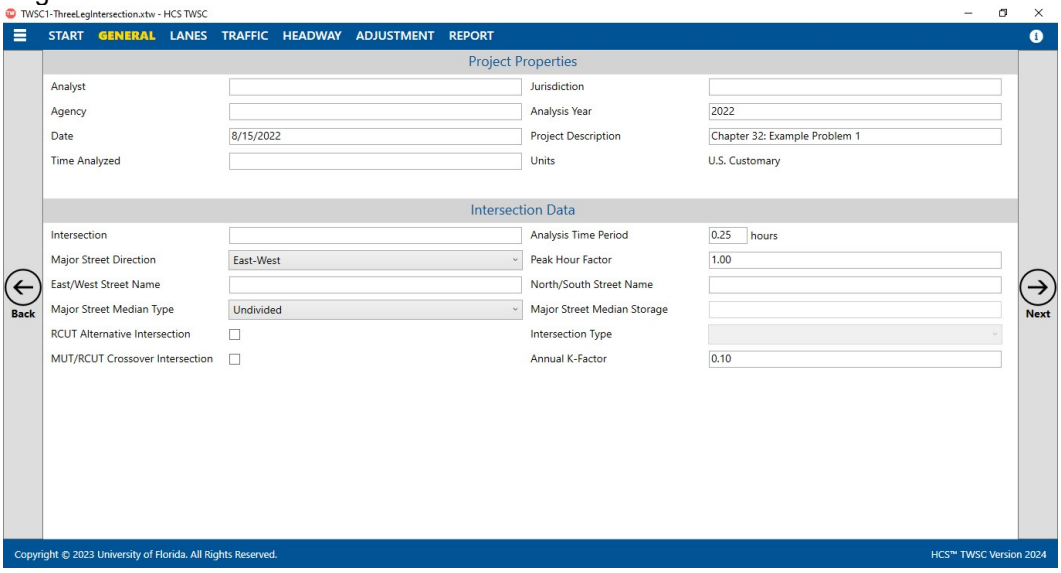



f. Selecting “Example Folder…” from the Start screen; this can be found below in the red box. Opening the example folder will open the path of the HCS example files in File Explorer. The desired example file can be double-clicked or right-clicked and selecting ‘Open’, which will open the example file in the TWSC program.

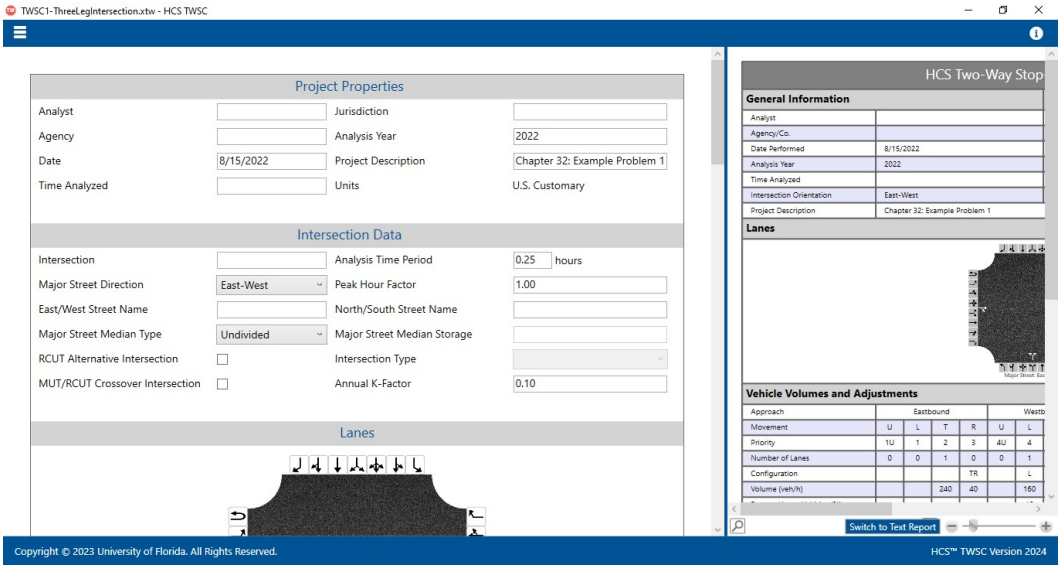



2. Once an existing file is opened, you will be brought to the General page if in Page View or the input screen split with the report either on the right or the bottom of the screen if in Full View

a. Page View



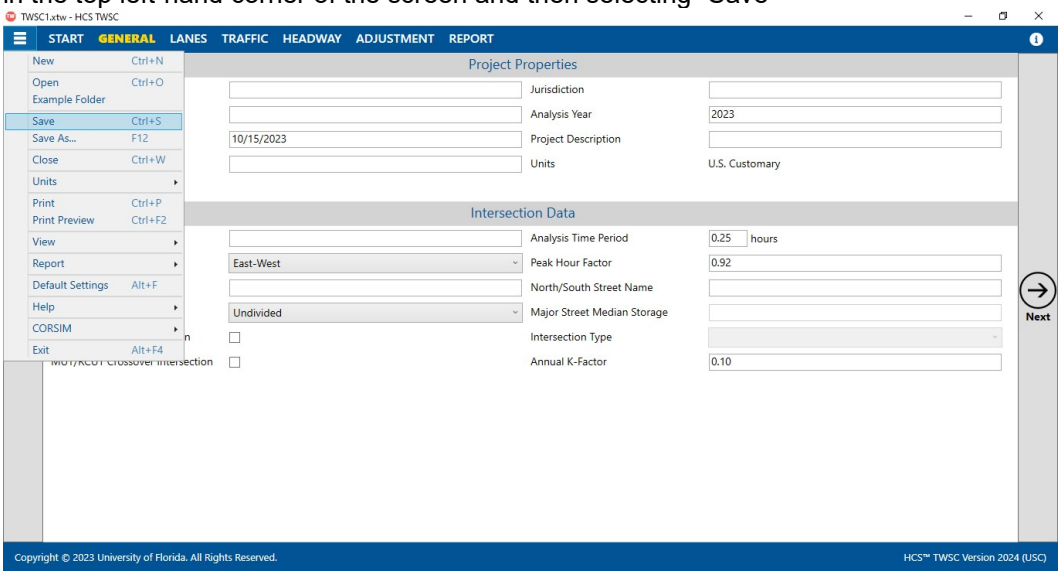

b. Full View



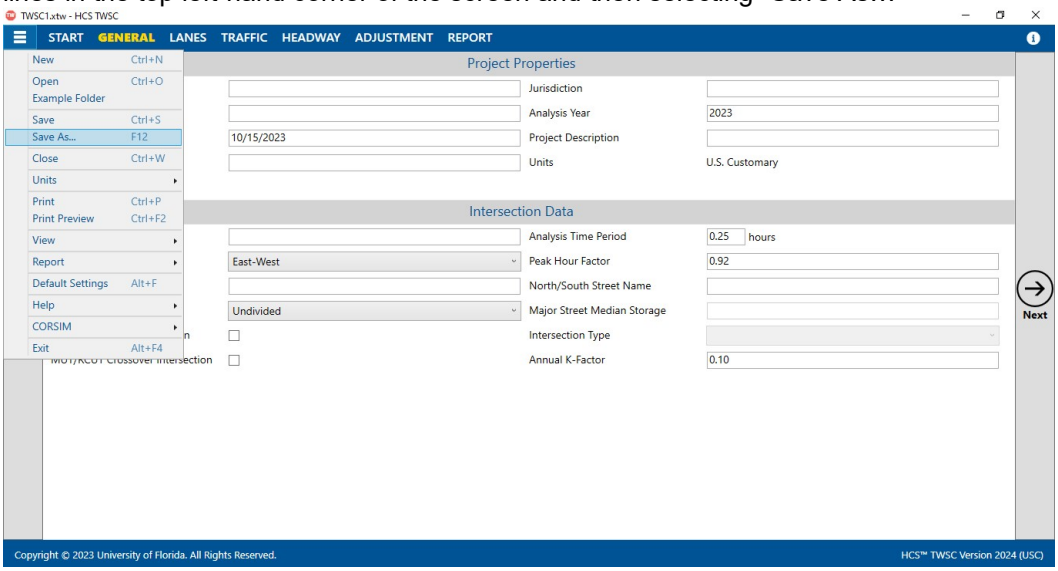
# Save a File

1. There are five options for saving an open file:

   a. Selecting *File* > *Save* from the main menu; this can be found by selecting the three lines in the top left-hand corner of the screen and then selecting “Save”



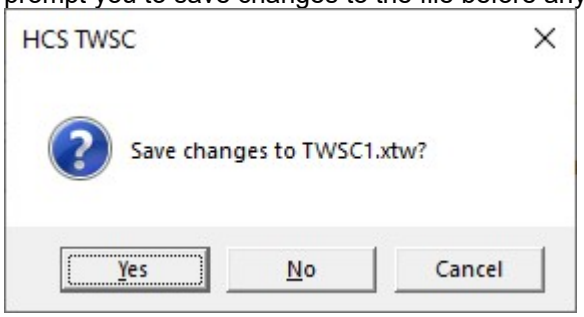

   b. Selecting *File* > *Save As…* from the main menu; this can be found by selecting the three lines in the top left-hand corner of the screen and then selecting “Save As…”




   c. Using the keyboard shortcut “Ctrl+S” for Save

   d. Using the keyboard shortcut “F12” for Save As

e. Exiting the program or closing the file without saving changes beforehand; this will prompt you to save changes to the file before anything is closed




i. Selecting “Yes” will save the file if it is an existing file. If the file has not been previously saved, the Save As dialog box will pop up allowing you to change the file name and save it.

ii. Selecting “No” will exit the program or close the file without saving the file

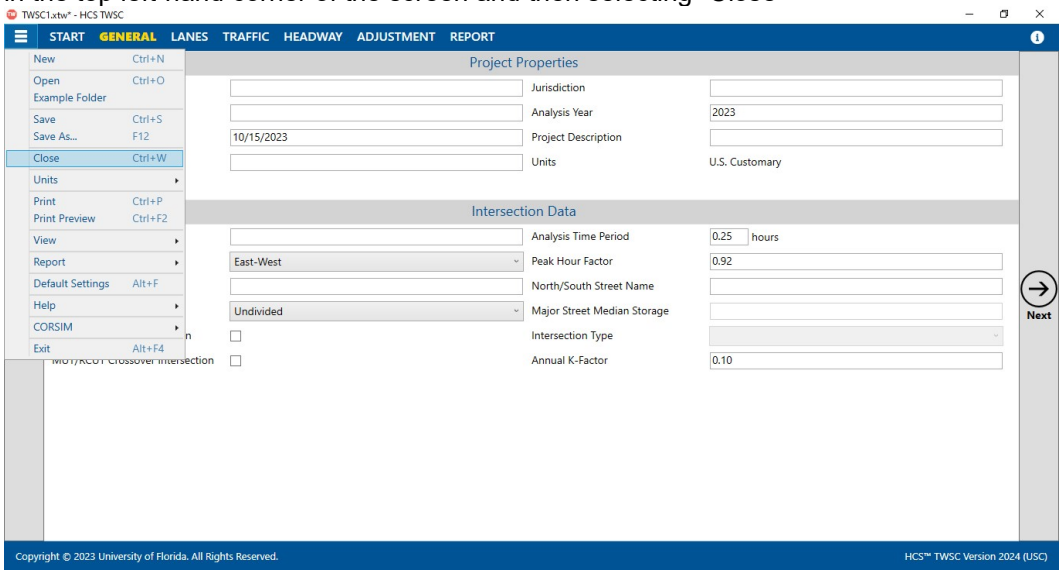
iii. Selecting “Cancel” will prevent the file from closing

*Note: Using Save with an existing file will save a file without prompting you to specify a file name. Using Save with a new file will bring up the Save As dialog box for you to specify a file name for saving. Using Save As will always bring up the Save As dialog box for you to specify a file name for saving.*

# Close a File

1. There are three options for closing an open file:

a. Selecting *File* > *Close* from the main menu; this can be found by selecting the three lines in the top left-hand corner of the screen and then selecting “Close”




b. Using the keyboard shortcut “Ctrl+W”

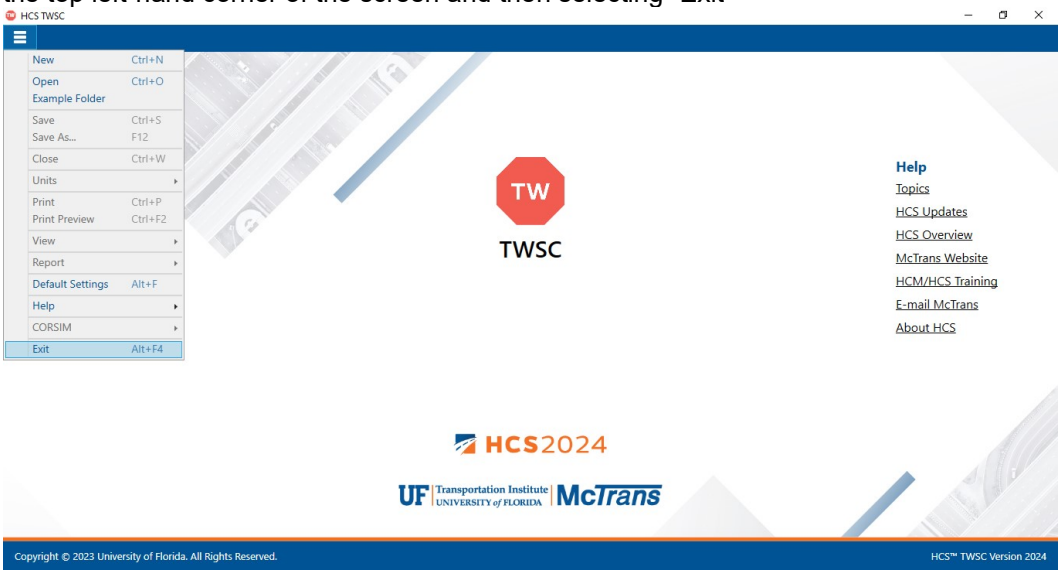
*c.* Exiting the program itself; please see *How To: Exit the Program*

# Exit the Program

1. From the Start screen, there are three options for exiting the program:

*Note: The program can be exited even if a file is still open; you do not need to start from the Start screen.*

   a. Selecting *File* > *Exit* from the main menu; this can be found by selecting the three lines in the top left-hand corner of the screen and then selecting “Exit”




   b. Using the keyboard shortcut “Alt+F4”

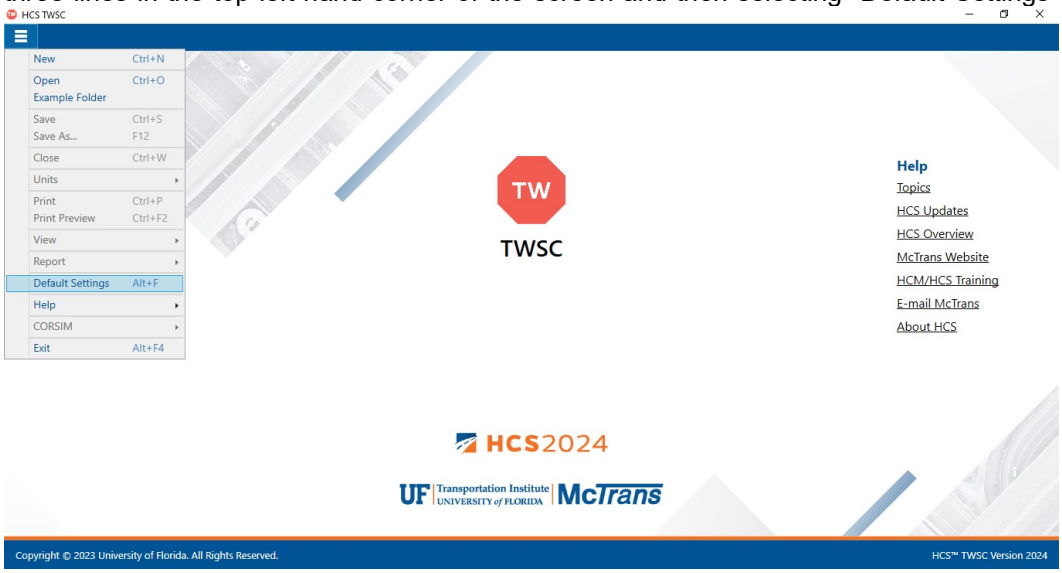
c. Selecting “X” in the top right-hand corner of the screen; this can be found below in the red box

# Edit the Default Settings

1. From the Start screen, there are two options for editing the Default Settings:

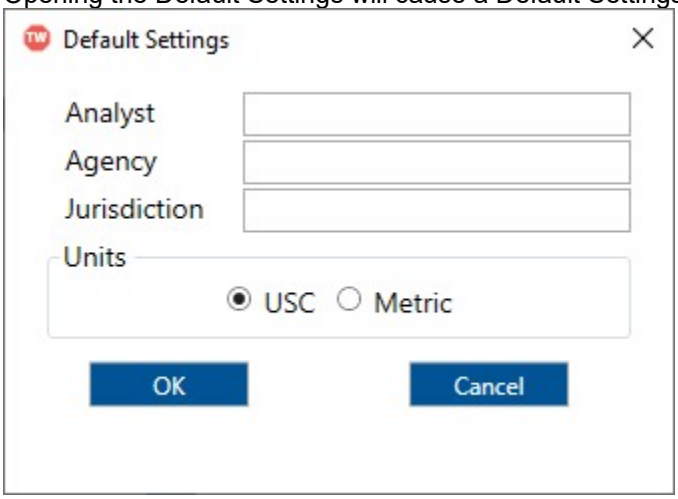
*Note: The Default Settings can be changed even if an existing file is already open; you do not need to start from the Start screen.*

a. Selecting *File* > *Default Settings* from the main menu; this can be found by selecting the three lines in the top left-hand corner of the screen and then selecting "Default Settings"




b. Using the keyboard shortcut "Alt+F"

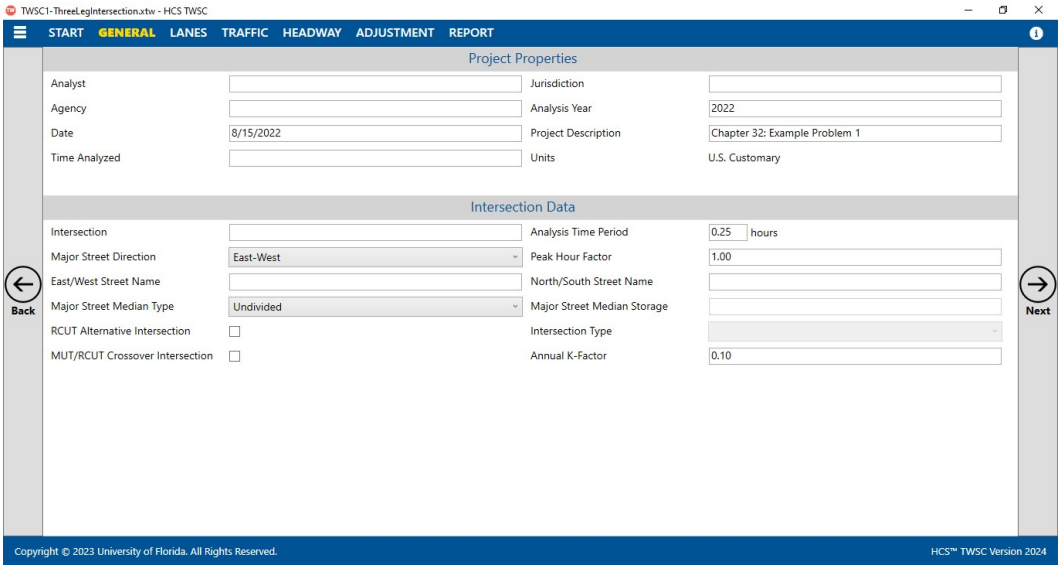
2. Opening the Default Settings will cause a Default Settings window to pop up:



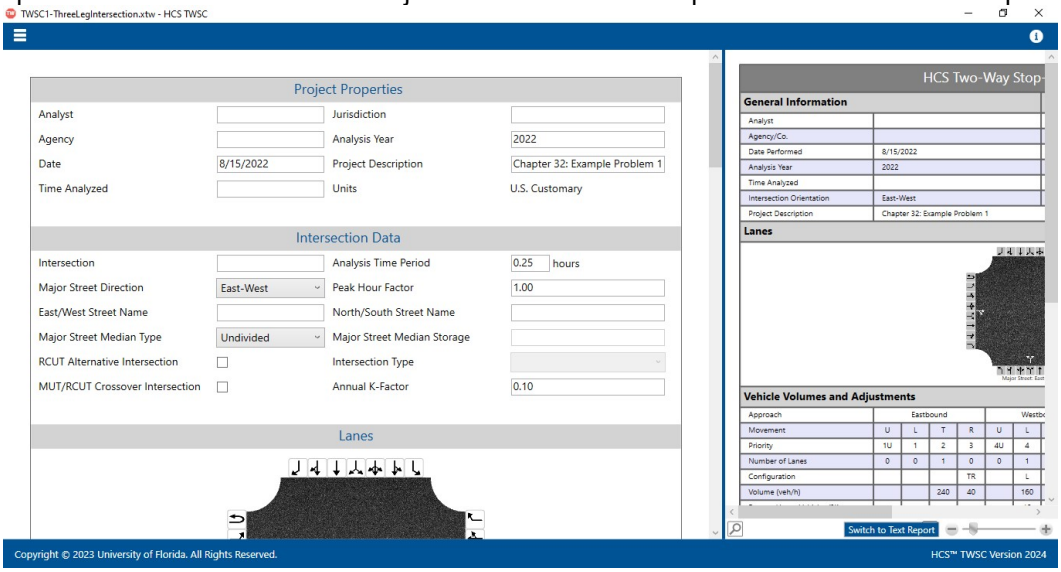

3. You can specify Analyst, Agency, and Jurisdiction by clicking in the corresponding text boxes and typing the desired text.
4. Under 'Units', you are given the option of running the analysis in either *U.S. Customary (USC)* or *SI (Metric)* units.
5. Clicking "OK" will save the changes made and close the Default Settings window; clicking "Cancel" will close the Default Settings window without saving any changes.
6. When a new file is created, the Analyst, Agency, and Jurisdiction fields will automatically be populated with the text specified in the Default Settings.
7. When starting a new file, the input and results will display according to the units specified in the Default Settings.

