CodeGREEN

User Guide

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McTrans CodeGREEN User Guide v4.0

This document is a practical guide for traffic professionals engaged in traffic signal operations and creating timing plans for traffic signals. This user guide provides instruction on setting up intersections and arterials and generating a holistic set of timing plans to manage them. It also provides steps for integrating several timing plans into a managed schedule of operations with offsets, green tunnel bandwidth, and other coordination settings

Note: *Refer to the McTrans CodeGREEN Data Module User Guide for a description of all available data charts and their meaning.*

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Introduction

McTrans CodeGREEN simplifies the signal timing workflow into one seamlessly integrated software.

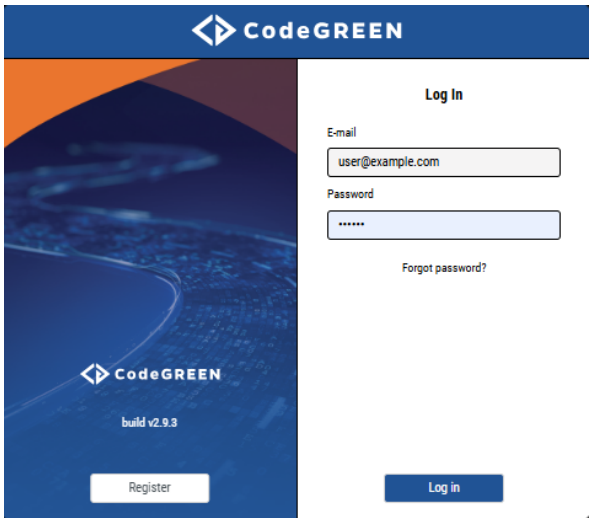
McTrans CodeGREEN fetches turning movement counts directly from the field to the software to enable the creation of data-driven day-of-the-week, time-of-the-day timing plans. Traffic counts data can also be provided from an external file import.

McTrans CodeGREEN uses a mathematical algorithm to generate the most adequate timing plan with optimal coordination and length of the offsets, phase sequence, and phase duration. Its biggest advantage is the ability to create a wide variety of data-driven, time-specific timing plans, including ones for each day of the week, for special events, off-peak plans with lower cycle lengths, and seasonal plans. With this tool, even the most challenging of traffic conditions and patterns can be handled by creating as many timing plans as necessary. The real-time controller communication allows McTrans CodeGREEN to seamlessly deploy timing plans with no signal transition in-between.

Let's go through the steps of creating timing plans.

Log in

Open a web-browser and navigate to cgoptimizer.com.



First-time Log in

To be able to use the application, register an individual account (if your organization has a policy for registering generic accounts, ask your administrator if one has already been created)

1. To register an account, enter your name, email address, and set up a new password.

2. If an account has already been registered for you, then go straight to the ***Login*** pane.

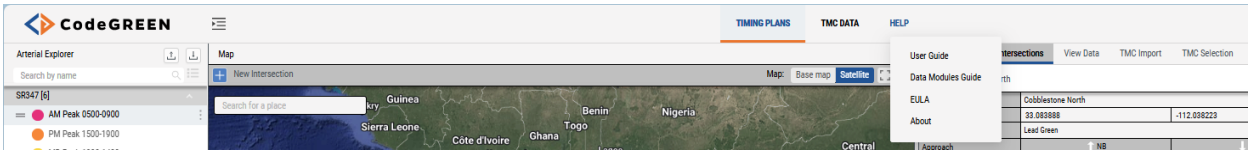
Resetting a Password

If you need to reset your password or username, click on the ***Forgot username or password?*** link.

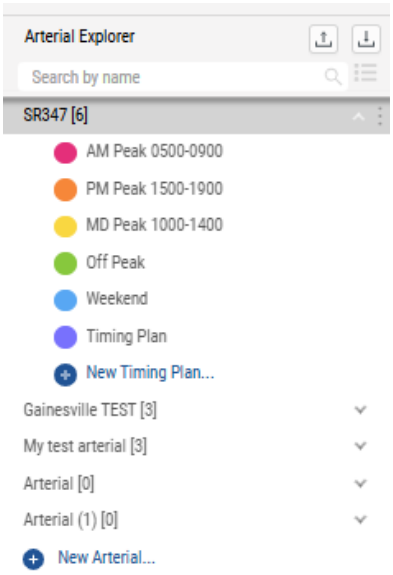
Help Menu

Once you are logged in, the home page will display three tabs: TIMING PLANS, TMC DATA, and HELP menu.

The HELP section provides resources to guide you through the process flow.



Configuring Your Arterial



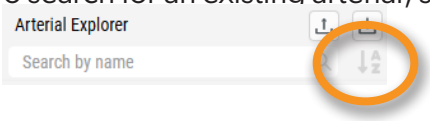
Click on the TIMING PLANS tab to set up the arterial, based on which the timing plans will be generated.

Arterial Explorer

Lists existing arterials with location and traffic coordination parameters. You can search for and sort arterials by name, in ascending or descending alphabetical order.

1. To add a new arterial, click on the button highlighted in blue

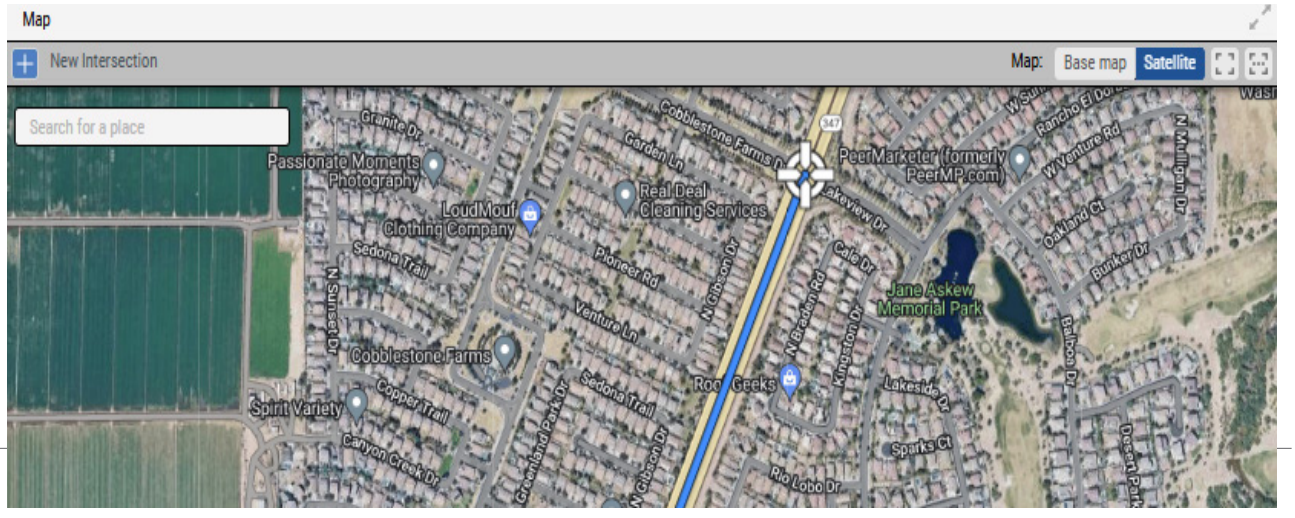
2. To search for an existing arterial, start typing in the search box.



3. To view all arterials setup in the system, scroll down the list.
4. To sort arterial names alphabetically, click on the icon next to the search box.
5. To view timing plans, configured for an arterial, double-click on the arterial name. This will:
   - Display a list of relevant timing plans in ***Arterial Explorer***
   - Highlight the arterial and its constituent intersections on the map

Arterial Map

The map indicates the geographic position of an arterial. All arterials, configured and saved in the system, are displayed simultaneously until a specific one is selected.



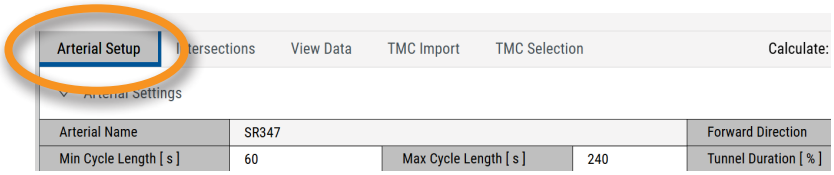
Two map layers are available for convenience - ***Base map*** and ***Satellite*** aerial view.

1. Click on the empty square icon to view the whole arterial, with all intersections from start to end positioned on the map.
2. Clicking on the grid icon with a dotted line inside visualizes all configured and saved arterials.
3. When selected in ***Arterial Explorer***, an arterial is shown in a blue color.

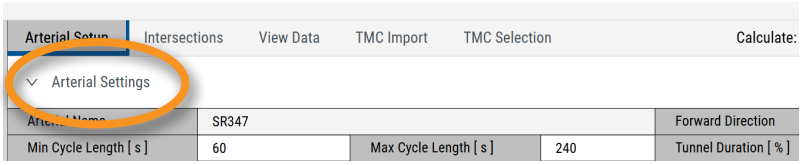
Arterial Setup Tab

Define the settings for a new arterial and its intersections from this tab. Available settings, necessary for describing traffic along the arterial, include direction of movement, average speed, minimum and maximum cycle length, distance between intersections, etc. The more precise these parameters are, the higher the accuracy of the timing plan designed by the system.

1. Open the ***Arterial Setup*** tab

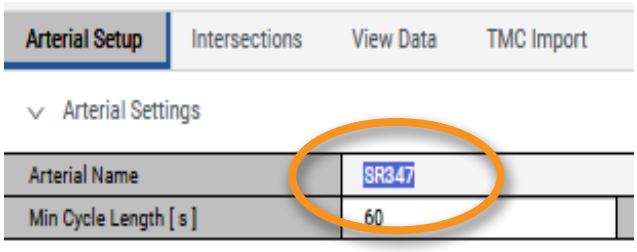


Go to ***Arterial Settings*** and define the following:

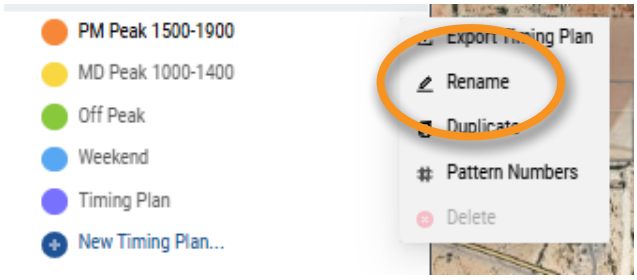


- **Arterial Name** – A default label *Arterial* is displayed for any new route.

Alternatively, you can overwrite the default entry in the ***Arterial Name*** field.

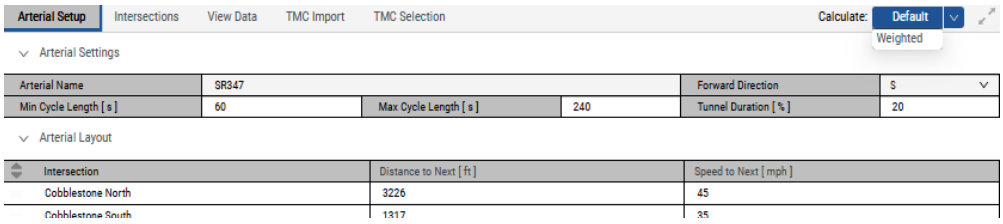


a. To change the name, click on the context menu (vertical dots), and click ***Rename***.



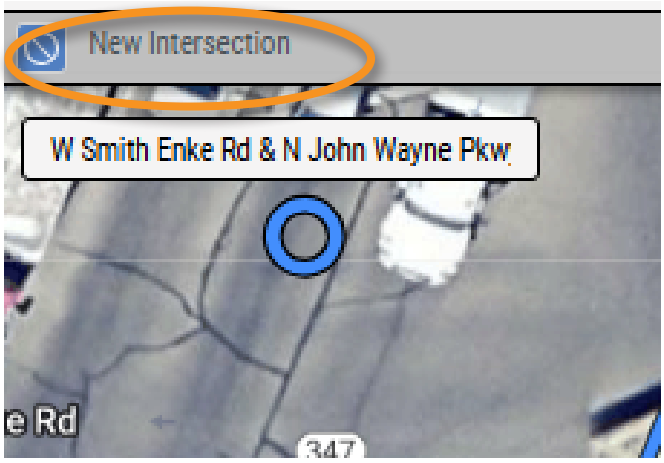
b. Overwrite the default label and click on the checkmark to confirm the new naming. On the ***Arterial Setup*** panel, populate the following data fields with values, relevant to the primary arterial:

- **Forward Direction** – Select the direction in which intersections will be coordinated. The coordination runs in both directions but in this field, you must define the primary direction.
- **Cycle Length** [Minimum Maximum] – Enter those values in seconds, considering the desired local cycle lengths at all intersections on the arterial. The system will define the optimal cycle length based on the collected Turning Movement Counts, but here you can limit lower and upper boundaries.
- **Speed to Next** [mph] – Enter the speed to the next intersection, or the desired speed used for timing plan coordination and progression between these two intersections.
- **Distance to Next** [ft] – Distance to the downstream intersection, in the forward direction. The last intersection should have 0 as a value. Fill in the values in feet after you have created all intersections on the arterial.