# Change the View

1. When a file is open, there are three main options for the view of the program:
    a. Page View: the inputs and results reports are separated into pages as seen below. You can navigate between pages using the “Back” and “Next” buttons or by clicking the page names found at the top of the screen.

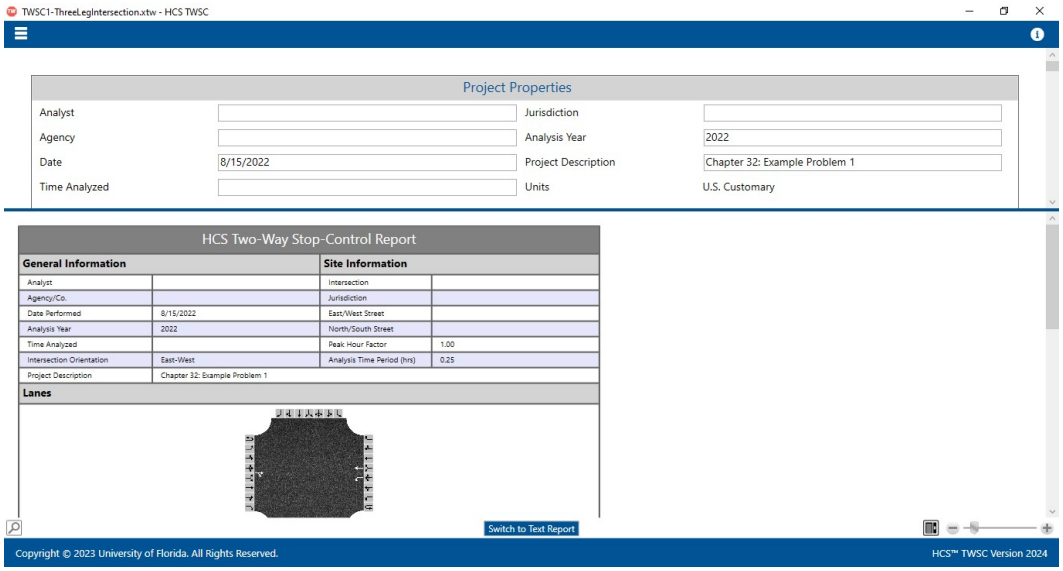



    b. Full View with the report on the right of the screen: the screen is split with all inputs on the left side and the results reports on the right side. You can access all inputs and view all of the current report by using the corresponding scroll bars. There is also a screen splitter that can be moved to adjust the views of the input screen and results report.

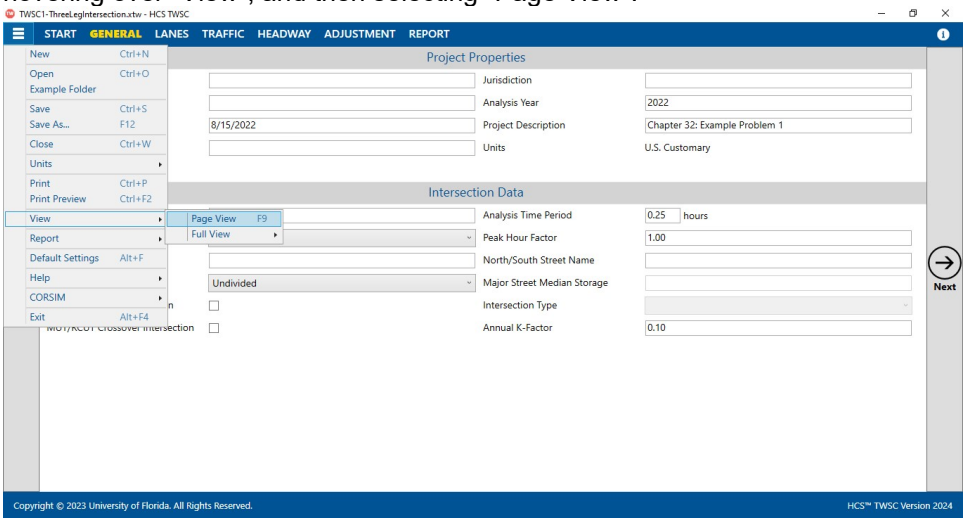



    c. Full View with the report on the bottom of the screen: the screen is split with all inputs on the top of the screen and the results reports on the bottom of the screen. You can access all inputs and view all of the current report by using the corresponding scroll bars. There

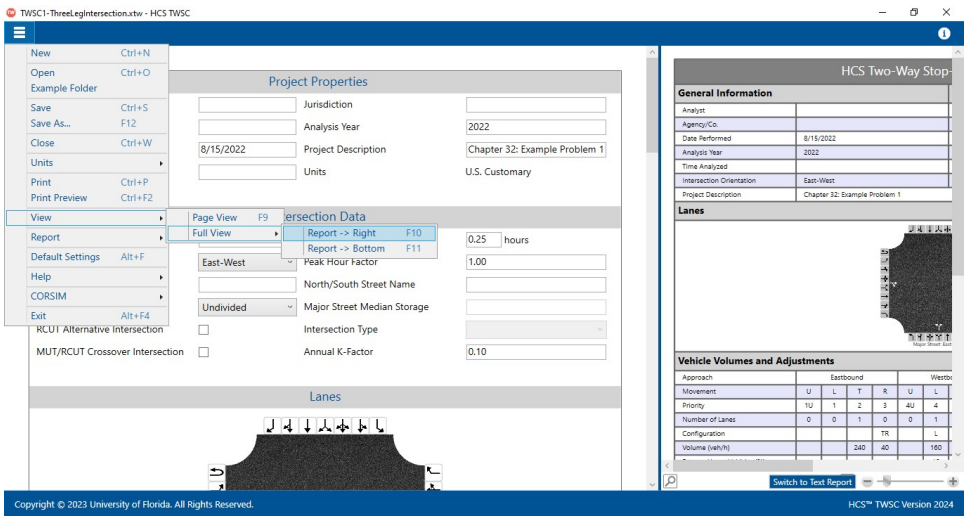
is also a screen splitter that can be moved to adjust the view of the input screen and results report.



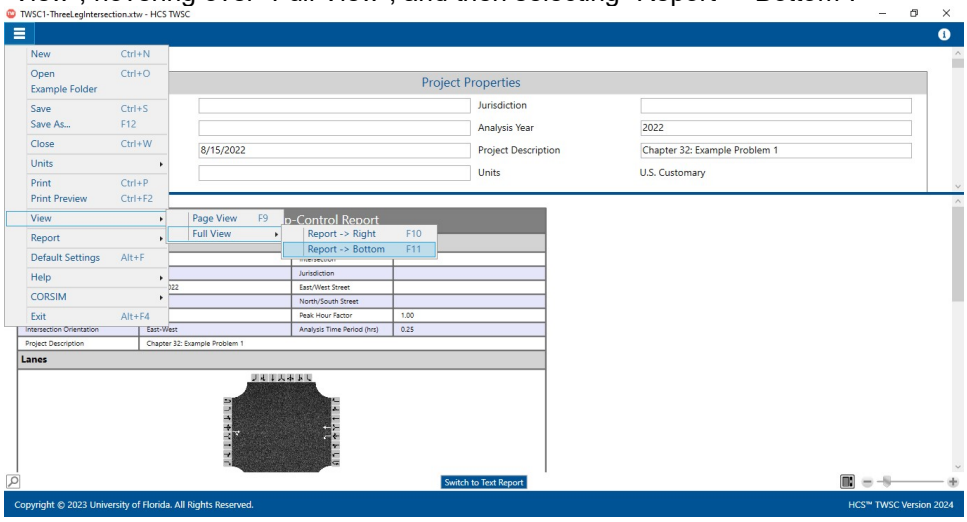

2. Views can be changed by using the main menu items or the keyboard shortcuts.
    a. Main Menu Items
        i. To switch to Page View, select *File* > *View* > *Page View* from the main menu; this can be found by selecting the three lines in the top left-hand corner of the screen, hovering over “View”, and then selecting “Page View”.




        ii. To switch to Full View with the report on the right of the screen, select *File* > *View* > *Full View* > *Report -> Right* from the main menu; this can be found by selecting the three lines in the top left-hand corner of the screen, hovering over “View”, hovering over “Full View”, and then selecting “Report -> Right”.




iii. To switch to Full View with the report on the bottom of the screen, select *File* > *View* > *Full View* > *Report -> Bottom* from the main menu; this can be found by selecting the three lines in the top left-hand corner of the screen, hovering over "View", hovering over "Full View", and then selecting "Report -> Bottom".




b. Keyboard Shortcuts

i. Page View: keyboard shortcut is "F9"

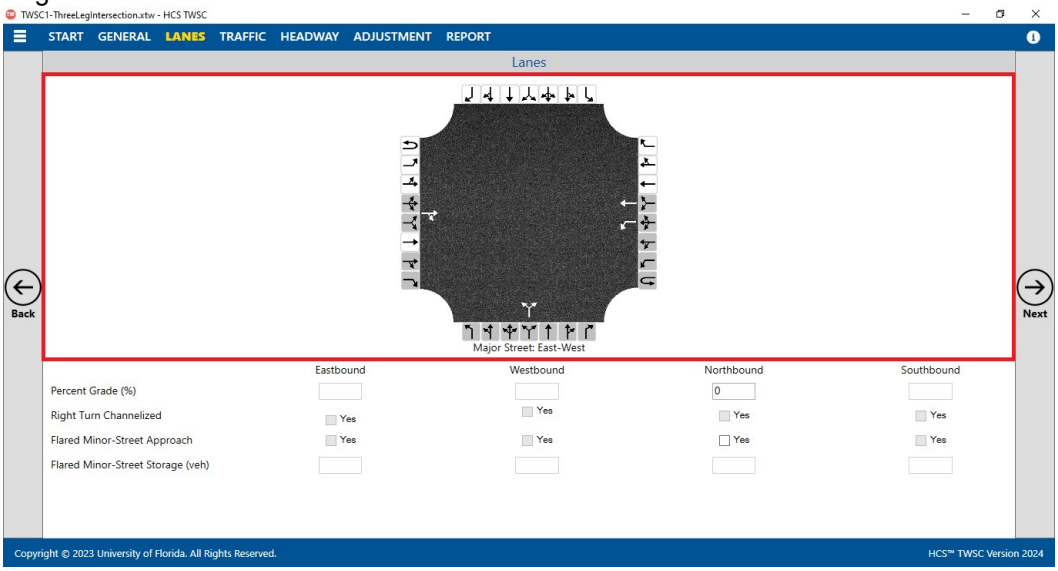
ii. Full View with report on the right of the screen: keyboard shortcut is "F10"

iii. Full View with report on the bottom of the screen: keyboard shortcut is "F11"

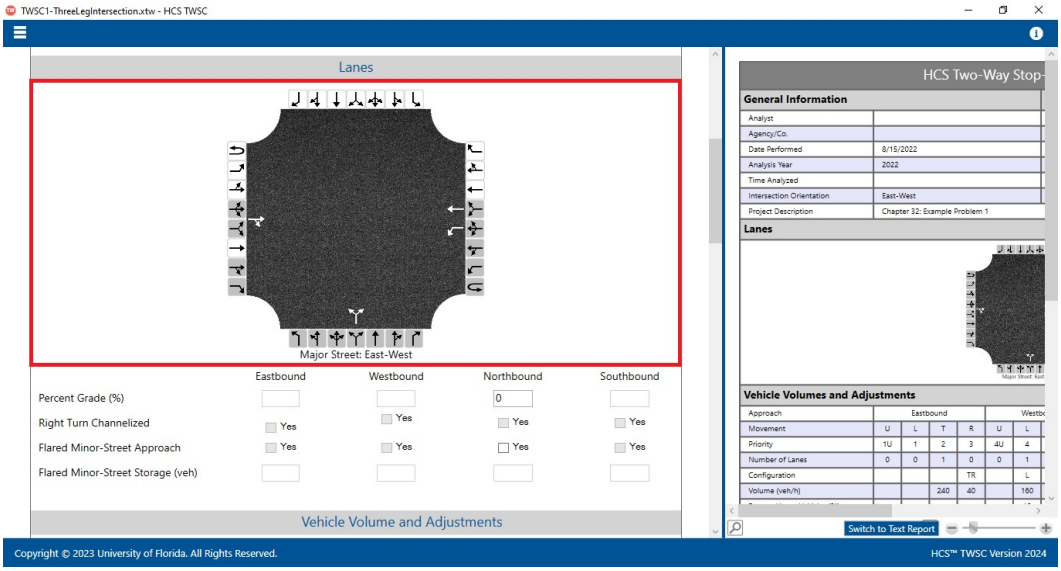
# Change the Lane Configuration

1. When a new file is created or an existing file is opened, the lane configuration can be changed under the Lanes section. This can be found on the Lanes page if using Page View or the input portion of the split screen if using Full View.

a. Page View

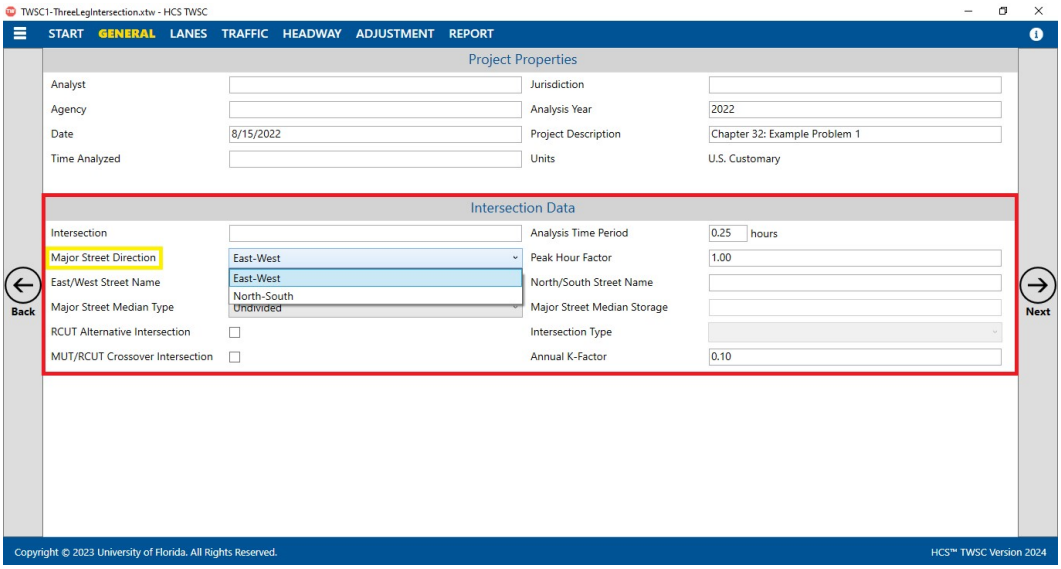



b. Full View




2. To add lanes, click on the lane buttons (black arrows) on the edges of the lanes graphic. If the background of a lane button is white, the lane is available to add to the corresponding approach. If the background of a lane button is gray, it is disabled and cannot be added to the corresponding approach based on the current lane configuration.

    a. The ‘Major Street Direction’ must be specified to determine which lanes can be added for each of the approaches. This can be found under the ‘Intersection Data’ section on the General page if using Page View or the input portion of the split screen if using Full View.




i. The default is ‘East-West’.