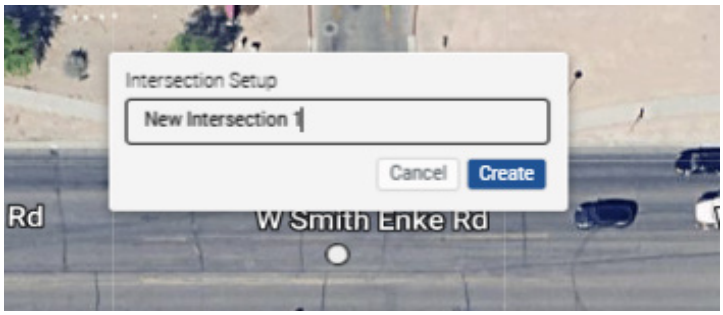


2. Add the intersections of interest to the arterial. Start typing the name of the streets in the ***Enter a Location*** field.

a. Click on the ***+ New Intersection*** button in the top left corner of the ***Map***. The cursor takes a circular shape and can be dragged to the location where the physical intersection is found on the map.



b. Drop the circle mark to the center of the intersection and give a name to the new intersection.



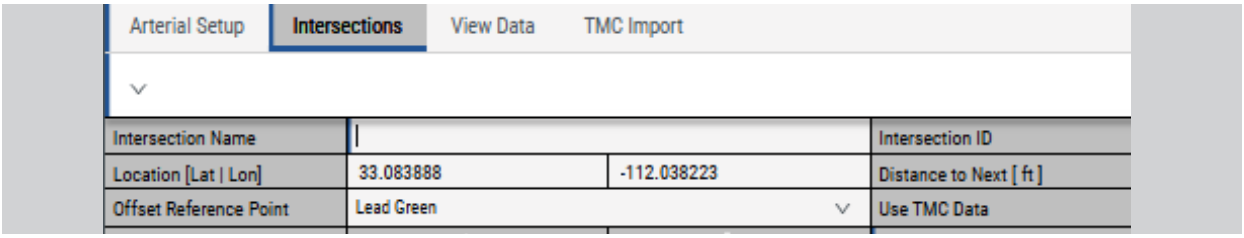
c. The intersection appears under ***Arterial Layout*** under ***Arterial Settings***.

Cobblestone North

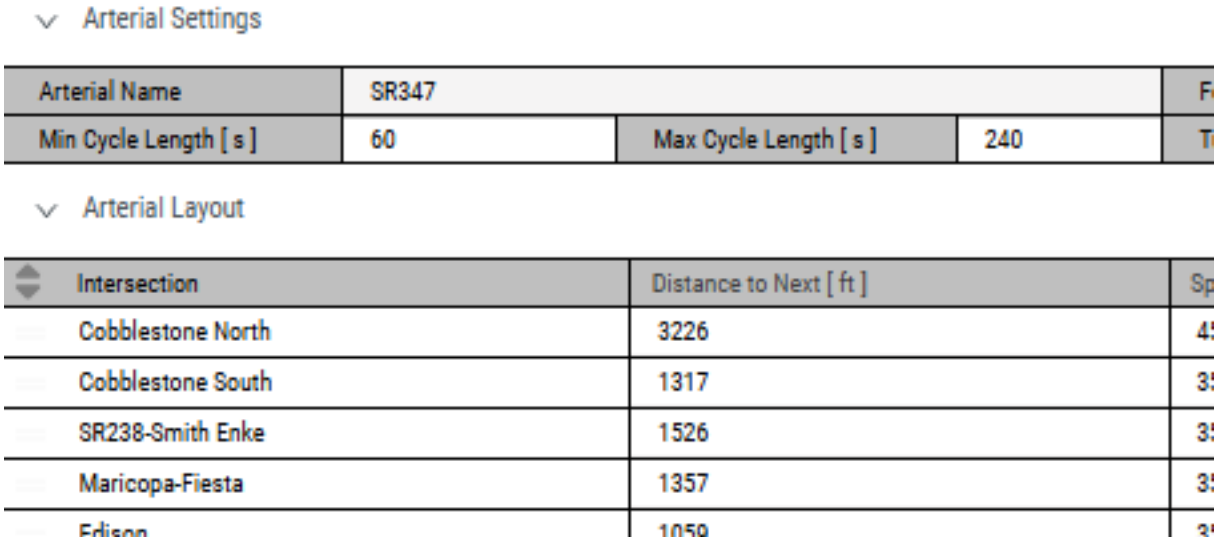
Intersection Name	Cobblestone North																							
Location [Lat | Lon]	33.083888						-112.038223						Distance to Next [ft]						3226					
Offset Reference Point	Lead Green																							
Approach	NB						SB						EB						WB					
Movement	L			T		R	L			T		R	L			T		R	L			T		R
Phases	1			6			5			2			8			8			4			4		
Phase Ring	2			1			1			2			1			2			2			1		
Pedestrian Phases	6						2						8						4					
Lane Configuration	NBL	NBLT	NBA	NBT	NBTR	NBR	SBL	SBLT	SBA	SBT	SBTR	SBR	EBL	EBLT	EBA	EBT	EBTR	EBR	WBL	WBLT	WBA	WBT	WBTR	WB
Number of Lanes	1			2		1	1			3		1	1			1		1		1				1
Left Turn / Approach Type	Protected						Protected						Protected						Protected					

3. Repeat the process to add other intersections. As intersections are added, they will be automatically connected on the map.

Note: Whenever a field requires input that is missing or incomplete, a vertical blue bar will highlight that field and section title. This visualization prompt helps ensure the quality of the data entry process.



4. After adding all intersections, fill in the distance in between each two in the ***Distance to Next*** fie

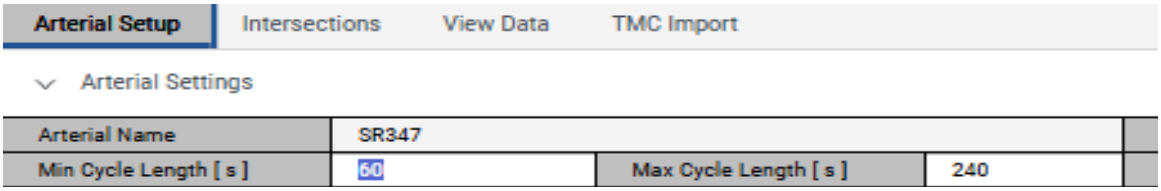


5. Save the configuration in the end.

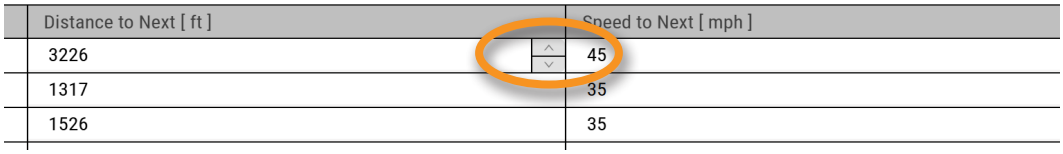
Modifying Arterial Settings

The software allows modifying all arterial settings before they have been saved. The ***Save*** button will appear once you have made a change.

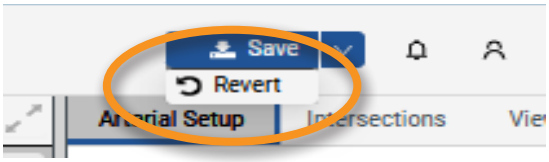
- Modify any of the numerical settings by means of the up/down arrows in the field.



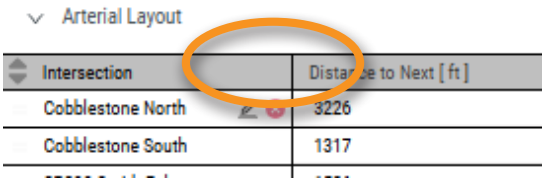
- The ***Distance to Next*** and ***Speed to Next*** can also be modified by hovering over the cell and adjusting the up and down arrows on the far right.



- An intersection's name can be modified by clicking on the ***Edit*** (pen) sign. Changes made to the intersection can be discarded by click on Revert. This option can be used, for example, when trying different timing plans.



- Delete an intersection by clicking the red X next to the name.

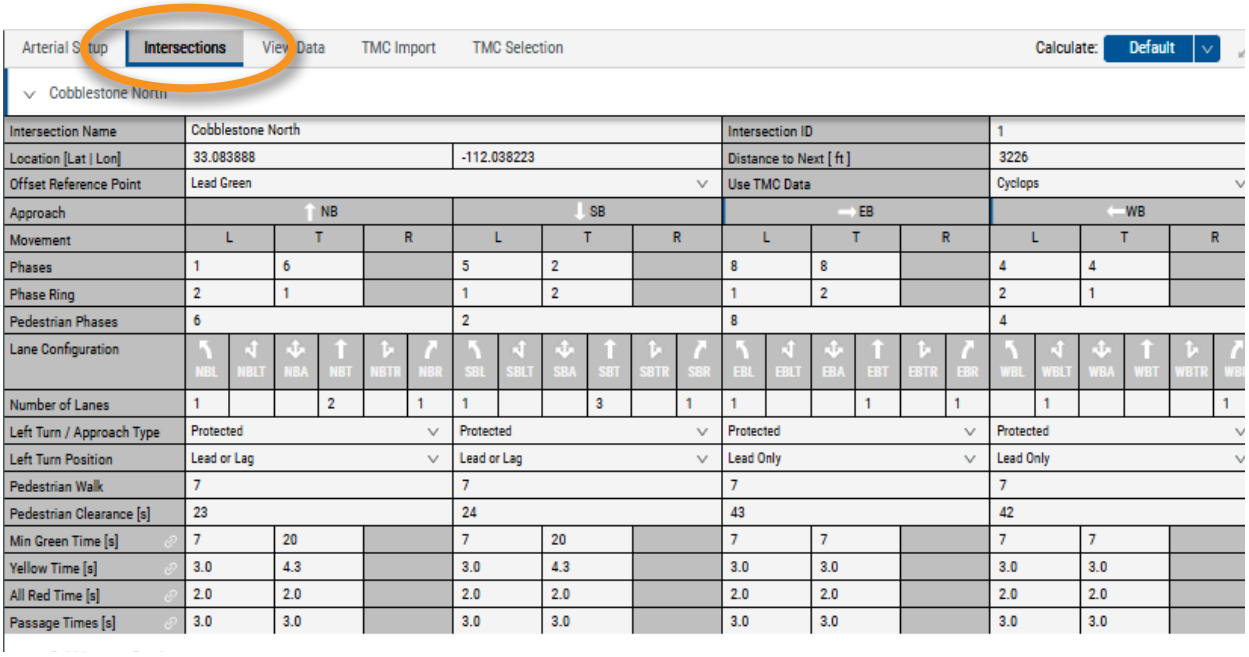


Configuring Intersections

Intersections Tab

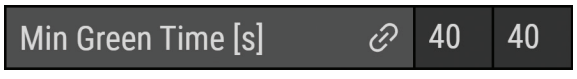
On the ***Intersections*** tab, you can define all details specific to an individual intersection: orientation, phasing, left-turn position, signal timing thresholds etc. These inputs are used by the software to subsequently generate the Phase Sequence Diagram and the Time-Space Diagram.

1. Click the intersection tab and define the following settings:



- **Intersection Name** – Type in the name of the intersection.
- **Location** – Enter the longitude and latitude of the camera installation spot or click on the map to get the location details populate automatically.
- **Distance to Next** – Populates from the Arterial setup tab. If you modify this setting here, the change will be reflected automatically in the Arterial Setup tab as well.
- **Approach and Movement** – Select depending on the intersection geometry.
- **Phases** – Select phases that are available for vehicular movement at the intersection.
- **Pedestrian Phases** – Select phases that are available to clear pedestrian demand.
- **Lane Configuration** – Displays a full selection of viable options from which to choose.

- **Number of Lanes** – Only active lanes have an underlining indication 1, 2, etc., standing for the number of lanes in that direction. No figure means that a lane is not on the intersection plan.
- **Left Turn Type** – Select from the drop-down menu:
  - Permissive
  - Protected
  - Protected-Permissive
  - No left turn
  - Split phase – Switches a green phase on for all vehicle movements in one direction followed by a phase for all movements in the opposite direction. Selecting Split phase for one approach automatically selects it for the opposite one as well.
  - Flashing Yellow Arrow
- **Left Turn Position:**
  - Lead – The left turn phase is switched on before the green light for the through phase.
  - Lag – The left turn phase is switched on after the green light for the through phase.
- **Pedestrian Walk** – Duration of the Ped Walk time, allowing pedestrians to enter the crosswalk. The system supports precision parsing to the second.
- **Pedestrian Clearance** a.k.a. Pedestrian Clear Interval – The time required by pedestrians who leave the curb to complete crossing while a flashing **DON'T WALK** indication is displayed, before conflicting movements are released.
- **Min Green Time** [s] – The least amount of time a green signal indication is displayed when a signal phase is activated. This should match the controller settings.
  - The link symbol at the right of the field allows applying the same value in all columns for all active lanes. Switching the link off allows populating different values in each column.