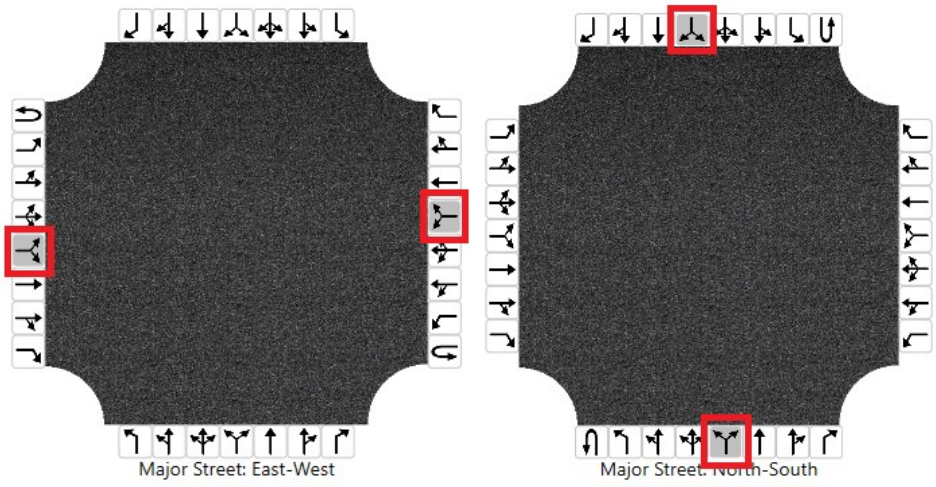
ii. Choices include: East-West, North-South

1. East-West indicates the major street approaches are eastbound (EB) and westbound (WB); the minor street approaches are northbound (NB) and southbound (SB)

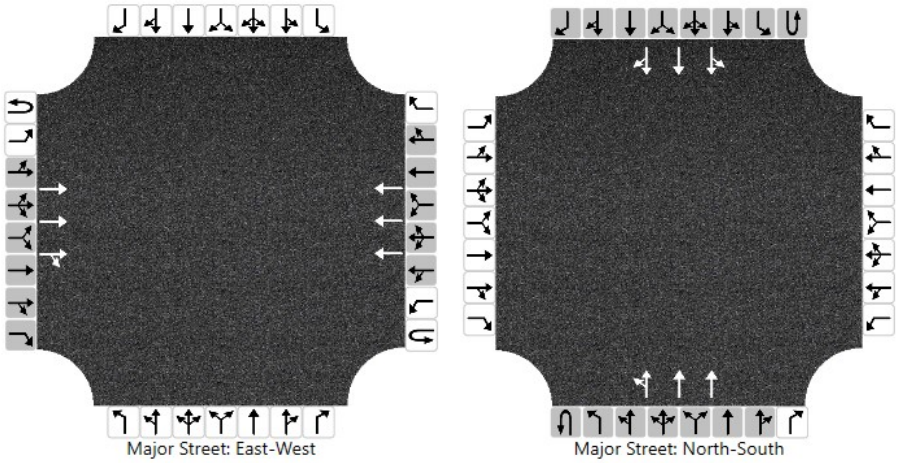
2. North-South indicates the major street approaches are northbound (NB) and southbound (SB); the minor street approaches are westbound (WB) and eastbound (EB)

b. Major Street Approaches

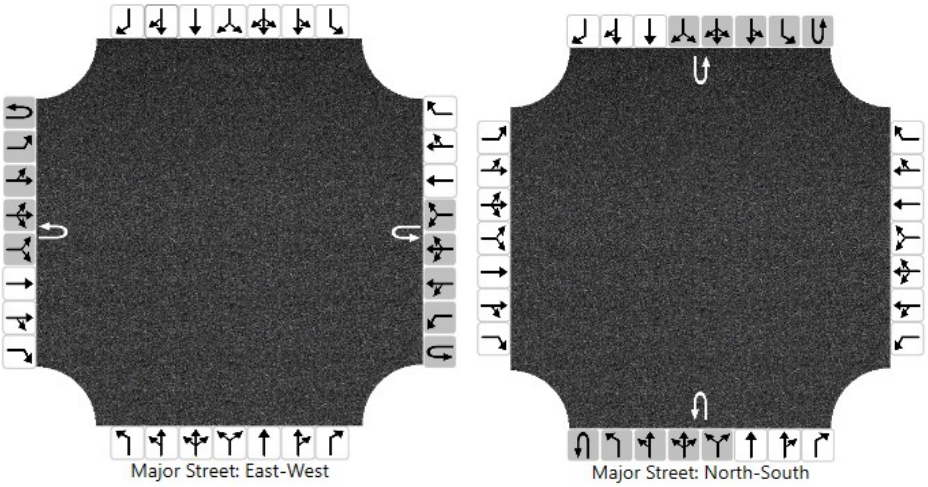
i. Major Street approaches do not allow shared left-right (LR) lanes; this lane is always disabled



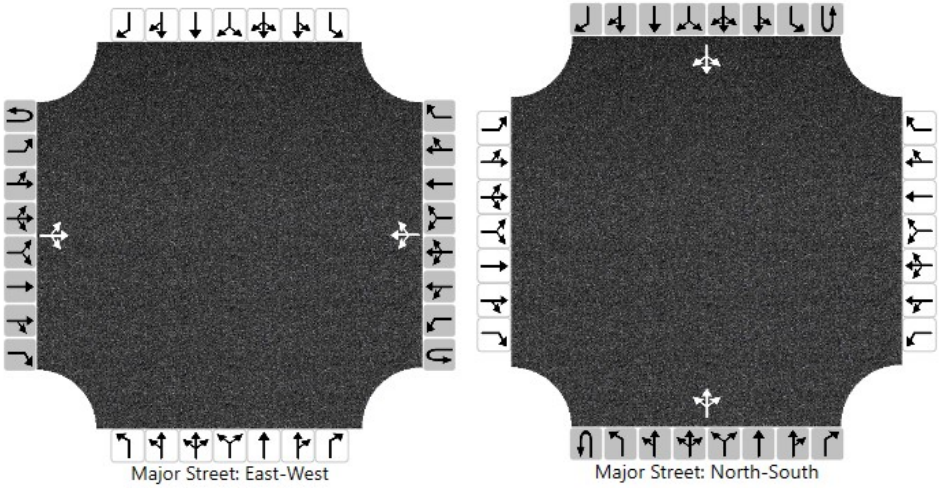
ii. Each approach allows up to three thru (either exclusive or shared) lanes to be added



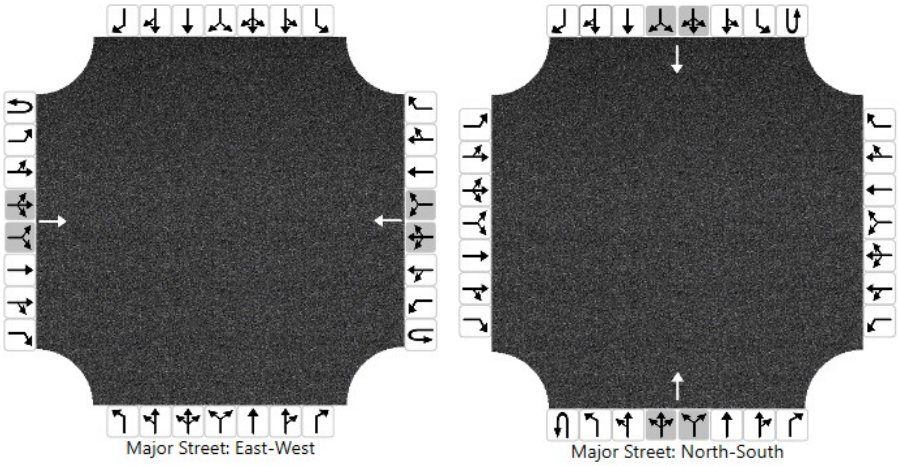

iii. Adding a U-turn (U) lane will disable the U-turn (U), exclusive left-turn (L), shared left-thru (LT), and shared left-thru-right (LTR) lanes; the shared left-right (LR) lane should already be disabled



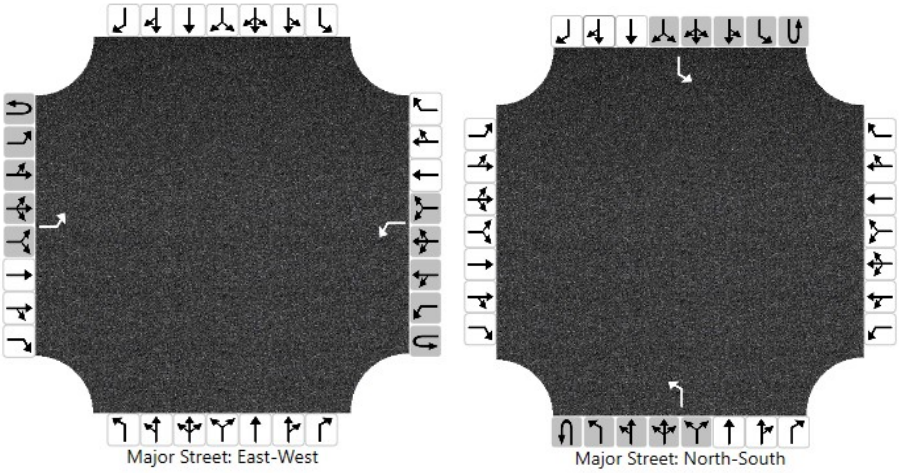

iv. Adding a shared left-thru-right (LTR) lane will disable all lanes



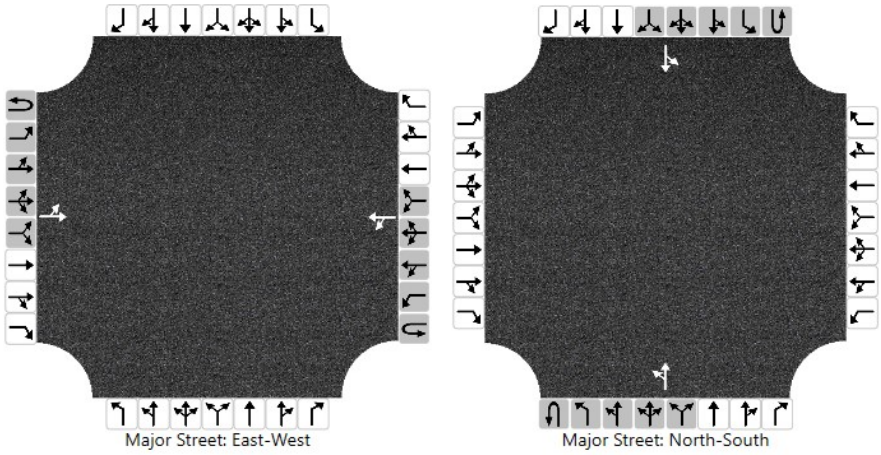
v. Adding an exclusive thru (T) lane will disable the shared left-thru-right (LTR) lane; the shared left-right (LR) lane should already be disabled



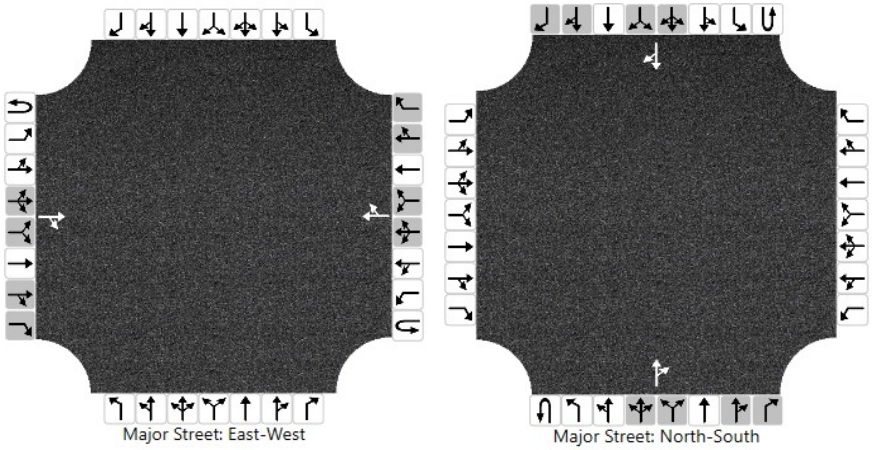

vi. Adding an exclusive left-turn (L) lane will disable the U-turn (U), exclusive left-turn (L), shared left-thru (LT), and shared left-thru-right (LTR) lanes; the shared left-right (LR) lane should already be disabled



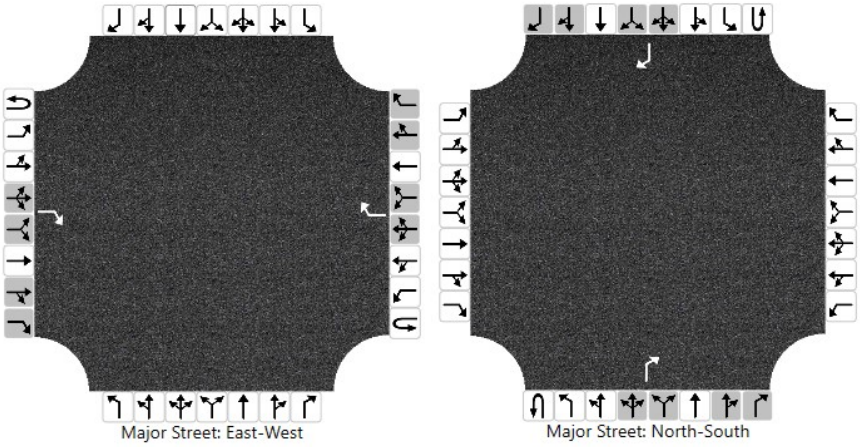

vii. Adding a shared left-thru (LT) lane will disable the U-turn (U), exclusive left-turn (L), shared left-thru (LT), and shared left-thru-right (LTR) lanes; the shared left-right (LR) lane should already be disabled



viii. Adding a shared thru-right (TR) lane will disable the shared left-thru-right (LTR), shared thru-right (TR), and exclusive right-turn (R) lanes; the shared left-right (LR) lane should already be disabled

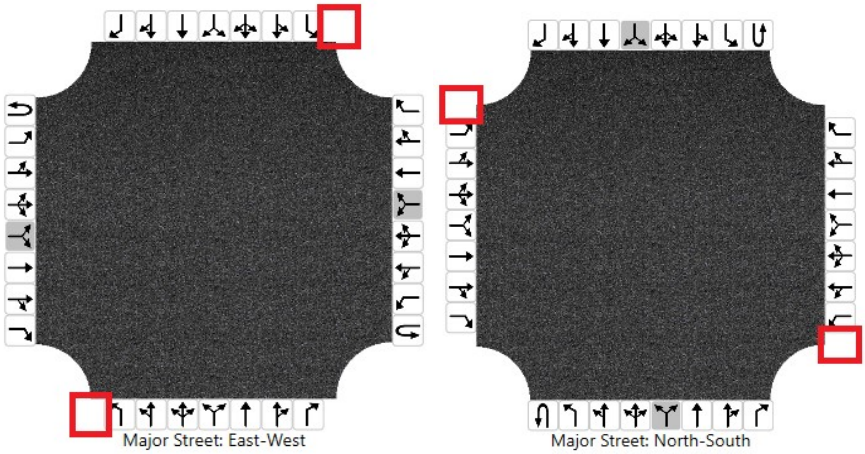



ix. Adding an exclusive right-turn (R) lane will disable the shared left-thru-right (LTR), shared thru-right (TR), and exclusive right-turn (R) lanes; the shared left-right (LR) lane should already be disabled

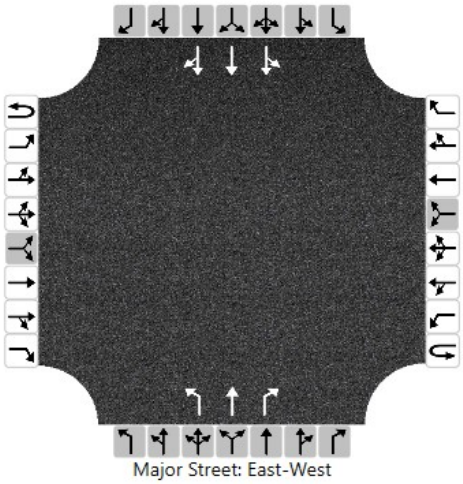


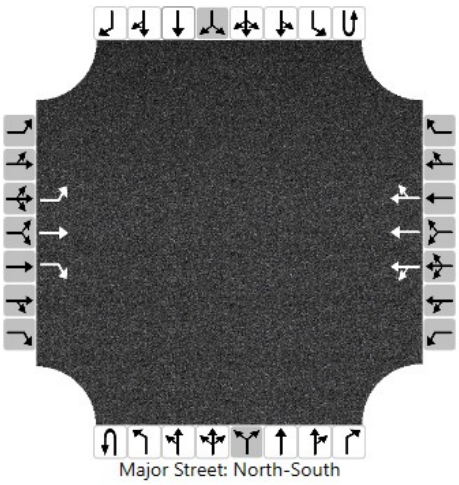

c. Minor Street Approaches

i. Minor Street approaches do not allow U-turn (U) lanes; there is no U-turn button available

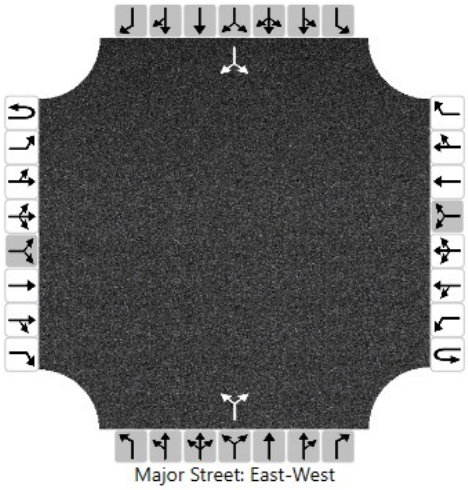


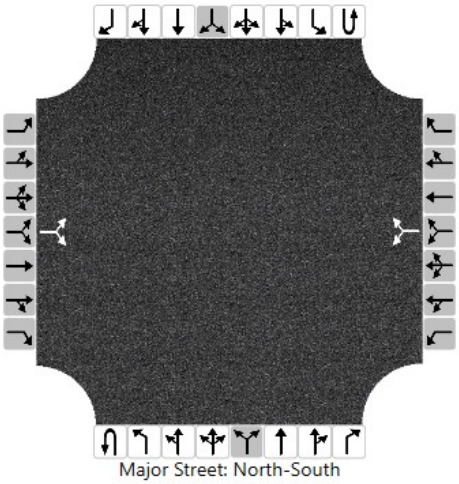
ii. Each approach allows up to three lanes (with no more than one exclusive lane for each movement on the minor-street approach)



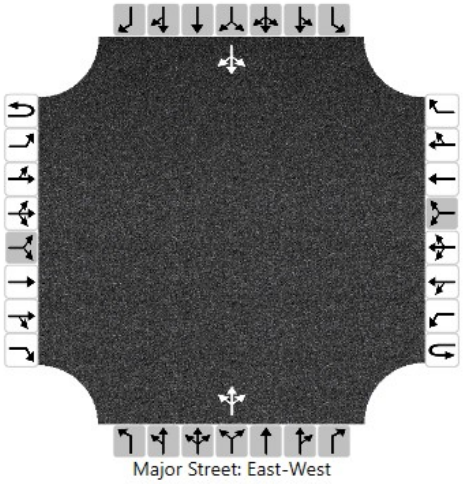



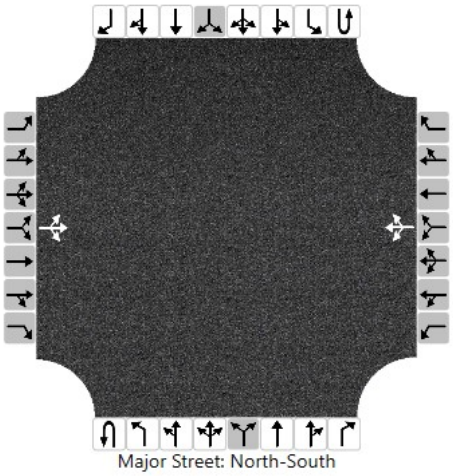

iii. Adding a shared left-right (LR) lane will disable all lanes



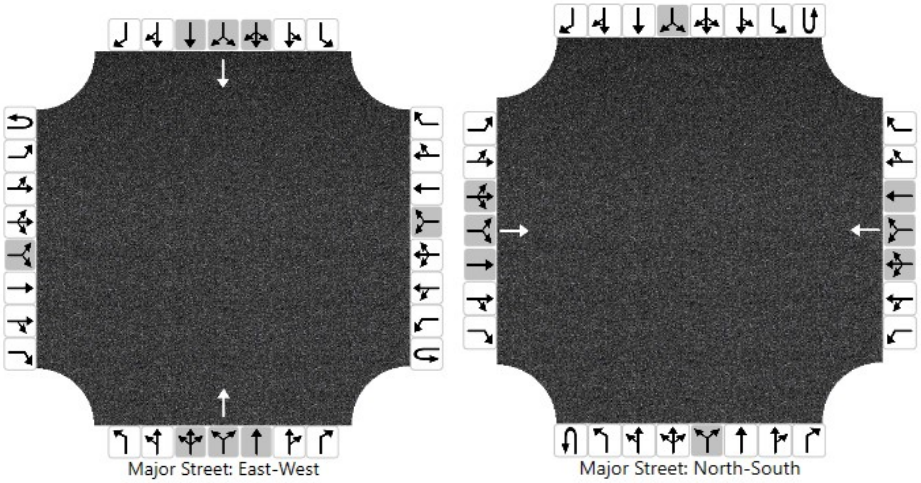




iv. Adding a shared left-thru-right (LTR) lane will disable all lanes

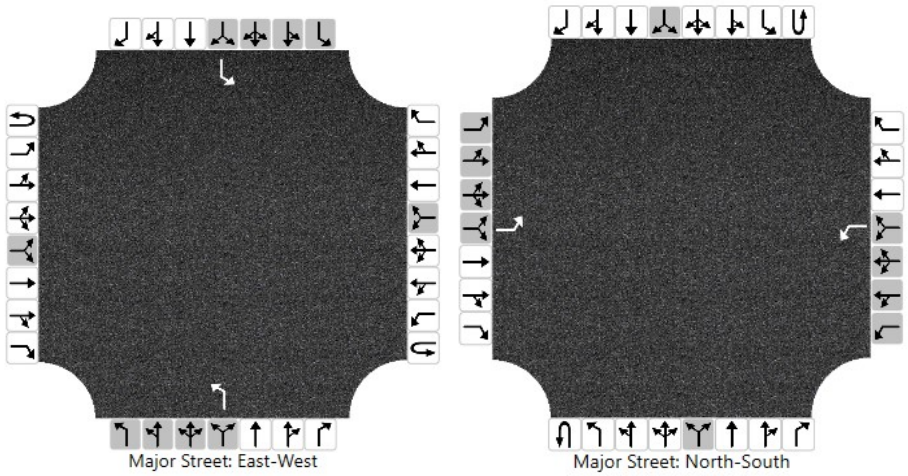


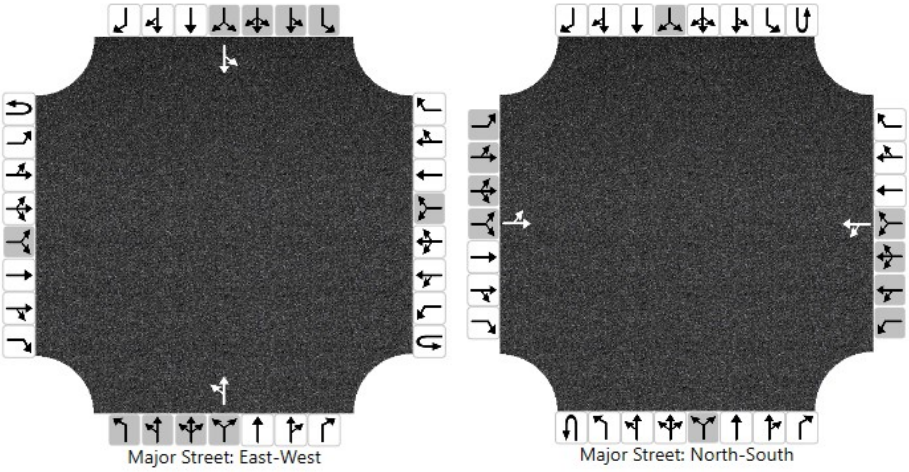
v. Adding an exclusive thru (T) lane will disable the shared left-thru-right (LTR), shared left-right (LR), and exclusive thru (T) lanes



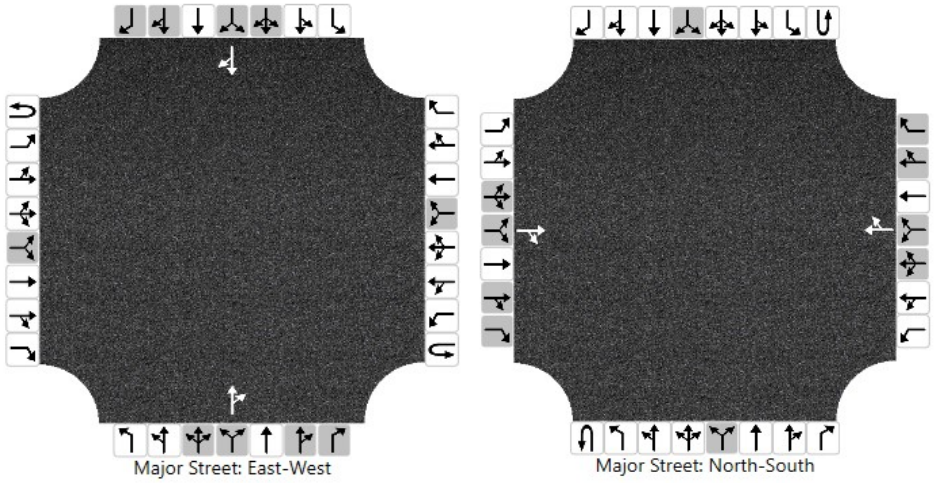

vi. Adding an exclusive left-turn (L) lane will disable the exclusive left-turn (L), shared left-thru (LT), shared left-thru-right (LTR), and shared left-right (LR) lanes



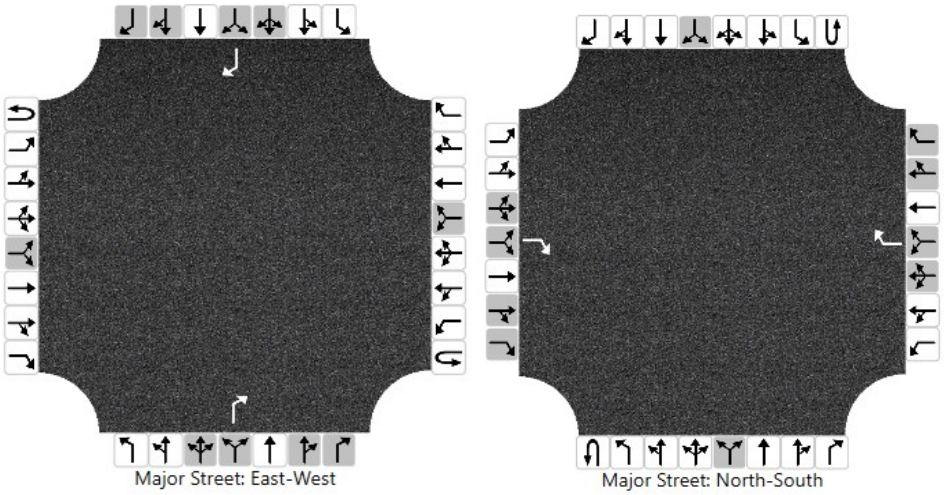

vii. Adding a shared left-thru (LT) lane will disable the exclusive left-turn (L), shared left-thru (LT), shared left-thru-right (LTR), and shared left-right (LR) lanes



viii. Adding a shared thru-right (TR) lane will disable the shared left-thru-right (LTR), shared left-right (LR), shared thru-right (TR), and exclusive right-turn (R) lanes



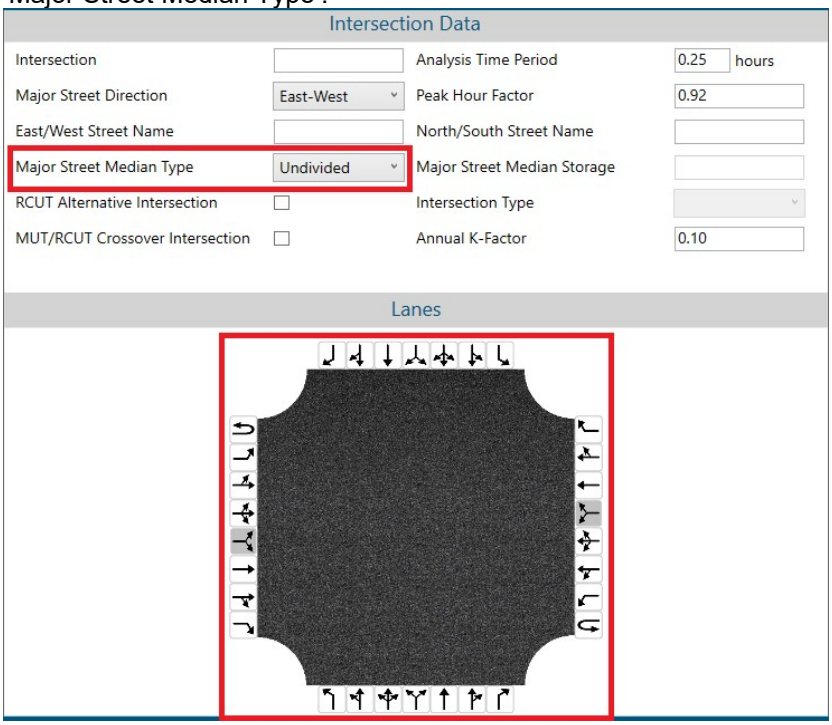

ix. Adding an exclusive right-turn (R) lane will disable the shared left-thru-right (LTR), shared left-right (LR), shared thru-right (TR), and exclusive right-turn (R) lanes




3. To remove lanes, click on the lanes within the center of the lanes graphic (white arrows). Clicking on an arrow will immediately remove the lane and change which lane buttons are enabled/disabled for the corresponding approach.
4. Changes to the lane configuration on the lanes graphic in the input screen will be reflected on the lanes graphic in the formatted report and the lane information in both the formatted and text reports.

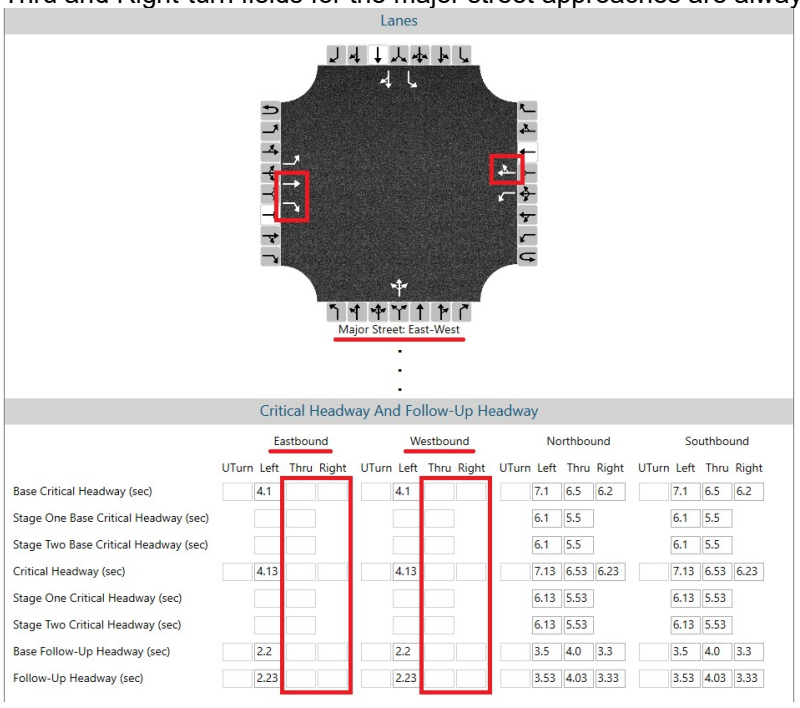
# Enable and Edit the Headway Fields

1. Enabling and editing of the different headway fields are dependent on the lane configuration and 'Major Street Median Type'.

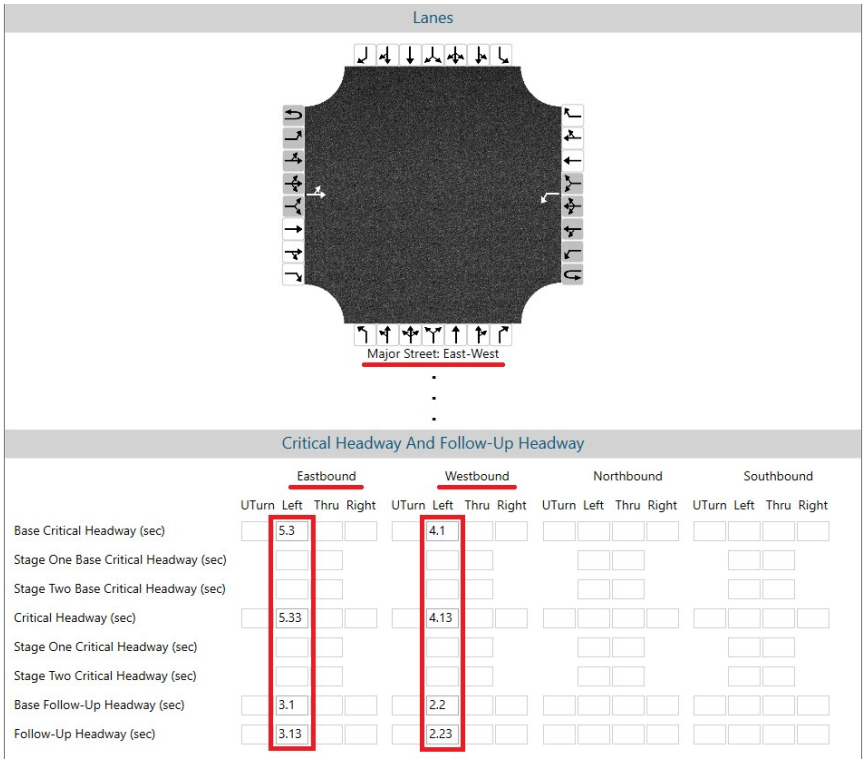



2. To enable headways for specific movements of an approach, the movement must exist by adding an appropriate lane to the lane configuration.

    a. Thru and Right-turn fields for the major street approaches are always disabled



b. Left-turn fields for a major street approach are enabled if either a shared or exclusive left-turn lane is coded

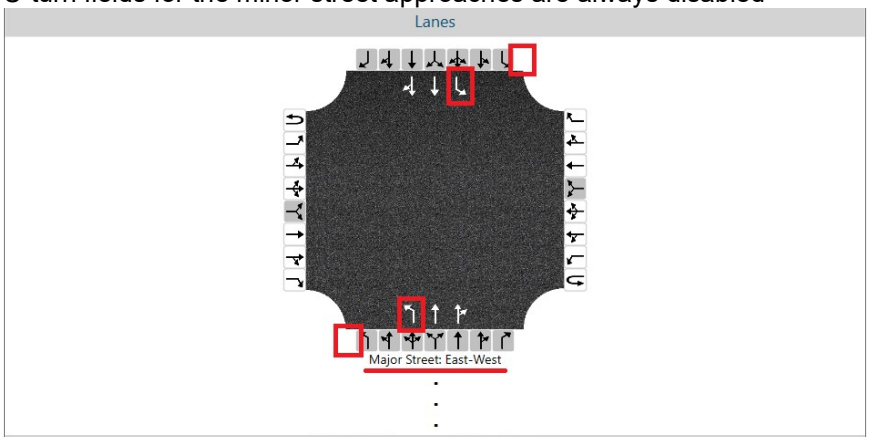


c. U-turn fields for a major street approach will enable if one of the following is true:

i. The corresponding U-turn lane is coded and at least two opposing thru lanes are coded

ii. An exclusive left-turn lane is coded in the subject approach, at least two thru lanes are coded in the opposing approach, and the volume for the corresponding U-turn is greater than 0

d. U-turn fields for the minor street approaches are always disabled



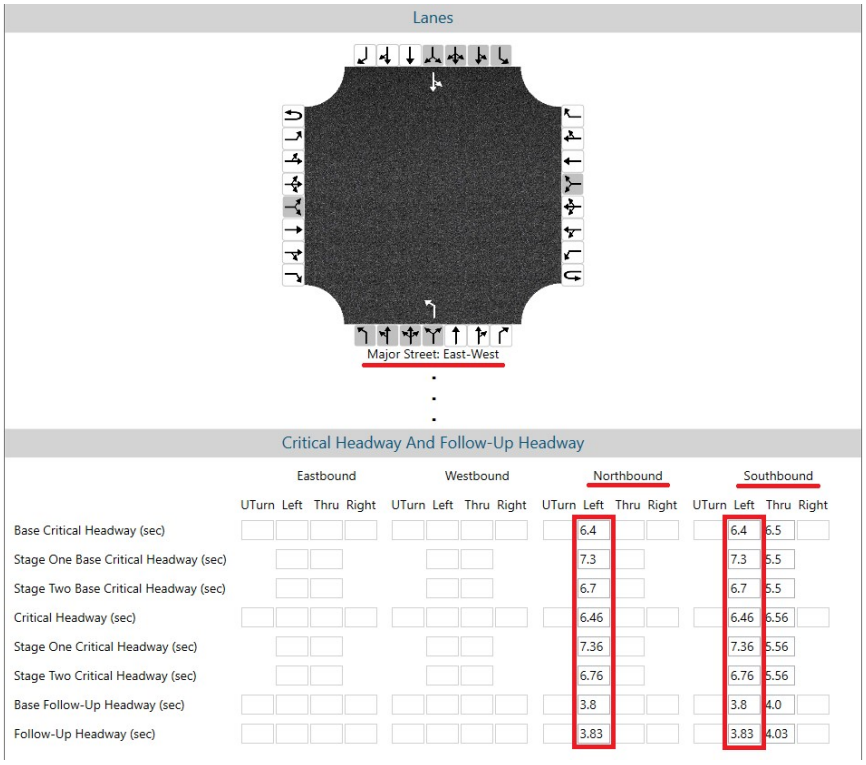

Vehicle Volume and Adjustments

| | Eastbound | | | | Westbound | | | | Northbound | | | | Southbound | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | UTurn | Left | Thru | Right | UTurn | Left | Thru | Right | UTurn | Left | Thru | Right | UTurn | Left | Thru | Right |
| Priority | 1U | 1 | 2 | 3 | 4U | 4 | 5 | 6 | | 7 | 8 | 9 | | 10 | 11 | 12 |
| Volume (vph) | | | | | | | | | | 0 | 0 | 0 | | 0 | 0 | 0 |
| Percent Heavy Vehicles (%) | | | | | | | | | | 3 | 3 | 3 | | 3 | 3 | 3 |
| Short Left-Turn Pocket | | Yes | | | | Yes | | | | Yes | | | | Yes | | |
| Left-Turn Storage | | | | | | | | | | | | | | | | |
| Saturation Flow Rate (vph) | | | | | | | | | | | | | | | | |
| Percent Thrus Using Shared Lane (%) | | | | | | | | | | | 50 | | | | 50 | |

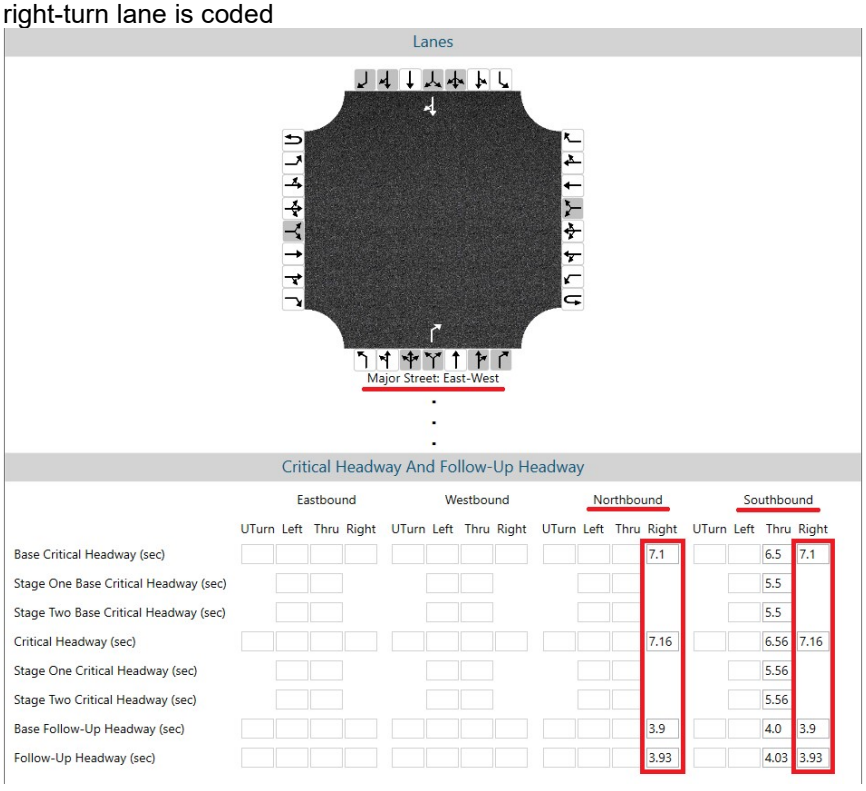
Critical Headway And Follow-Up Headway

| | Eastbound | | | | Westbound | | | | Northbound | | | | Southbound | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | UTurn | Left | Thru | Right | UTurn | Left | Thru | Right | UTurn | Left | Thru | Right | UTurn | Left | Thru | Right |
| Base Critical Headway (sec) | | | | | | | | | | 6.4 | 6.5 | 7.1 | | 6.4 | 6.5 | 7.1 |
| Stage One Base Critical Headway (sec) | | | | | | | | | | 7.3 | 5.5 | | | 7.3 | 5.5 | |
| Stage Two Base Critical Headway (sec) | | | | | | | | | | 6.7 | 5.5 | | | 6.7 | 5.5 | |
| Critical Headway (sec) | | | | | | | | | | 6.46 | 6.56 | 7.16 | | 6.46 | 6.56 | 7.16 |
| Stage One Critical Headway (sec) | | | | | | | | | | 7.36 | 5.56 | | | 7.36 | 5.56 | |
| Stage Two Critical Headway (sec) | | | | | | | | | | 6.76 | 5.56 | | | 6.76 | 5.56 | |
| Base Follow-Up Headway (sec) | | | | | | | | | | 3.8 | 4.0 | 3.9 | | 3.8 | 4.0 | 3.9 |
| Follow-Up Headway (sec) | | | | | | | | | | 3.83 | 4.03 | 3.93 | | 3.83 | 4.03 | 3.93 |