- **Yellow Time** [s] – The yellow change settings are input for each signal phase. This should match the controller settings.
- **All Red Time** [s] – The all red interval duration. This should match the controller settings.
  - The link symbol at the right of the field allows applying the same value in all columns

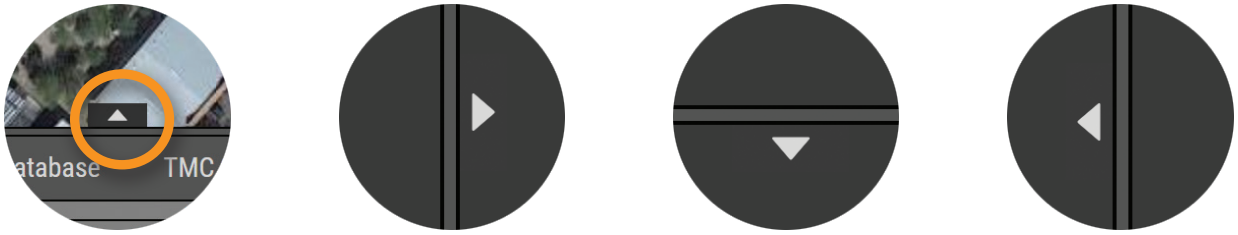
for all active lanes.
    - Switching the link off requires that you manually populate a value in each column.

- **Passage Time** [s] – The maximum allowable duration of time between vehicle calls on a phase before the phase is terminated.

2. Once you have set up the first intersection, do the same for all the rest.

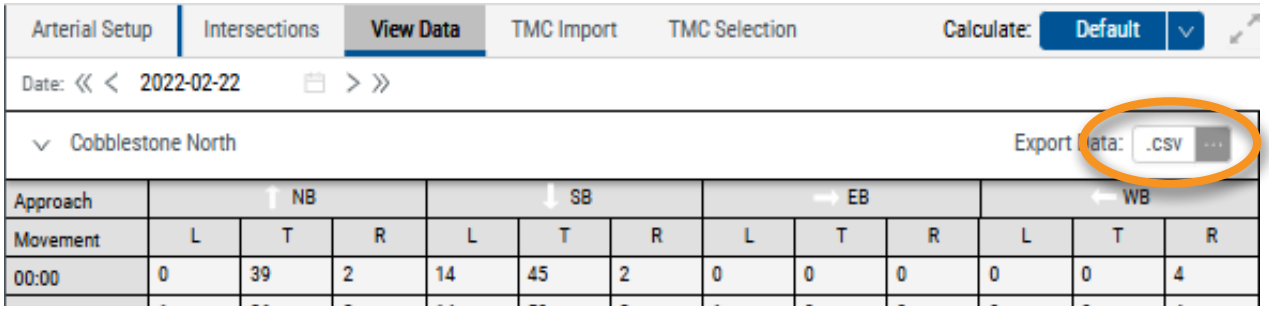
Minimizing/Maximizing the View

All thematic panels on the home screen can be minimized and maximized to view a closeup or a broader perspective of the arterial. Fullscreen and shrinking back to a multi-panel view are also possible by clicking the re-size arrows.



Data Viewing and Export

Data can be exported into a structured .csv (Excel) or .vol file format, for validation or for importing a specific time set back into the system. Click on an option to download the respective data file.



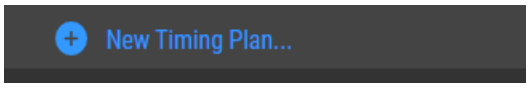
Creating a Timing Plan

To create a new timing plan, Turning Movement Counts, collected by the camera, need to be selected from the database.

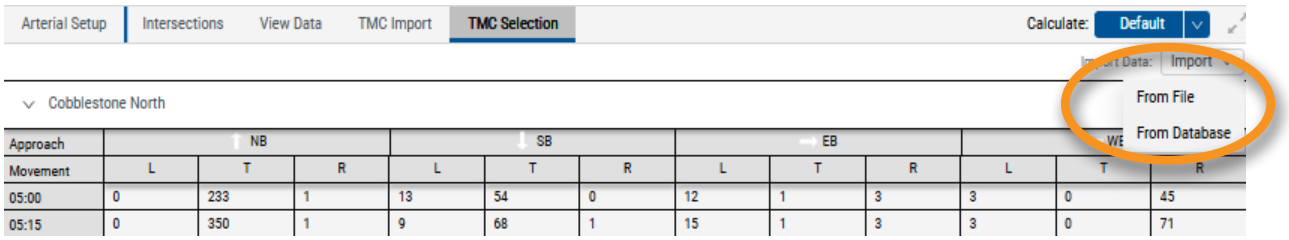
Importing from Database

This feature involves importing data centrally stored in the master McTrans CodeGREEN database into the new timing plan. You can select the day and time period you need data for. Data is binned into 15-minute intervals. Data can also be imported from a file into the timing plan. The supported file formats are .CSV and .VOL.

1. Open a New Timing Plan screen. The ***TMC Selection*** tab visualizes next to the ***Intersections*** tab. From this tab, data selected for a particular time period, can be imported from the database into the timing plan TMC table. A timing plan is generated based on those specific values.