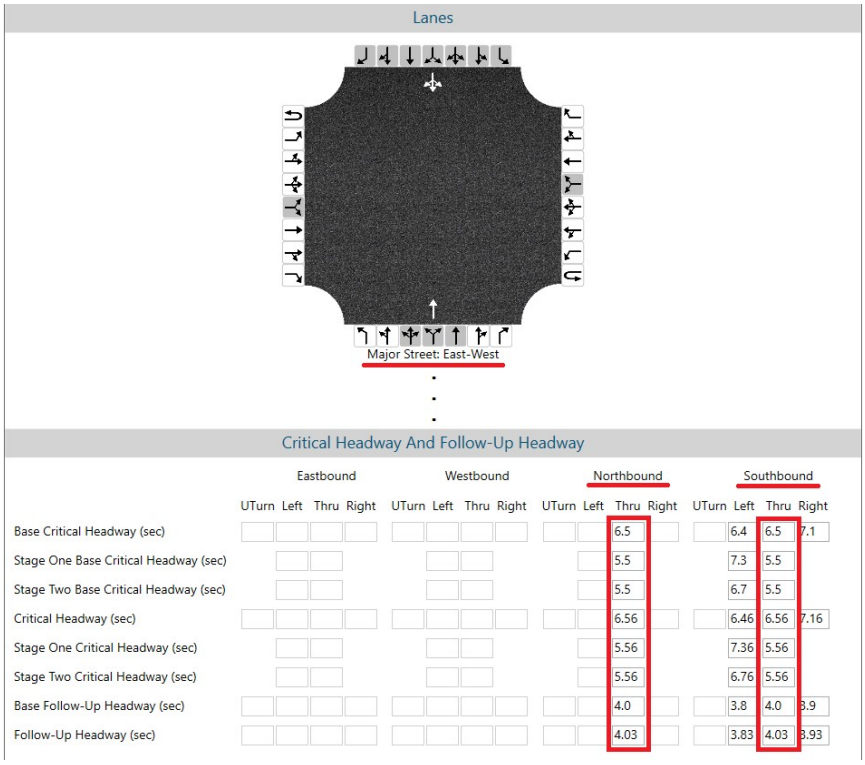
e. Left-turn fields for a minor street approach are enabled if either a shared or exclusive left-turn lane is coded



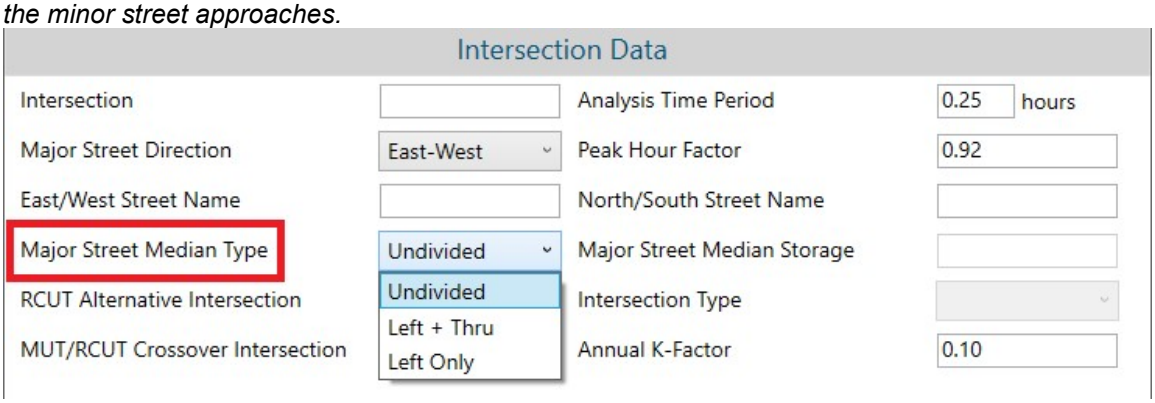

f. Right-turn fields for a minor street approach are enabled if either a shared or exclusive right-turn lane is coded



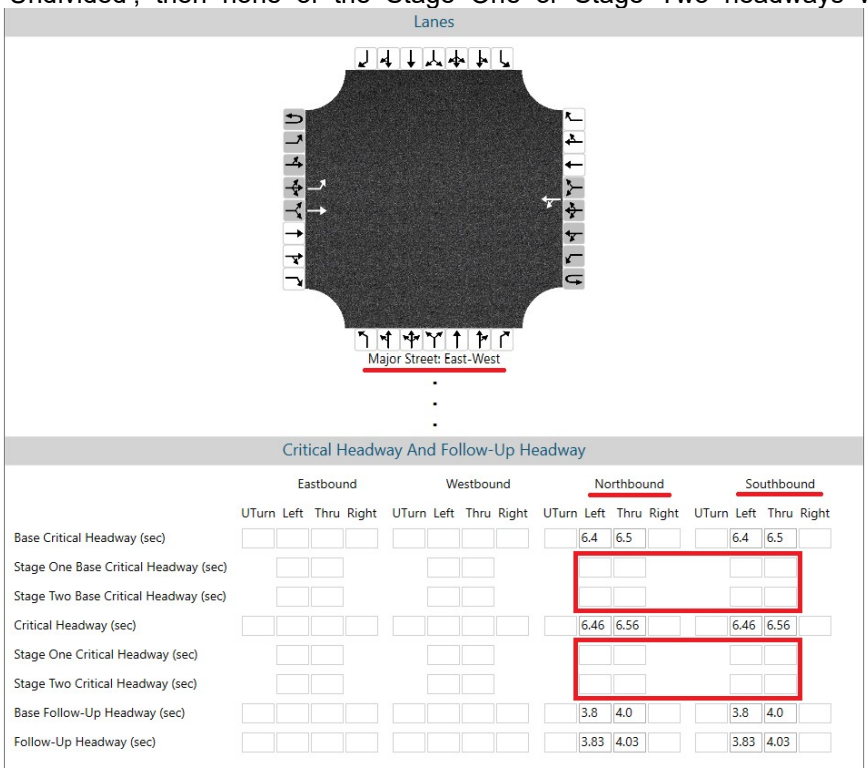
g. Thru fields for a minor street approach are enabled if either a shared or exclusive thru lane is coded



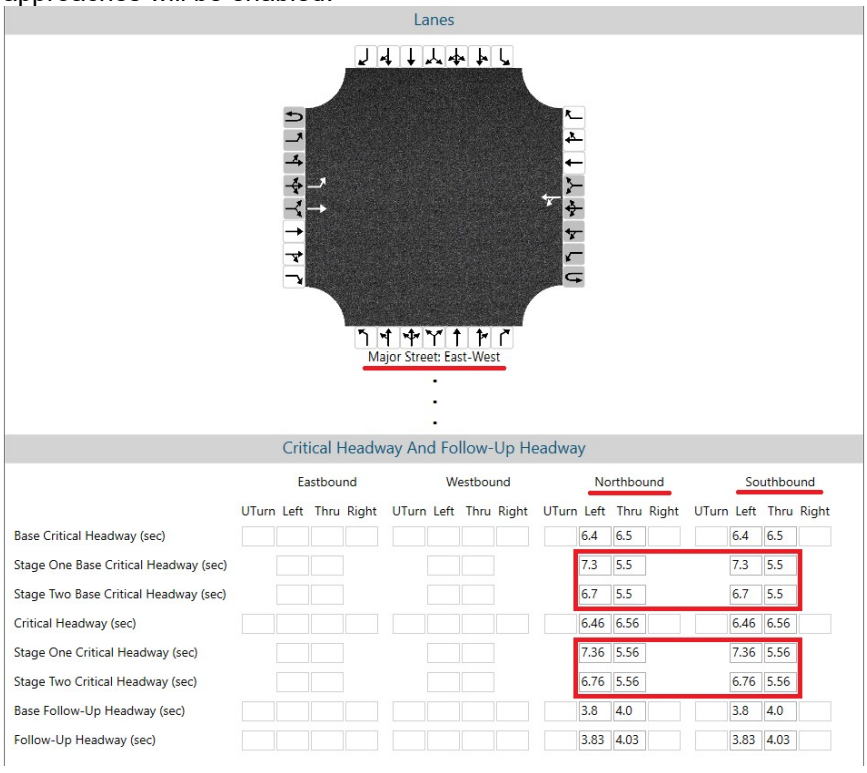

3. To enable Stage One and Stage Two headways, the Major Street Median Type must be specified. Choices include: *Undivided*, *Left + Thru*, and *Left Only*. The default selection is 'Undivided'. *Note: Stage One and Stage Two headways will only apply to left and thru fields from the minor street approaches.*



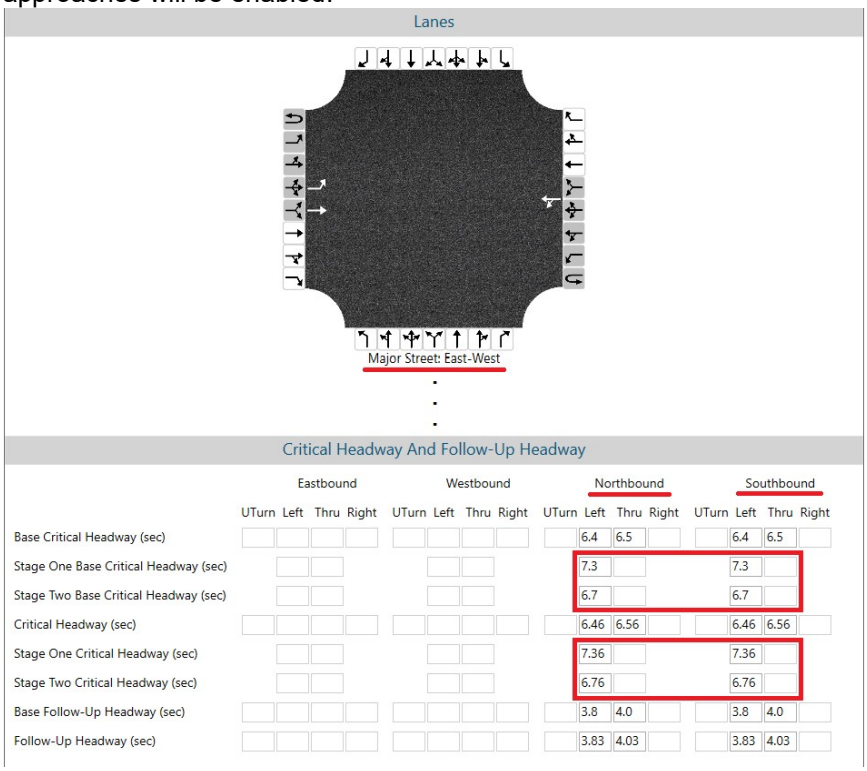
a. If the left and thru movements exist and the 'Major Street Median Type' selected is 'Undivided', then none of the Stage One or Stage Two headways will be enabled.




b. If the left and thru movements exist and the 'Major Street Median Type' selected is 'Left + Thru', then both the Left and Thru fields for Stage One and Stage Two of the minor street approaches will be enabled.



c. If the left and thru movements exist and the 'Major Street Median Type' selected is 'Left Only', then only the Left fields for Stage One and Stage Two of the minor street approaches will be enabled.



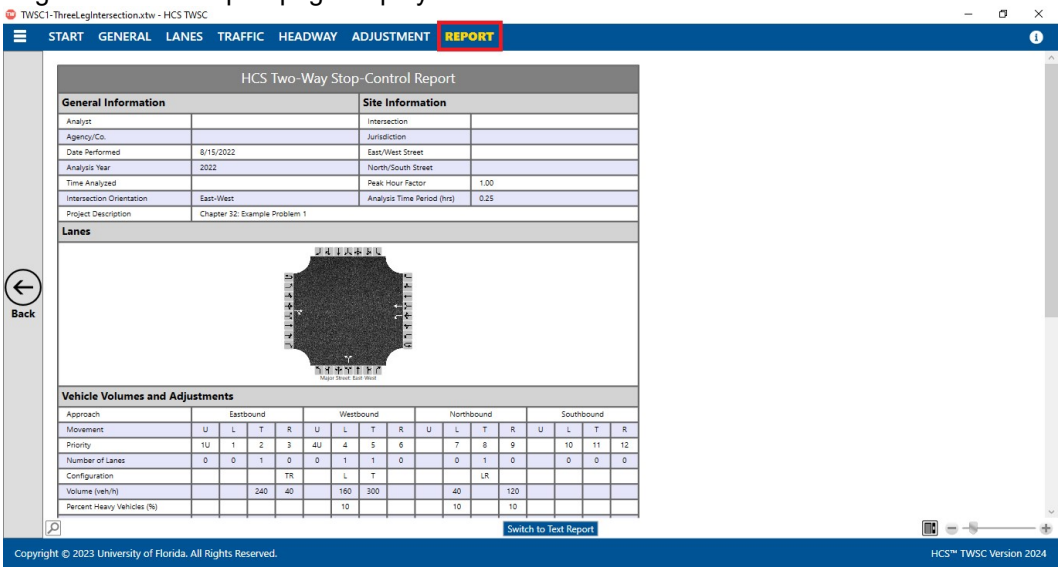

d. If a left movement does not exist, then the corresponding Stage One and Stage Two fields will be disabled regardless of the Major Street Median Type selected.

e. If a thru movement does not exist, then the corresponding Stage One and Stage Two fields will be disabled regardless of the Major Street Median Type selected.

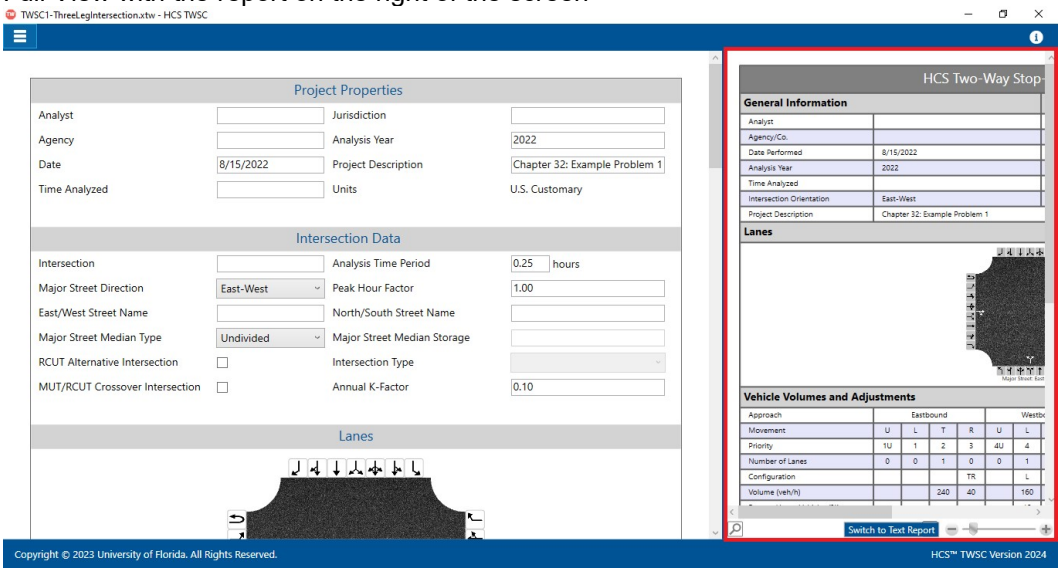
# View Results of the Analysis

1. After editing all the necessary inputs, results of the analysis can be found in the form of reports. Reports can be found on the Report page if using Page View or on the results portion of the split screen if using Full View.

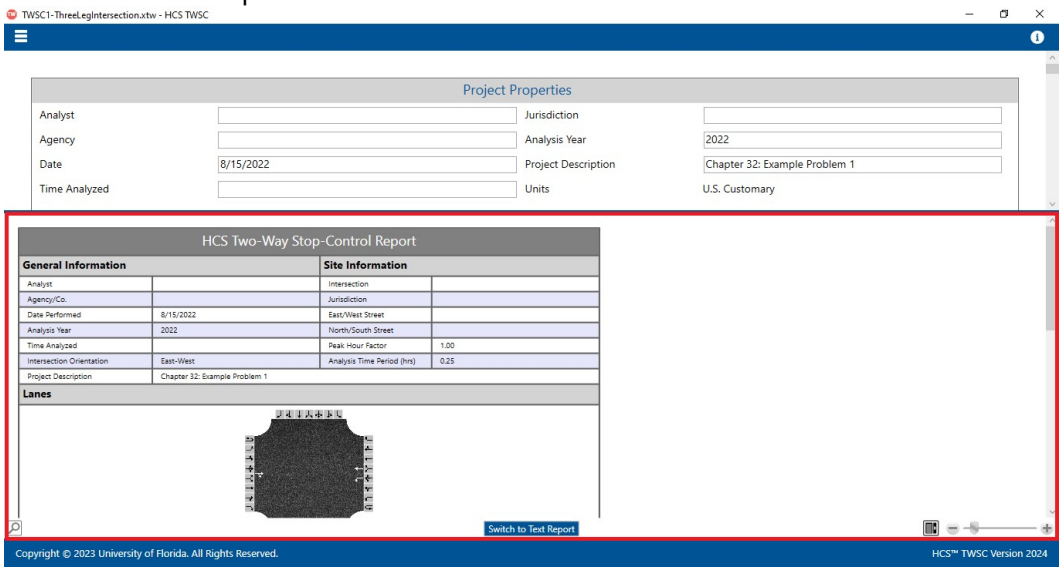
a. Page View with Report page displayed




b. Full View with the report on the right of the screen



c. Full View with the report on the bottom of the screen



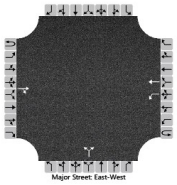

2. There are two options for reports: Formatted and Text

a. Formatted reports show the most important results in a presentable format

## HCS Two-Way Stop-Control Report

| General Information | | Site Information | |
|---|---|---|---|
| Analyst | | Intersection | |
| Agency/Co. | | Jurisdiction | |
| Date Performed | 8/15/2022 | East/West Street | |
| Analysis Year | 2022 | North/South Street | |
| Time Analyzed | | Peak Hour Factor | 1.00 |
| Intersection Orientation | East-West | Analysis Time Period (hrs) | 0.25 |
| Project Description | Chapter 32: Example Problem 1 | | |

**Lanes**




**Vehicle Volumes and Adjustments**

| Approach | Eastbound | | | | Westbound | | | | Northbound | | | | Southbound | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Movement | U | L | T | R | U | L | T | R | U | L | T | R | U | L | T | R |
| Priority | 1U | 1 | 2 | 3 | 4U | 4 | 5 | 6 | | 7 | 8 | 9 | | 10 | 11 | 12 |
| Number of Lanes | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | | 0 | 1 | 0 | | 0 | 0 | 0 |
| Configuration | | | | TR | | L | T | | | | LR | | | | | |
| Volume (veh/h) | | | 240 | 40 | | 160 | 300 | | | 40 | | 120 | | | | |
| Percent Heavy Vehicles (%) | | | | | | 10 | | | | 10 | | 10 | | | | |
| Proportion Time Blocked | | | | | | | | | | | | | | | | |
| Percent Grade (%) | | | | | | | | | | 0 | | | | | | |
| Right Turn Channelized | | | | | | | | | | | | | | | | |
| Median Type \| Storage | | | | Undivided | | | | | | | | | | | | |

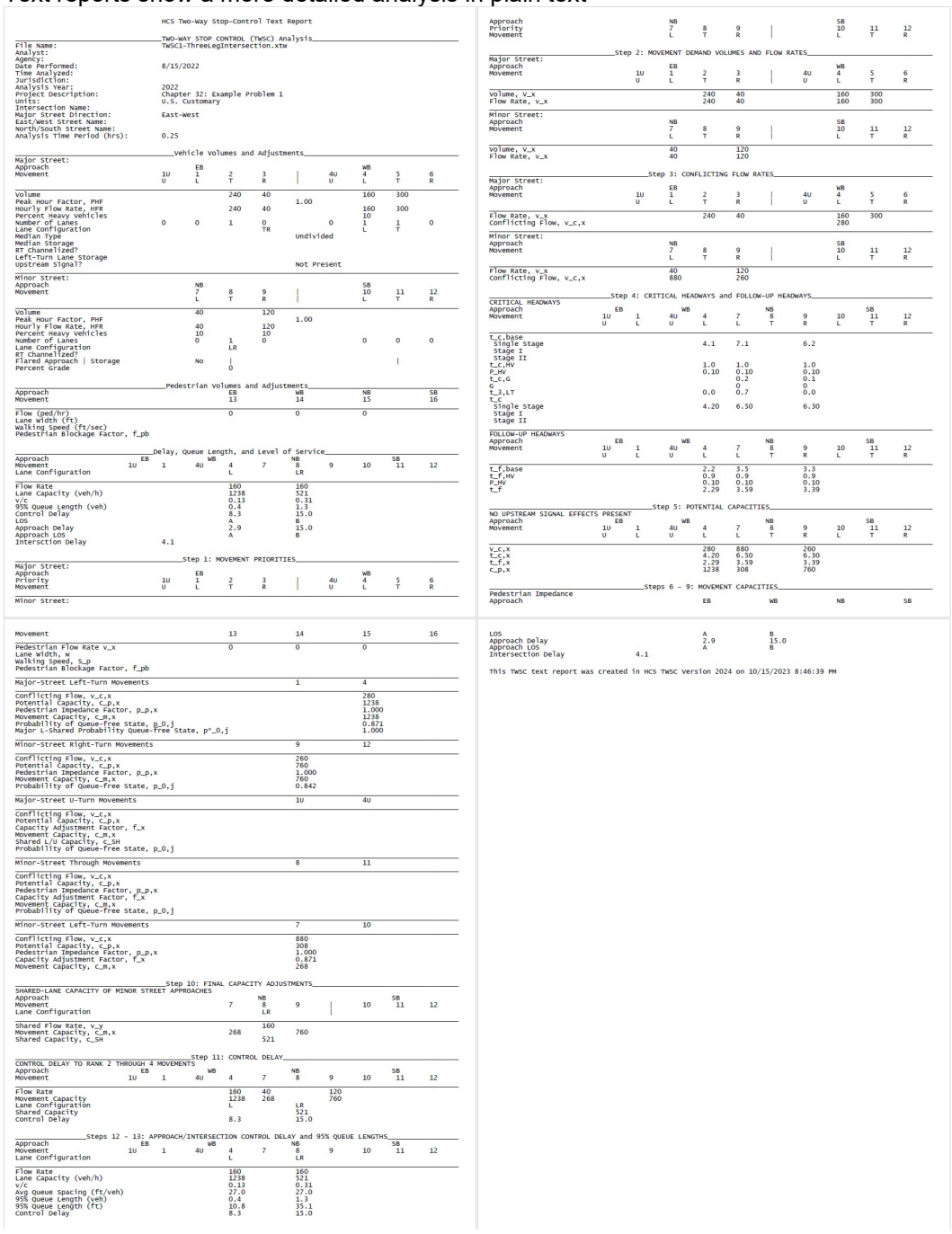
**Critical and Follow-up Headways**

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Base Critical Headway (sec) | | | | | | 4.1 | | | | 7.1 | | 6.2 | | | | |
| Critical Headway (sec) | | | | | | 4.20 | | | | 6.50 | | 6.30 | | | | |
| Base Follow-Up Headway (sec) | | | | | | 2.2 | | | | 3.5 | | 3.3 | | | | |
| Follow-Up Headway (sec) | | | | | | 2.29 | | | | 3.59 | | 3.39 | | | | |

**Delay, Queue Length, and Level of Service**

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Flow Rate, v (veh/h) | | | | | | 160 | | | | | 160 | | | | | |
| Capacity, c (veh/h) | | | | | | 1238 | | | | | 521 | | | | | |
| v/c Ratio | | | | | | 0.13 | | | | | 0.31 | | | | | |
| 95% Queue Length, $Q_{95}$ (veh) | | | | | | 0.4 | | | | | 1.3 | | | | | |
| 95% Queue Length, $Q_{95}$ (ft) | | | | | | 10.8 | | | | | 35.1 | | | | | |
| Control Delay (s/veh) | | | | | | 8.3 | | | | | 15.0 | | | | | |
| Level of Service (LOS) | | | | | | A | | | | | B | | | | | |
| Approach Delay (s/veh) | | | | | | 2.9 | | | | 15.0 | | | | | | |
| Approach LOS | | | | | | A | | | | B | | | | | | |

b. Text reports show a more detailed analysis in plain text



```
                                HCS Two-Way Stop-Control Text Report

                    TWO-WAY STOP CONTROL (TWSC) Analysis
File Name:                      TWSC1-ThreeLegIntersection.xtw
Analyst:
Agency:
Date Performed:                 8/15/2022
Time Analyzed:
Jurisdiction:
Analysis Year:                  2022
Project Description:            Chapter 32: Example Problem 1
Units:                          U.S. Customary
Intersection Name:
Major Street Direction:         East-West
East/West Street Name:
North/South Street Name:
Analysis Time Period (hrs):     0.25

                        Vehicle Volumes and Adjustments
Major Street:
Approach                        EB                              WB
Movement                1U      1       2       3       4U      4       5       6
                        U       L       T       R       U       L       T       R
-------------------------------------------------------------------------------------
Volume                          240     40              160     300
Peak Hour Factor, PHF                           1.00
Hourly Flow Rate, HFR           240     40              160     300
Percent Heavy Vehicles                                  10
Number of Lanes         0       0       1       0       0       1       1       0
Lane Configuration                      TR                      L       T
Median Type                                     Undivided
Median Storage
RT Channelized?
Left-Turn Lane Storage
Upstream Signal?                                Not Present
-------------------------------------------------------------------------------------
Minor Street:
Approach                        NB                              SB
Movement                7       8       9                       10      11      12
                        L       T       R                       L       T       R
-------------------------------------------------------------------------------------
Volume                          40              120
Peak Hour Factor, PHF                           1.00
Hourly Flow Rate, HFR           40              120
Percent Heavy Vehicles          10              10
Number of Lanes         0       1       0                       0       0       0
Lane Configuration              LR
RT Channelized?                 |                               |
Flared Approach | Storage       No      |                       |
Percent Grade                   0

                        Pedestrian Volumes and Adjustments
Approach                        EB              WB              NB              SB
Movement                        13              14              15              16
-------------------------------------------------------------------------------------
Flow (ped/hr)                   0               0               0
Lane Width (ft)
Walking Speed (ft/sec)
Pedestrian Blockage Factor, f_pb

                    Delay, Queue Length, and Level of Service
Approach                EB              WB              NB              SB
Movement        1U      1       4U      4       7       8       9       10      11      12
Lane Configuration                      L                       LR
-------------------------------------------------------------------------------------
Flow Rate                       160                     160
Lane Capacity (veh/h)           1238                    521
v/c                             0.13                    0.31
95% Queue Length (veh)          0.4                     1.3
Control Delay                   8.3                     15.0
LOS                             A                       B
Approach Delay                  2.9                     15.0
Approach LOS                    A                       B
Intersection Delay      4.1

                        Step 1: MOVEMENT PRIORITIES
Major Street:
Approach                        EB                              WB
Priority                1U      1       2       3       4U      4       5       6
Movement                U       L       T       R       U       L       T       R
-------------------------------------------------------------------------------------
Minor Street:
```

```
Approach                        NB                              SB
Priority                        7       8       9               10      11      12
Movement                        L       T       R               L       T       R

                    Step 2: MOVEMENT DEMAND VOLUMES AND FLOW RATES
Major Street:
Approach                        EB                              WB
Movement                1U      1       2       3       4U      4       5       6
                        U       L       T       R       U       L       T       R
-------------------------------------------------------------------------------------
Volume, V_x                     240     40              160     300
Flow Rate, v_x                  240     40              160     300
-------------------------------------------------------------------------------------
Minor Street:
Approach                        NB                              SB
Movement                        7       8       9               10      11      12
                                L       T       R               L       T       R
-------------------------------------------------------------------------------------
Volume, V_x                     40              120
Flow Rate, v_x                  40              120

                    Step 3: CONFLICTING FLOW RATES
Major Street:
Approach                        EB                              WB
Movement                1U      1       2       3       4U      4       5       6
                        U       L       T       R       U       L       T       R
-------------------------------------------------------------------------------------
Flow Rate, V_x                  240     40              160     300
Conflicting Flow, v_c,x                                 280
-------------------------------------------------------------------------------------
Minor Street:
Approach                        NB                              SB
Movement                        7       8       9               10      11      12
                                L       T       R               L       T       R
-------------------------------------------------------------------------------------
Flow Rate, V_x                  40              120
Conflicting Flow, v_c,x         880             260

                    Step 4: CRITICAL HEADWAYS and FOLLOW-UP HEADWAYS
CRITICAL HEADWAYS
Approach                EB              WB              NB              SB
Movement        1U      1       4U      4       7       8       9       10      11      12
                U       L       U       L       L       T       R       L       T       R
-------------------------------------------------------------------------------------
t_c,base                                4.1     7.1             6.2
 Single Stage
 Stage I
 Stage II
t_c,HV                          1.0     1.0             1.0
P_HV                            0.10    0.10            0.10
t_c,G                           0.2     0.1
G                               0       0
t_3,LT                          0.0     0.7             0.0
t_c
 Single Stage                   4.20    6.50            6.30
 Stage I
 Stage II
FOLLOW-UP HEADWAYS
Approach                EB              WB              NB              SB
Movement        1U      1       4U      4       7       8       9       10      11      12
                U       L       U       L       L       T       R       L       T       R
-------------------------------------------------------------------------------------
t_f,base                        2.2     3.5             3.3
t_f,HV                          0.9     0.9             0.9
P_HV                            0.10    0.10            0.10
t_f                             2.29    3.59            3.39

                        Step 5: POTENTIAL CAPACITIES
NO UPSTREAM SIGNAL EFFECTS PRESENT
Approach                EB              WB              NB              SB
Movement        1U      1       4U      4       7       8       9       10      11      12
                U       L       U       L       L       T       R       L       T       R
-------------------------------------------------------------------------------------
v_c,x                           280     880             260
t_c,x                           4.20    6.50            6.30
t_f,x                           2.29    3.59            3.39
C_p,x                           1238    308             760

                        Steps 6 - 9: MOVEMENT CAPACITIES
Pedestrian Impedance
Approach                        EB              WB              NB              SB
```

```
Movement                        13              14              15              16
-------------------------------------------------------------------------------------
Pedestrian Flow Rate v_x        0               0               0
Lane Width, w
Walking Speed, S_p
Pedestrian Blockage Factor, f_pb
-------------------------------------------------------------------------------------
Major-Street Left-Turn Movements                1               4
-------------------------------------------------------------------------------------
Conflicting Flow, v_c,x                                         280
Potential Capacity, C_p,x                                       1238
Pedestrian Impedance Factor, p_p,x                              1.000
Movement Capacity, c_m,x                                        1238
Probability of Queue-free State, p_0,j                          0.871
Major L-Shared Probability Queue-Free State, p^_0,j             1.000
-------------------------------------------------------------------------------------
Minor-Street Right-Turn Movements               9               12
-------------------------------------------------------------------------------------
Conflicting Flow, v_c,x                         260
Potential Capacity, C_p,x                       760
Pedestrian Impedance Factor, p_p,x              1.000
Movement Capacity, c_m,x                        760
Probability of Queue-free State, p_0,j          0.842
-------------------------------------------------------------------------------------
Major-Street U-Turn Movements                   1U              4U
-------------------------------------------------------------------------------------
Conflicting Flow, v_c,x
Potential Capacity, C_p,x
Capacity Adjustment Factor, f_x
Movement Capacity, c_m,x
Shared L/U Capacity, C_SH
Probability of Queue-free State, p_0,j
-------------------------------------------------------------------------------------
Minor-Street Through Movements                  8               11
-------------------------------------------------------------------------------------
Conflicting Flow, v_c,x
Potential Capacity, C_p,x
Pedestrian Impedance Factor, p_p,x
Capacity Adjustment Factor, f_x
Movement Capacity, c_m,x
Probability of Queue-free State, p_0,j
-------------------------------------------------------------------------------------
Minor-Street Left-Turn Movements                7               10
-------------------------------------------------------------------------------------
Conflicting Flow, v_c,x                         880
Potential Capacity, C_p,x                       308
Pedestrian Impedance Factor, p_p,x              1.000
Capacity Adjustment Factor, f_x                 0.871
Movement Capacity, c_m,x                        268

                        Step 10: FINAL CAPACITY ADJUSTMENTS
SHARED-LANE CAPACITY OF MINOR STREET APPROACHES
Approach                        NB                              SB
Movement                7       8       9               10      11      12
Lane Configuration              LR
-------------------------------------------------------------------------------------
Shared Flow Rate, v_y           160
Movement Capacity, c_m,x        268     760
Shared Capacity, c_SH           521

                        Step 11: CONTROL DELAY
CONTROL DELAY TO RANK 2 THROUGH 4 MOVEMENTS
Approach                EB              WB              NB              SB
Movement        1U      1       4U      4       7       8       9       10      11      12
-------------------------------------------------------------------------------------
Flow Rate                       160     40              120
Movement Capacity               1238    268             760
Lane Configuration              L                       LR
Shared Capacity                                         521
Control Delay                   8.3                     15.0

                    Steps 12 - 13: APPROACH/INTERSECTION CONTROL DELAY and 95% QUEUE LENGTHS
Approach                EB              WB              NB              SB
Movement        1U      1       4U      4       7       8       9       10      11      12
Lane Configuration              L                       LR
-------------------------------------------------------------------------------------
Flow Rate                       160             160
Lane Capacity (veh/h)           1238            521
v/c                             0.13            0.31
Avg Queue Spacing (ft/veh)      27.0            27.0
95% Queue Length (veh)          0.4             1.3
95% Queue Length (ft)           10.8            35.1
Control Delay                   8.3             15.0
```

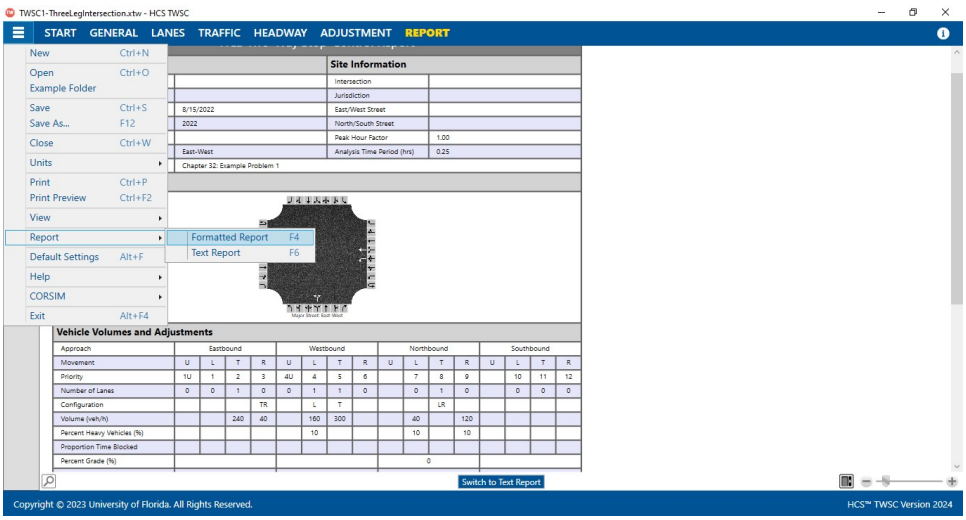
```
LOS                             A               B
Approach Delay                  2.9             15.0
Approach LOS                    A               B
Intersection Delay      4.1

This TWSC text report was created in HCS TWSC Version 2024 on 10/15/2023 8:46:39 PM
```

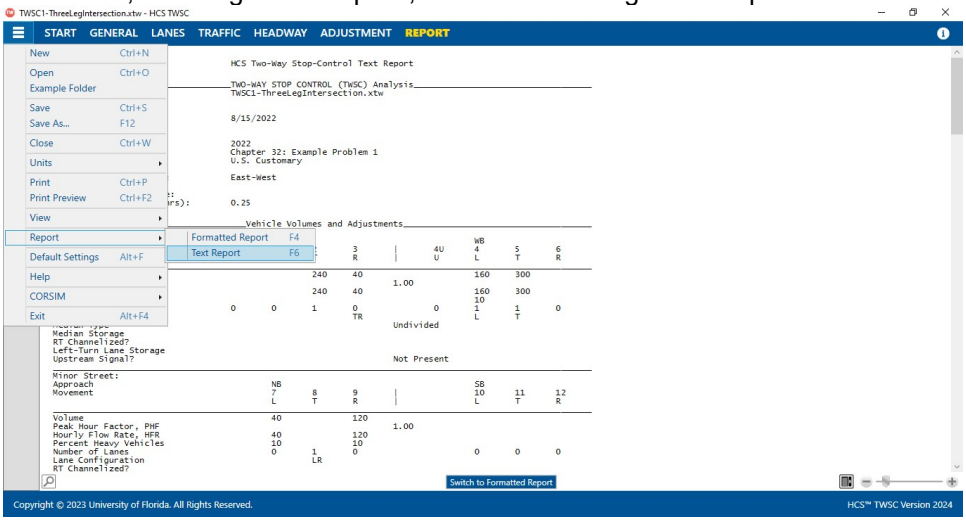
3. The type of report displayed can be changed by using the main menu items, keyboard shortcuts, or toggle buttons found under the report

    a. Main Menu Items

        i. To switch to the Formatted Report, select *File* > *Report* > *Formatted Report* from the main menu; this can be found by selecting the three lines in the top left-hand corner of the screen, hovering over “Report”, and then selecting “Formatted Report”.




ii. To switch to the Text Report, select *File* > *Report* > *Text Report* from the main menu; this can be found by selecting the three lines in the top left-hand corner of the screen, hovering over "Report", and then selecting "Text Report".