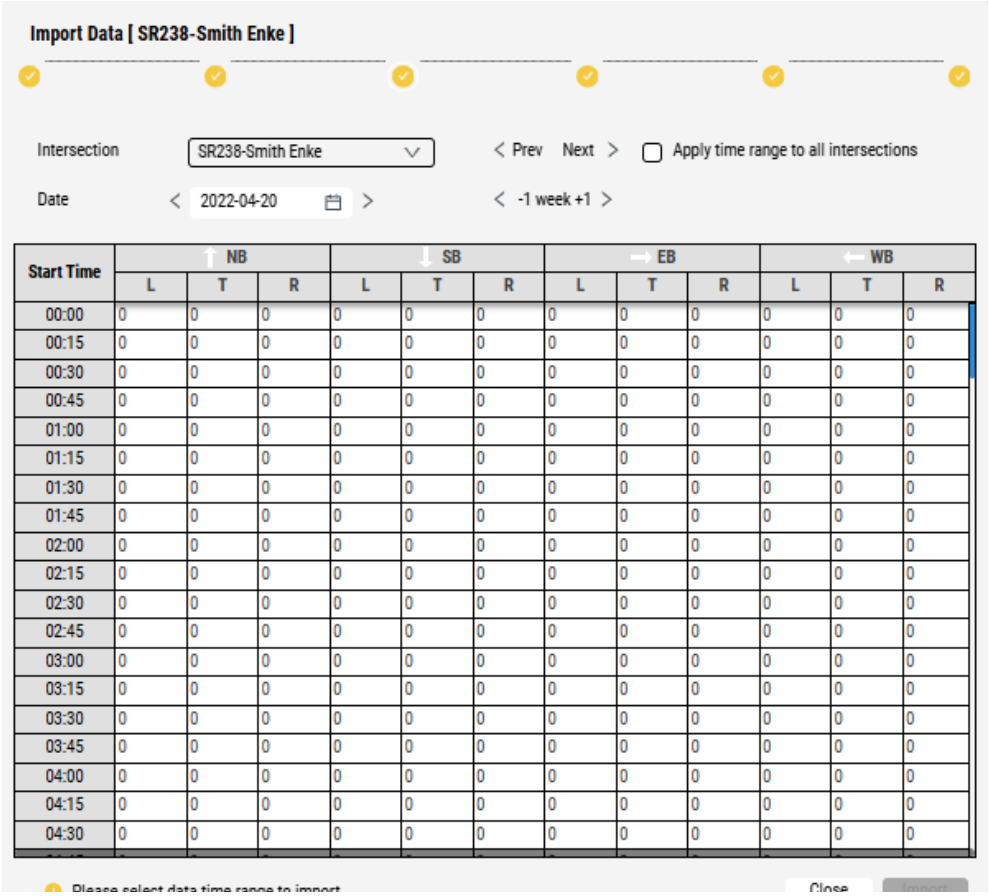


2. Click the ***Import > From Database*** button.



3. On the next screen, select the correct intersection, date and time range to apply the data feed from the camera.

4. TMCs can be imported for each intersection, or in bulk – simultaneously for all intersections, as long as the time range is kept consistent:



a. **Individual Import** – This feature allows selecting different date and time period per intersection. Click on the ***Import*** button and verify that the data is reflected in the TMC tab on the main screen. Then save the imported data. Upon successful import, the intersection node turns green.

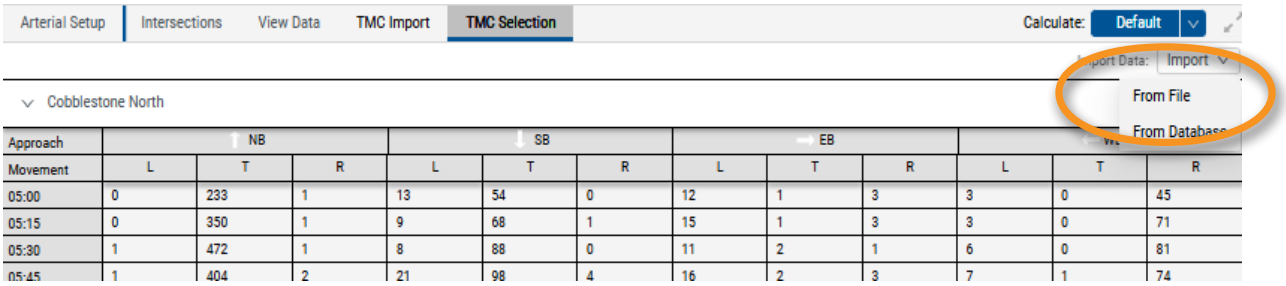
b. **Bulk Import** – Bulk import allows selecting the same date and time for all intersections. Check the box ***Apply date/hour range to all intersections*** and click ***Import***. Upon successful result, all nodes turn green.

5. Verify that data is populated correctly on the TMC tab so that all ensuing diagrams show accurate results.

Data from File into Timing Plan

1. Select the option for importing turning movement counts from a file into ***TMC Selection***. This data is going to update only the current timing plan without overwriting the system database.

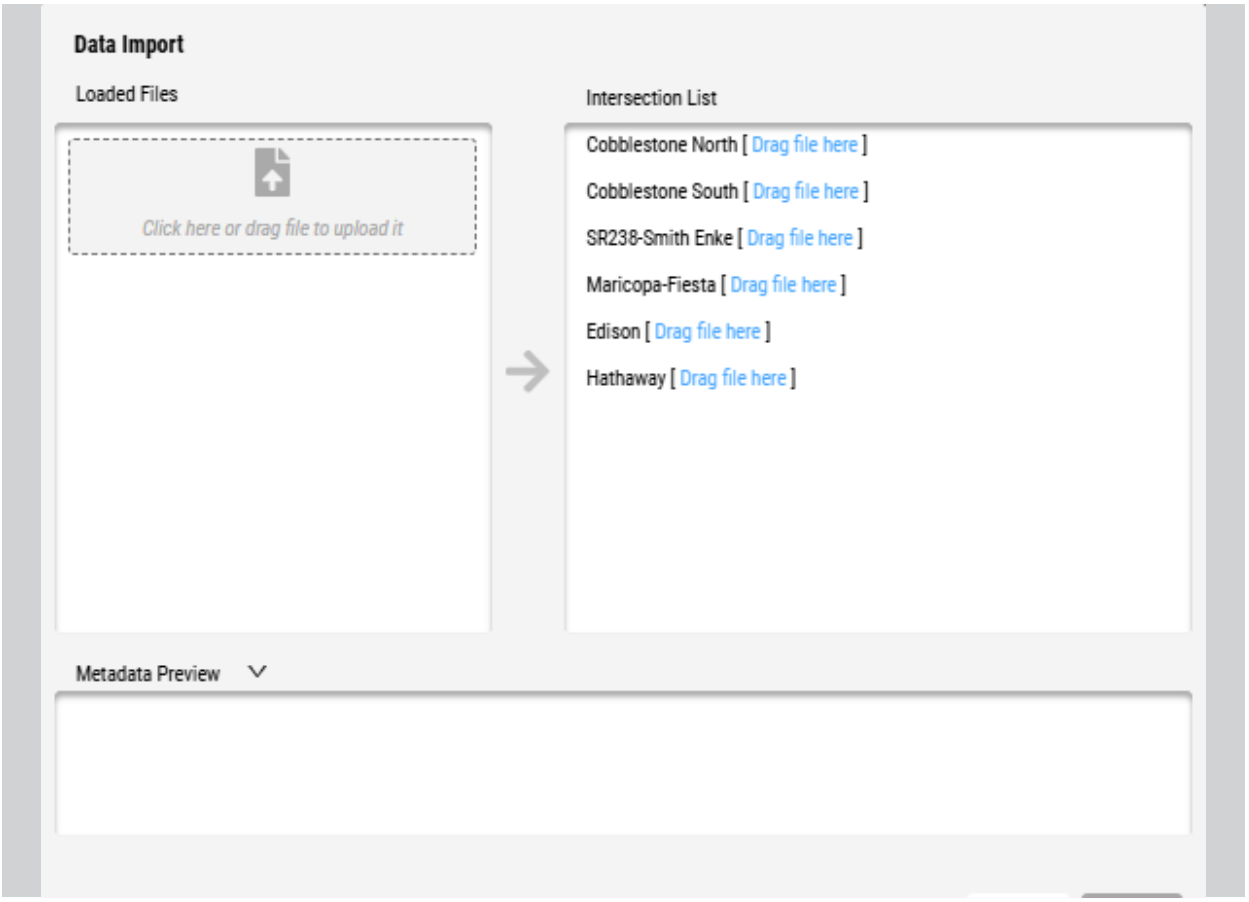
2. Click on ***From File***.