b. Keyboard Shortcuts

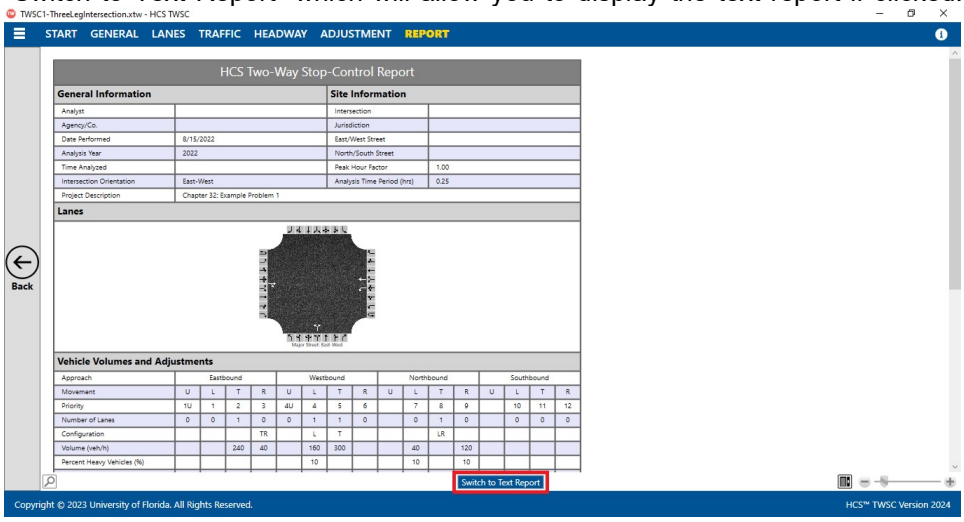
   i. Formatted Report: keyboard shortcut is "F4"

   ii. Text Report: keyboard shortcut is "F6"

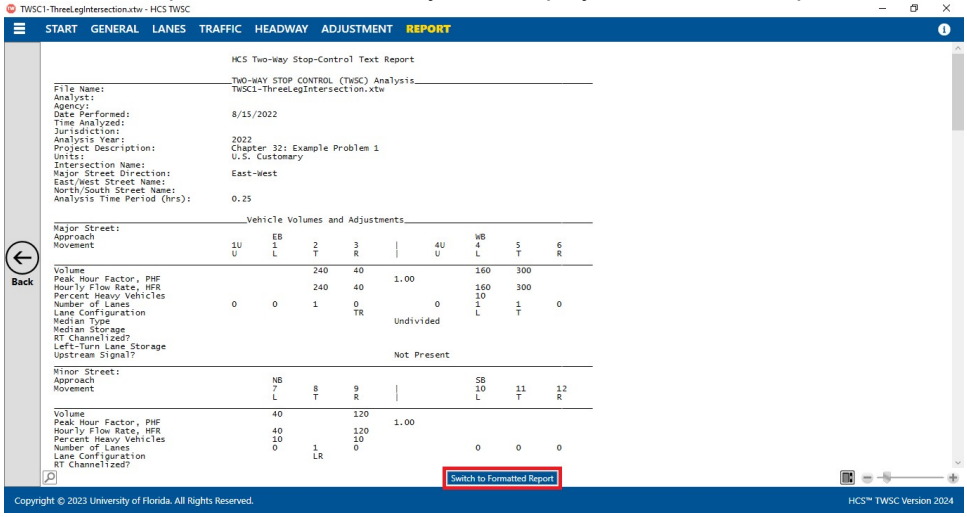
c. Report Toggle Buttons

   i. Whether viewing the report in Page View or Full View, a toggle button will be available at the bottom of the screen underneath the report.

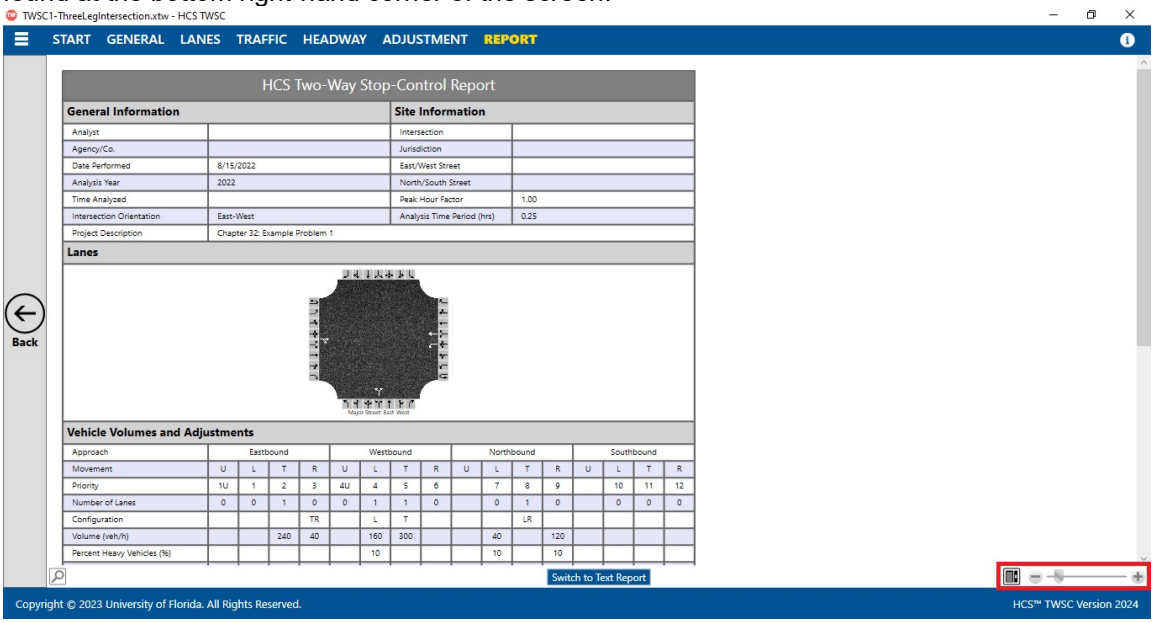
ii. If the formatted report is currently being displayed, the toggle button will say "Switch to Text Report" which will allow you to display the text report if clicked.




iii. If the text report is currently being displayed, the toggle button will say "Switch to Formatted Report" which will allow you to display the formatted report if clicked.



4. The magnification of the report currently being displayed can be changed using the zoom slider found at the bottom right-hand corner of the screen.




   a. To zoom in, drag the slider to the right; to zoom out, drag the slider to the left

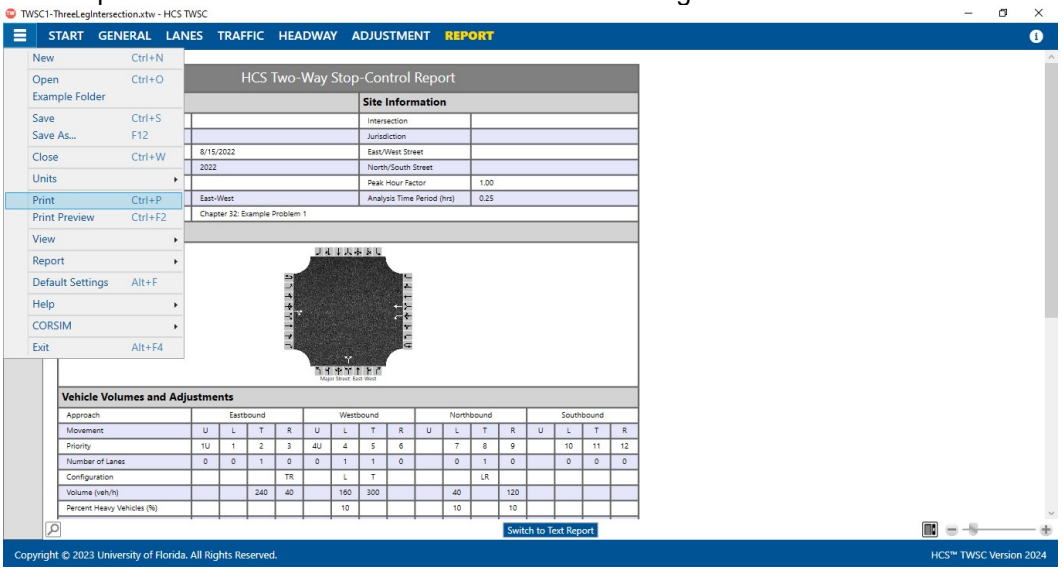
   b. Clicking the plus (+) button will zoom in; clicking the minus (-) button will zoom out

   c. Holding down “ctrl” on the keyboard and scrolling up on the mouse wheel will zoom in; holding down “ctrl” on the keyboard and scrolling down on the mouse wheel will zoom out

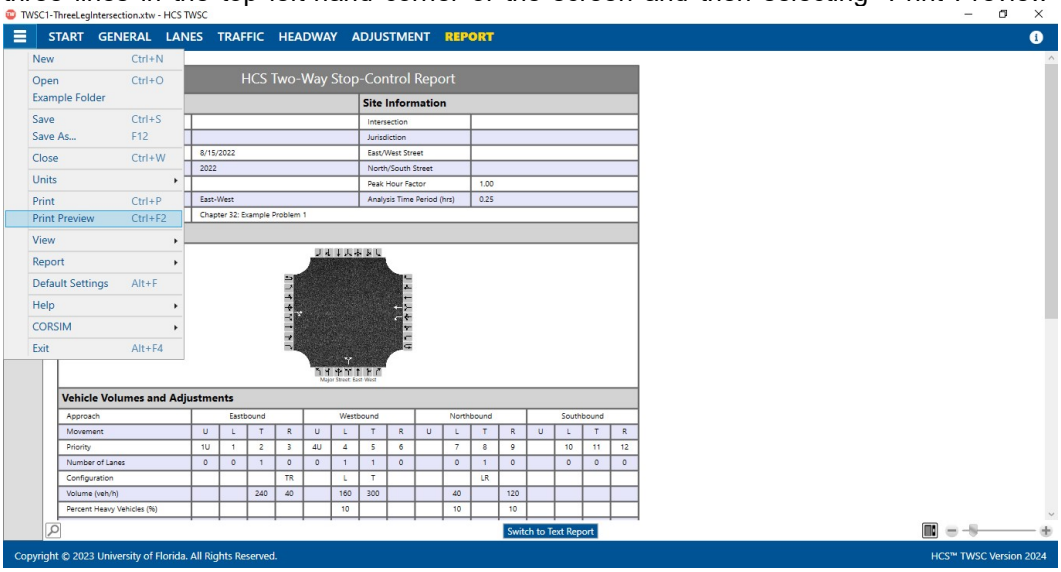
# Print a Report

1. There are four options for printing a report:

   a. Selecting *File* > *Print* from the main menu; this can be found by selecting the three lines in the top left-hand corner of the screen and then selecting “Print”



b. Selecting *File* > *Print Preview* from the main menu; this can be found by selecting the three lines in the top left-hand corner of the screen and then selecting “Print Preview”

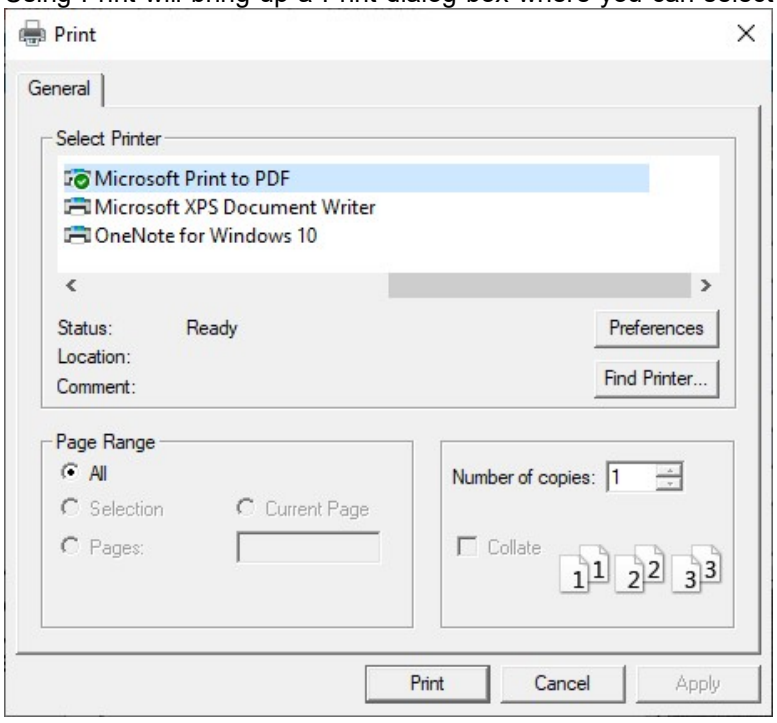



c. Using keyboard shortcut “Ctrl+P” for Print

d. Using keyboard shortcut “Ctrl+F2” for Print Preview

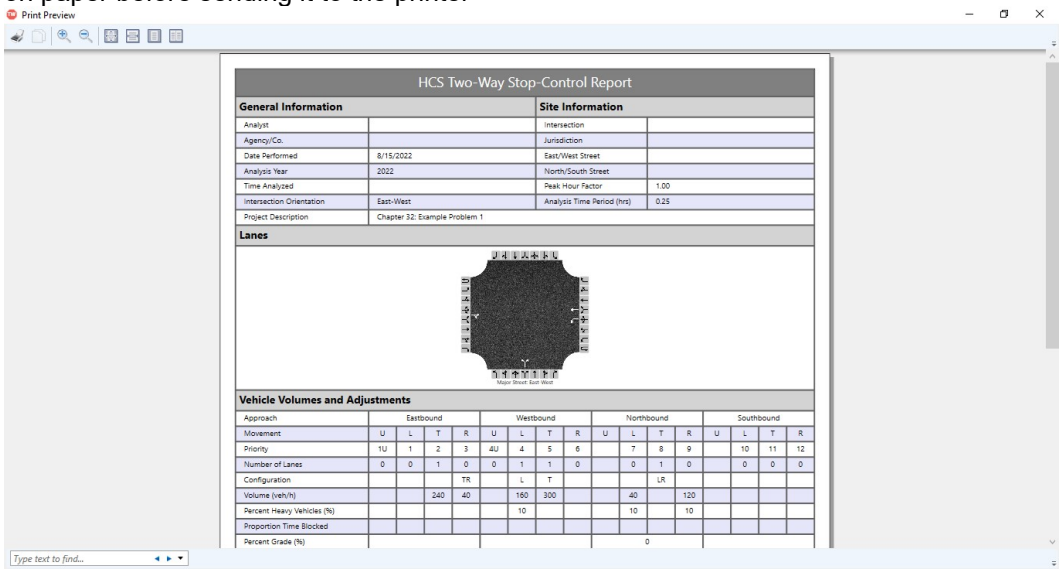
2. Print

a. Using Print will bring up a Print dialog box where you can select which printer to print to



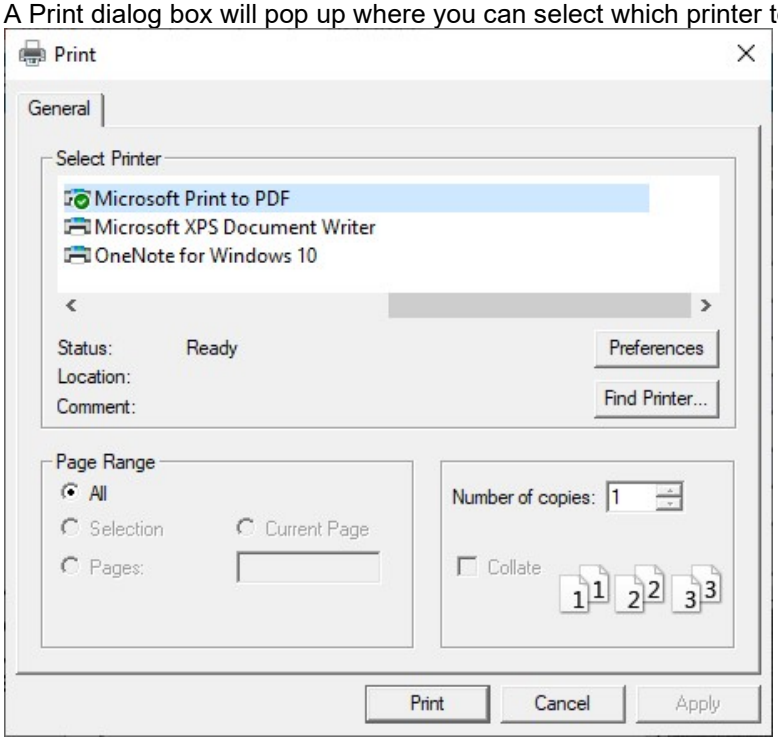
3. Print Preview

   a. Using Print Preview will bring up a window where you can view how the report will look on paper before sending it to the printer




   b. The print icon in the toolbar found in the top left-hand corner can then be selected

   c. A Print dialog box will pop up where you can select which printer to print to



# Glossary of Terms

## Agency

This field is provided to document the agency or company associated with this analysis or project.

## Analysis Time Period

The length of time (T) the peak flow remains constant (usually 0.25 hr) and is used in the delay equations. If v/c exceeds 0.90, control delay may be significantly affected by the value of T.

## Analysis Year

This field is provided to document the year for which the analysis is being performed.

## Analyst

The field is provided to document the individual performing the analysis.

## Annual K-Factor

The proportion of AADT that occurs during the peak hour

## Base Critical Headway

This value is obtained for each movement for two-lane, four-lane or six-lane major streets and is used to calculate the critical headway. See exhibit below.

| Vehicle Movement | Base Critical Headway, $t_{c,base}$ (s) | | |
|---|---|---|---|
| | Two Lanes | Four Lanes | Six Lanes |
| Left turn from major street | 4.1 | 4.1 | 5.3 |
| U-turn from major street | NA | 6.4 (wide)[a]<br>6.9 (narrow)[a] | 5.6 |
| Right turn from minor street | 6.2 | 6.9 | 7.1 |
| Through traffic on minor street | 1 stage: 6.5<br>2 stage, Stage I: 5.5<br>2 stage, Stage II: 5.5 | 1 stage: 6.5<br>2 stage, Stage I: 5.5<br>2 stage, Stage II: 5.5 | 1 stage: 6.5[b]<br>2 stage, Stage I: 5.5[b]<br>2 stage, Stage II: 5.5[b] |
| Left turn from minor street | 1 stage: 7.1<br>2 stage, Stage I: 6.1<br>2 stage, Stage II: 6.1 | 1 stage: 7.5<br>2 stage, Stage I: 6.5<br>2 stage, Stage II: 6.5 | 1 stage: 6.4<br>2 stage, Stage I: 7.3<br>2 stage, Stage II: 6.7 |

Notes: NA = not available.
[a] Narrow U-turns have a median nose width <21 ft; wide U-turns have a median nose width ≥21 ft.
[b] Use caution; values estimated.

## Base Follow-Up Headway

This value is obtained for each movement for two-lane, four-lane or six-lane major roads and is used to calculate the follow-up headway.

| Vehicle Movement | Base Follow-Up Headway, $t_{f,base}$ (s) | | |
|---|---|---|---|
| | Two Lanes | Four Lanes | Six Lanes |
| Left turn from major street | 2.2 | 2.2 | 3.1 |
| U-turn from major street | NA | 2.5 (wide)[a]<br>3.1 (narrow)[a] | 2.3 |
| Right turn from minor street | 3.3 | 3.3 | 3.9 |
| Through traffic on minor street | 4.0 | 4.0 | 4.0 |
| Left turn from minor street | 3.5 | 3.5 | 3.8 |

Notes: NA = not available.
[a] Narrow U-turns have a median nose width <21 ft; wide U-turns have a median nose width ≥21 ft.

## Calibrated Conflicting Flow Factors

Each movement at a TWSC intersection faces a different set of conflicts that is directly related to the nature of the subject movement. HCM exhibits and equations illustrate the computation of the parameter $v_{c,x}$, the conflicting flow rate for movement $x$—that is, the total flow rate (in vehicles per hour) that conflicts with movement $x$.

In the computation of $v_{c,x}$, there are default conflicting flow factors, $f_{c,x,y}$. If the user wishes to calibrate these values, they can choose to check 'Calibrated Conflicting Flow Factors'. If checked, this will enable applicable fields within the 'Conflicting Flow Factor Table'. Editing these fields will change the factors used in the computation of $v_{c,x}$. Unchecking the checkbox will revert the factors back to the HCM defaults.