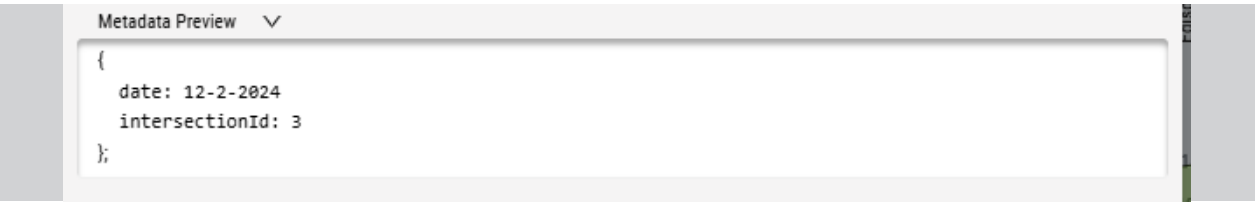
Approach	NB			SB			EB					
Movement	L	T	R	L	T	R	L	T	R	L	T	R
05:00	0	233	1	13	54	0	12	1	3	3	0	45
05:15	0	350	1	9	68	1	15	1	3	3	0	71
05:30	1	472	1	8	88	0	11	2	1	6	0	81
05:45	1	404	2	21	98	4	16	2	3	7	1	74

3. Browse to upload the file that will be imported and upload it under ***Loaded Files***.

4. Drag and drop the file over the intersection where it applies. One file can be used over one intersection only.



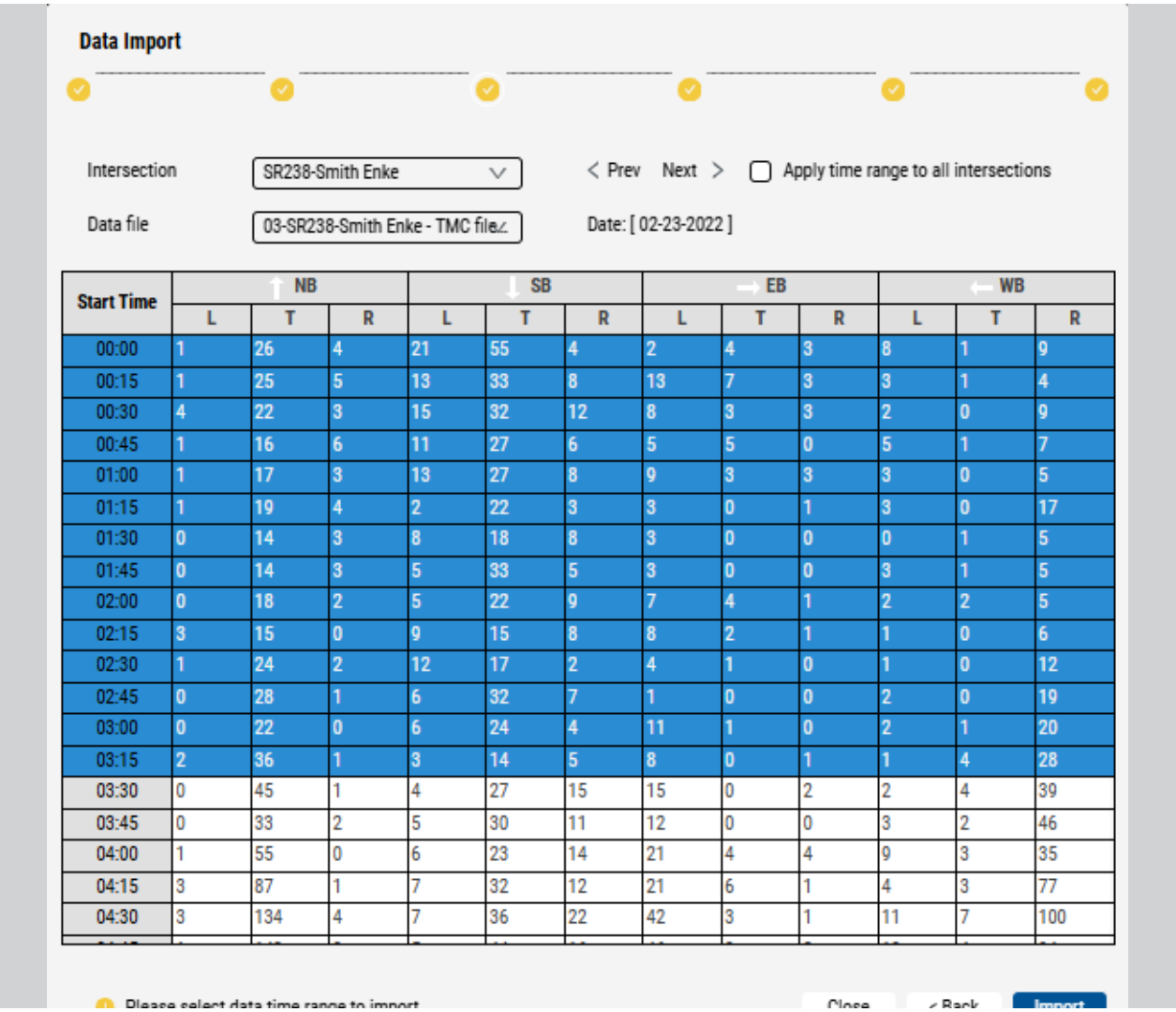
5. It is possible to preview some metadata to make sure the selection is correct.