## Capacity

Capacity is the maximum hourly rate at which persons or vehicles can be reasonably expected to traverse a point or uniform segment of a lane or roadway during a given time period under prevailing roadway, traffic, and roadway conditions.

## Control Delay

Control Delay is the portion of total delay attributed to traffic control measures, either traffic signals or stop signs.

## Critical Headway

*Vehicles*

The minimum time interval in the major-street that allows intersection entry to one minor-street vehicle. Factors that influence the calculation of critical headway include the number of lanes in each direction on the major street, the proportion of heavy vehicles, percent grade, intersection geometry, and base critical headway values. See *Base Critical Headway* for the HCM default values. Please note that values for U-turns from a four-lane major road depend on whether the median nose is narrow (less than 21 ft, or 6.4 m in metric) or wide (21 ft, or 6.4 m in metric, or wider).

The following equation is used to calculate critical headway:

$t_{c,x} = t_{c,base} + t_{c,HV}P_{HV} + t_{c,G}G - t_{3,LT}$

where

$t_{c,x}$ = critical headway for movement *x* (s);

$t_{c,base}$ = base critical headway (s);

$t_{c,HV}$ = adjustment factor for heavy vehicles (1.0 for major streets with one lane in each direction; 2.0 for major streets with two or three lanes in each direction) (s);

$P_{HV}$ = proportion of heavy vehicles for movement *x* (expressed as a decimal; e.g., $P_{HV}$ = 0.02 for 2% heavy vehicles);

$t_{c,G}$ = adjustment factor for grade for given movement (0.1 for Movements 9 and 12; 0.2 for Movements 7, 8, 10, and 11) (s);

$G$ = percent grade (expressed as an integer; e.g., G = -2 for a 2% downhill grade); and

$t_{3,LT}$ = adjustment factor for intersection geometry (0.7 for minor-street left-turn movement at three-leg intersections; 0.0 otherwise) (s).

*Pedestrians*

The minimum headway in the traffic stream that will allow a pedestrian, or group of pedestrians, to cross without the need for vehicles to yield.

## Crossing Treatment

The exhibit below provides information on average motorist responses to typical pedestrian crossing treatments summarized from a number of research efforts.

| Crossing Treatment | Yield Rate (%) Average | Yield Rate (%) Range | Sample Size (sites) |
|---|---|---|---|
| No treatment (unmarked) | 24 | 0–100 | 37 |
| Crosswalk markings only (any type) | 33 | 0–95 | 58 |
| Crosswalk markings, plus: | | | |
| Pedestal-mounted flashing beacon | 26 | 0–52 | 2 |
| Overhead sign | 35 | 12–57 | 2 |
| Overhead flashing beacon (push-button activation) | 51 | 13–91 | 14 |
| Overhead flashing beacon (passive activation) | 73 | 61–76 | 29 |
| In-roadway warning lights | 58 | 53–65 | 11 |
| Median refuge island | 60 | 0–100 | 21 |
| Pedestrian crossing flags | 74 | 72–80 | 6 |
| In-street pedestrian crossing signs | 76 | 35–88 | 20 |
| Rectangular rapid-flashing beacon (RFFB) | 82 | 31–100 | 64 |
| School crossing guard | 86 | — | 1 |
| School crossing guard and RFFB | 92 | — | 1 |
| Pedestrian hybrid beacon (HAWK) | 91 | 73–99 | 37 |
| Mid-block crossing signals, half signals | 98 | 94–100 | 13 |

Sources: Ryus et al. (*14*), Fitzpatrick et al. (*15*), Huang et al. (*18*), Turner et al. (*19*), Banerjee and Ragland (*20*), Ellis Jr. et al. (*21*), Shurbutt et al. (*22*), Mitman et al. (*23*), Pécheaux et al. (*24*), Mitman et al. (*25*), Ross et al. (*26*), Brewer and Fitzpatrick (*27*), Fitzpatrick et al. (*28*), Nemeth et al. (*29*), Yang et al. (*30*), Zheng and Elefteriatou (*31*), Schneider et al. (*32*), Al-Kaisy et al. (*33*), and Hockmuth and Van Houten (*34*).

## Crosswalk Length

The length in feet (or meters in metric) of a pedestrian crosswalk. A pedestrian crosswalk is a connection between pedestrian facilities across sections of roadway used by automobiles, bicycles, and transit vehicles. Crosswalk lengths can be broken up into two stages if there is a median refuge. Crosswalks can be marked or unmarked.

## Crosswalk Markings

A checkbox is provided to indicate if the pedestrian crosswalk has any markings or not. Please also see *Marked Crosswalk* and *Unmarked Crosswalk*.

## Crosswalk Width

The width in feet (or meters in metric) of a pedestrian crosswalk. A pedestrian crosswalk is a connection between pedestrian facilities across sections of roadway used by automobiles, bicycles, and transit vehicles. Crosswalks can be marked or unmarked.

## Date

The date will default to the computer's date, but may be edited. The format of the date is determined by the user's 'Short date style' preferences (regional setting icon on the Control Panel).

## Delay

The difference between the travel time actually experienced and the reference travel time that would result during conditions with ideal geometric characteristics and in the absence of incidents, control, and traffic.

## Distance from Main Intersection to Crossover

The distance in feet (or meters in metric) from the main intersection to the U-Turn crossover. It is used in determining the Extra Distance Travel Time (EDTT).

## East/West Street Name

The name of the east/west intersecting street is coded to document the intersection being analyzed.

## Flared Minor-Street Approach

A shared right-turn lane that allows right-turning vehicles to complete their movement while other vehicles are occupying the lane.

This box is checked when two vehicles may occupy or depart from the stop line simultaneously as a result of a large curb radius, a tapered curb, or a parking prohibition. This geometry may result in a greater capacity than if turning and through movement share only one lane. The magnitude of this effect depends in part on the turning-movement flow rates and the resultant probability of there being two vehicles simultaneously at the stop line, and in part on the storage length available to feed the second position at the stop line.

## Flared Minor-Street Storage

The number of spaces for right-turning passenger cars that can queue at the stop line without obstructing the access to the stop line for other movements.

## Follow-Up Headway

The time between the departure of one vehicle from the minor street and the departure of the next vehicle using the same major-street headway under a condition of continuous queuing on the minor street. Factors that influence the calculation of follow-up headway include the number of lanes in each direction on the major street, the proportion of heavy vehicles, and base follow-up headway values. See *Base Follow-Up Headway* for the HCM default values. Please note that values for U-turns from a four-lane major road depend on whether the median nose is narrow (less than 21 ft, or 6.4 m in metric) or wide (21 ft, or 6.4 m in metric, or wider).

The following equation is used to calculate follow-up headway:

$t_{f,x} = t_{f,base} + t_{f,HV}P_{HV}$

where

$t_{f,x}$ = follow-up headway for movement *x* (s);

$t_{f,base}$ = base follow-up headway (s);

$t_{f,HV}$ = adjustment factor for heavy vehicles (0.9 for major streets with one lane in each direction; 1.0 for major streets with two or three lanes in each direction) (s), and

$P_{HV}$ = proportion of heavy vehicles for movement *x* (expressed as a decimal; e.g., $P_{HV}$ = 0.02 for 2% heavy vehicles).

## Intersection

The name of the intersection, usually defined by the two intersecting streets, is coded to document the intersection being analyzed and will be printed on the report.

## Intersection Type

When the RCUT Alternative Intersection checkbox is checked, the Intersection Type drop down menu will enable. The two RCUT intersection types include: RCUT with Stop Signs and RCUT with Merges.

## Jurisdiction

This field is provided to document any jurisdiction convention or project related information.

## Lane Width

The average width for all lanes in the approach is coded. This is measured in feet (or meters in metric).

## Lanes

Lanes is a graphic data entry screen for coding lane configuration data. Lane combinations can be selected by clicking on the appropriate arrows to place them on the central diagram for each approach. Clicking on an arrow on the central diagram will remove it. As arrows are selected, others may become disabled.

Note: As stipulated in the HCM methodology, each major-street approach can have up to three through lanes and one exclusive right- and/or left-turn lane (five lanes maximum). Each minor-street approach can have up to three lanes, a maximum of one exclusive lane for each movement.

## Left-Turn Storage

If a major-street left-turn lane exists, the storage length must be provided (in vehicles) to determine whether or not the computed queue will exceed the storage, and generate delay to the Rank 1 movements.

## Level of Service (LOS)

A level of service is a letter designation that describes a range of operating conditions on a particular type of facility. Six levels of service are defined, using the letters A through F. Level of service A represents the best level of service, and generally describes operation of free flow and very low delay. Level of service F represents the worst operating conditions.

LOS criteria for the motorized vehicle mode for TWSC intersections are given in the exhibit below.

| Control Delay (s/veh) | LOS by Volume-to-Capacity Ratio | |
|---|---|---|
| | $v/c \leq 1.0$ | $v/c > 1.0$ |
| 0–10 | A | F |
| >10–15 | B | F |
| >15–25 | C | F |
| >25–35 | D | F |
| >35–50 | E | F |
| >50 | F | F |

Note: The LOS criteria apply to each lane on a given approach and to each approach on the minor street. LOS is not calculated for major-street approaches or for the intersection as a whole.

LOS criteria for the pedestrian mode for TWSC intersections are given in the exhibit below.

| LOS | Condition | Comments |
|---|---|---|
| A | $P_D < 0.05$ | Nearly all pedestrians would be satisfied |
| B | $0.05 \leq P_D < 0.15$ | At least 85% of pedestrians would be satisfied |
| C | $0.15 \leq P_D < 0.25$ | Fewer than one-quarter of pedestrians would be dissatisfied |
| D | $0.25 \leq P_D < 0.33$ | Fewer than one-third of pedestrians would be dissatisfied |
| E | $0.33 \leq P_D < 0.50$ | Fewer than one-half of pedestrians would be dissatisfied |
| F | $P_D \geq 0.50$ | The majority of pedestrians would be dissatisfied |

Note: $P_D$ = proportion of pedestrians giving a "dissatisfied" rating or worse.

## Major Street Direction / Intersection Orientation

Defines the street with the two approaches that are uncontrolled. The minor street is the other street that is controlled by STOP signs. Select the Major Street Direction between East-West and North-South from the drop-down menu.

## Major Street Free-Flow Speed

Free-Flow Speed (FFS) on the major street. FFS is:

1. The theoretical speed when the density and flow rate on a study segment are both zero.
2. The prevailing speed on freeways at flow rates between 0 and 1,000 passenger cars per hour per lane (pc/h/ln).

## Major Street Median Storage

The number of vehicles able to be stored in the median to be used in the two-stage gap acceptance calculations.

## Major Street Median Type

The Median Type is coded for the major street, either Undivided, Thru & Left, or Left Only.

A raised, striped or two-way left-turn lane (TWLTL), often causes a special gap acceptance phenomenon known as two-stage gap acceptance where a significant proportion of the minor-street drivers cross part of the major-street then pause in the median to wait for a gap on the other approach.

Undivided is selected when there is no median storage, disabling that field. Thru & Left is selected if the geometry permits both thrus and lefts from the minor street to store in the median for two-stage movements. Left Only is selected if only left turns (not thrus) can be stored, in a TWLTL for example.

If a median type other than Undivided is selected, the Median Storage field will enable coding of the number of vehicles able to be stored.

## Marked Crosswalk

Any portion of a roadway at an intersection or elsewhere distinctly indicated as a pedestrian crossing by pavement marking lines on the surface, which might by supplemented by contrasting pavement texture, style, or color.

## Median Refuge

When a raised median refuge island is available, pedestrians typically cross in two stages. Determination of whether a median refuge exists may require engineering judgment. The main issue to determine is whether pedestrians cross the traffic streams in one or two stages. When pedestrians cross in two stages, pedestrian delay should be estimated separately for each stage of the crossing.

## Motorist Yield Rate

Rate at which motor vehicles yield and allow a pedestrian to cross the street. Motorist yield rates are influenced by a range of factors, including roadway geometry, travel speeds, pedestrian crossing treatments, local culture, and law enforcement practices.

## MUT/RCUT Crossover Intersection

A checkbox is provided for the user to indicate whether the dataset is an MUT/RCUT Crossover Intersection. If converting an existing file, a confirmation popup will appear to verify conversion of file to a crossover intersection and invalid side-street movements will be removed from the lanes graphic.

## North/South Street Name

The name of the north/south intersecting street is coded to document the intersection being analyzed.

## Peak Hour Factor

The hourly volume during the analysis hour divided by the peak 15-min flow rate within the analysis hour; a measure of traffic demand fluctuation within the analysis hour. The peak-hour factor (PHF) is entered for the intersection to compute peak flow rates.

## Pedestrian Critical Headway

The minimum time interval in seconds below which a pedestrian will not attempt to begin crossing the street. For a single pedestrian, critical headway is computed with the following equation:

$t_c = L / S_p + t_s$

where

$t_c$ = critical headway for a single pedestrian (s),

$S_p$ = average pedestrian walking speed (ft/s) (or m/s in metric),

$L$ = crosswalk length (ft) (or m in metric), and

$t_s$ = pedestrian start-up time and end clearance time (s).

## Pedestrian Flow

The pedestrian volume is the sum of pedestrians crossing each subject approach (i.e., "Eastbound" pedestrians are those crossing the Eastbound vehicular approach) individually, and groups of pedestrians crossing together, during the time period of study in pedestrians per hour.

## Pedestrian Platooning

This is checked when a there is a group of pedestrians traveling together as a group, either voluntarily or involuntarily because of geometrics or other factors.

## Pedestrian Start-Up Time and End Clearance Time

Start-up time is the average time between when the vehicle forming the start of the critical headway clears the crosswalk and the first waiting pedestrian enters the crosswalk; end clearance time is extra time buffer that pedestrians provide themselves prior to the arrival of the vehicle forming the end of the critical headway.

## Percent Grade

The percent grade is entered for each approach to compute the adjustment factor used in the computation of critical headway and follow-up headway.

## Percent Heavy Vehicles

The percentage of heavy vehicles is entered for each movement. This value is used in the calculation of critical headway and follow-up headway.

## Percent Thrus Using Shared Lane

When there is more than one thru lane coded (shared or exclusive), the fields are activated to provide for the turn proportions.

## Project Description

This field is provided for the user to document the analysis with any information for identification purposes.

## Proportion Time Blocked

To evaluate the impact of coordinated upstream signals, the urban streets segments methodology is used to estimate the proportion of time that each Rank 2 or lower movement will be effectively blocked by a platoon. The proportion of time blocked is denoted by $p_{b,x}$ where $x$ is the movement using the movement conventions provided in the following exhibit:

| | Proportion Blocked for Movement, $p_{b,x}$ | | |
|---|---|---|---|
| | | Two-Stage Movements | |
| Movement(s) $x$ | One-Stage Movements | Stage I | Stage II |
| 1, 1U | $p_{b,1}$ | NA | NA |
| 4, 4U | $p_{b,4}$ | NA | NA |
| 7 | $p_{b,7}$ | $p_{b,4}$ | $p_{b,1}$ |
| 8 | $p_{b,8}$ | $p_{b,4}$ | $p_{b,1}$ |
| 9 | $p_{b,9}$ | NA | NA |
| 10 | $p_{b,10}$ | $p_{b,1}$ | $p_{b,4}$ |
| 11 | $p_{b,11}$ | $p_{b,1}$ | $p_{b,4}$ |
| 12 | $p_{b,12}$ | NA | NA |

Note: NA = not applicable.

Coding the values directly into the corresponding fields within TWSC will modify the appropriate conflicting flows to account for the effects of the upstream signals. Because of the effects on the movements, the minor-street left and thru values will always be the same, and the minor-street left and major-street left values will always be the same for each direction.

## Queue Length

Queue Length is the number of vehicles in queue.

## RCUT Alternative Intersection

RCUT stands for Restricted Crossing U-Turn and is a type of alternative intersection. RCUTs are at-grade intersections at which minor-street left-turn and through movements are rerouted. Major-street left turns are not rerouted.

When there are invalid lanes coded and RCUT Alternative Intersection is checked, a dialog box will pop up asking for confirmation to convert the current file to an RCUT Alternative Intersection. If Yes, Lanes will remove the invalid side street movements.

Checking RCUT Alternative Intersection will also create three sections with additional inputs for the conventional intersection, RCUT main intersection, and the U-Turn crossovers.

## RCUT Main Intersection Storage Length

The storage length is specified for left turn lanes on the major street of the main intersection and for right turn lanes on the minor street of the main intersection. Storage length is the length of turn lane available for storing queued vehicles.

## Right Turn Channelized

This box is checked when the right-turning traffic from the major road is separated by a triangular island and has to comply with a stop or yield sign. This is a special case of an exclusive right-turn lane, which is coded in Lanes.

## Saturation Flow Rate

The equivalent hourly rate at which previously queued vehicles can traverse an intersection approach under prevailing conditions, assuming that green signal is available at all times and no lost times are experienced.

Where there is no separate left-turn lane, the saturation flow rate for major street right-turning and thru traffic is used to compute the probability that there will be no queue in the respective major-street shared lanes.

## Short Left-Turn Pocket

This box is checked when indicating that there is no exclusive left-turn lane provided on the major street, but instead a short left-turn pocket is present.

A short storage area for the major street left-turn movement may cause the major-street through (and possibly right-turning) traffic to be delayed by left-turning vehicles waiting for an acceptable gap.

## Show Pedestrian Delay and LOS

When this checkbox is checked, results relevant to the HCM Pedestrian LOS procedure will be shown on both the formatted and text reports.

The HCM procedure for pedestrian mode analysis does not apply to undivided streets with more than four lanes, but it can accommodate up to four lanes in each direction separated by a median.

## Stored Heavy Vehicle Length

The lane length in feet, or meters in metric, occupied by a queued heavy vehicle; this affects the computation of queue length

## Stored Passenger Car Length

The lane length in feet, or meters in metric, occupied by a queued passenger car; this affects the computation of queue length

## Time Analyzed

This field exists for documenting the time frame of the analysis as morning peak, afternoon peak, existing conditions, future projections, etc.

## Unmarked Crosswalk

Absent any pavement markings, the part of the roadway within an intersection formed by the extension of the lateral lines of a sidewalk across the roadway.

## Upstream Signal

This box is checked for the existence of a nearby upstream signalized intersection usually causing vehicles to arrive at the subject intersection in platoons, which may cause an increase in the minor-street capacity compared with the case of random arrivals. The greater the number of vehicles traveling in platoons, the higher the minor-street capacity for a given opposing flow because there is a greater proportion of large gap sizes that can be used by more than one minor-street vehicle.

To evaluate the impact of coordinated upstream signals, the urban street segments methodology is used to estimate the proportion of time that each Rank 2 or lower movement will be effectively blocked by a platoon. With these values, the proportion of the analysis period that is blocked for each minor movement can be computed.

## U-Turn Crossover

The intersection in an alternative intersection that a driver uses to make a U-Turn to complete a movement through the main intersection of an alternative intersection. For RCUTs, cross street left turn and through traffic from the main intersection makes a U-turn at the crossover. For example, if the major street is East-West and a driver needs to turn left from the south leg of the main intersection, they must first turn right and then make a U-turn at the east crossover and continue driving westbound to complete their movement.

## U-Turn Crossover Storage Length

The length of U-Turn crossover lane available for storing queued vehicles.

## v/c Ratio

The v/c ratio is the volume capacity ratio, which is the volume of one movement (or shared-lane movements) divided by the movement capacity of the movement (or shared-lane movements).

## Volume

The total number of vehicles or other roadway users that pass over a given point or section of a lane or roadway during a given time interval. The volumes ($V$) for each movement are coded in vehicles per hour (veh/h). An hourly volume is required for any movement to be included in the analysis. Note that U-turns off the major street are now analyzed.

## Walking Speed

The average pedestrian walking speed, measured in ft/s (or m/s in metric), is entered to calculate the pedestrian blockage factor.

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