6. Click on the intersection name to check the data. It is collected into fifteen-minute bins.

7. Select the time range and click ***Import***.

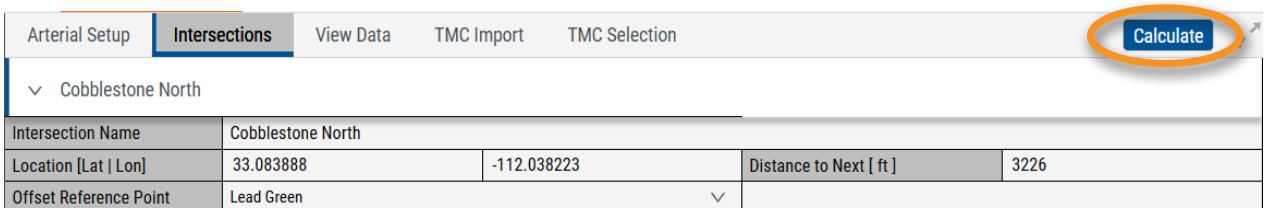
Note: Changes can be discarded before they have been saved.
Once saved, changes cannot be undone.



Start Time	NB			SB			EB			WB		
	L	T	R	L	T	R	L	T	R	L	T	R
00:00	1	26	4	21	55	4	2	4	3	8	1	9
00:15	1	25	5	13	33	8	13	7	3	3	1	4
00:30	4	22	3	15	32	12	8	3	3	2	0	9
00:45	1	16	6	11	27	6	5	5	0	5	1	7
01:00	1	17	3	13	27	8	9	3	3	3	0	5
01:15	1	19	4	2	22	3	3	0	1	3	0	17
01:30	0	14	3	8	18	8	3	0	0	0	1	5
01:45	0	14	3	5	33	5	3	0	0	3	1	5
02:00	0	18	2	5	22	9	7	4	1	2	2	5
02:15	3	15	0	9	15	8	8	2	1	1	0	6
02:30	1	24	2	12	17	2	4	1	0	1	0	12
02:45	0	28	1	6	32	7	1	0	0	2	0	19
03:00	0	22	0	6	24	4	11	1	0	2	1	20
03:15	2	36	1	3	14	5	8	0	1	1	4	28
03:30	0	45	1	4	27	15	15	0	2	2	4	39
03:45	0	33	2	5	30	11	12	0	0	3	2	46
04:00	1	55	0	6	23	14	21	4	4	9	3	35
04:15	3	87	1	7	32	12	21	6	1	4	3	77
04:30	3	134	4	7	36	22	42	3	1	11	7	100

Compute Timing Plan

Once the data has been imported successfully, click on the blue ***Calculate*** button in the top right corner of the screen.



This is when the algorithm computes the optimal phasing offset values, and the Coordination diagram.

Phase Sequence Diagram

DEFAULT VIEW

This diagram is generated based on the imported TMC data. It suggests the optimal order and duration of coordinated phases, as well as the cycle length. The diagram features the following elements:

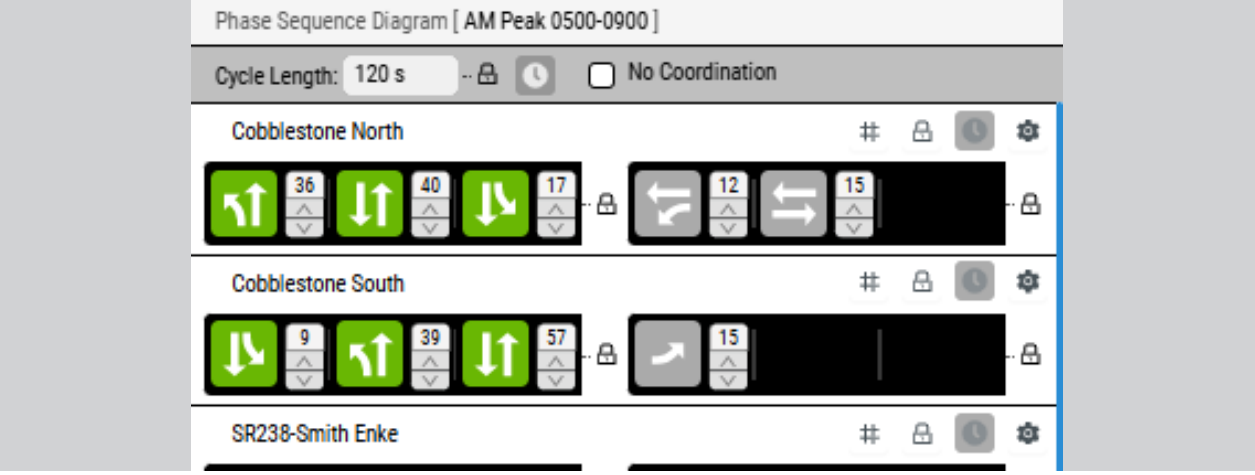
a. Phases on the coordinated movement are shown in green.

b. Phases on non-coordinated movements are grayed out.

c. Inactive phases take an empty frame.

d. Suggested duration of each phase is shown on the side.

e. Phase durations can be extended or reduced manually by clicking on small up and down arrow buttons.

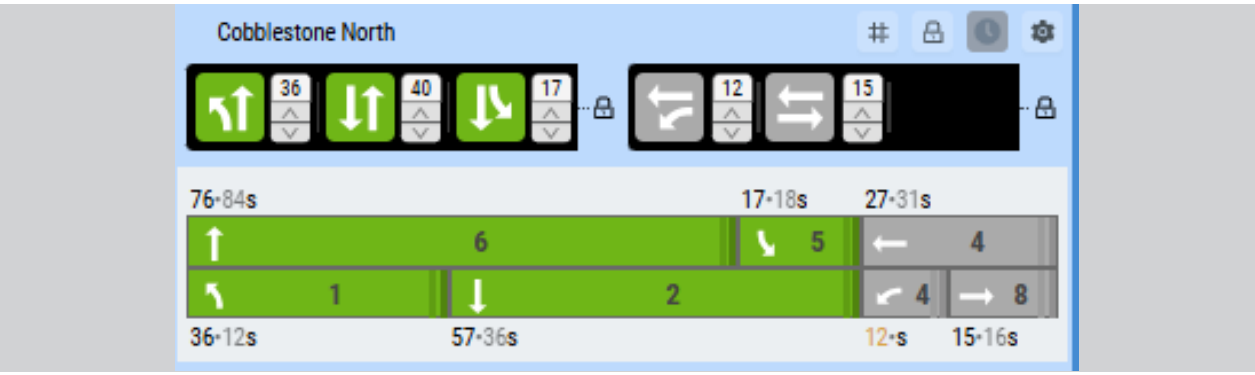


f. Optimal cycle length is displayed under the title bar. Il can be manually adjusted, if needed.

TRACKS VIEW

This feature allows some manual adjustments of the phase sequence duration. These options are meant to assist traffic professionals in matching the system-computed configuration with the observed field conditions.

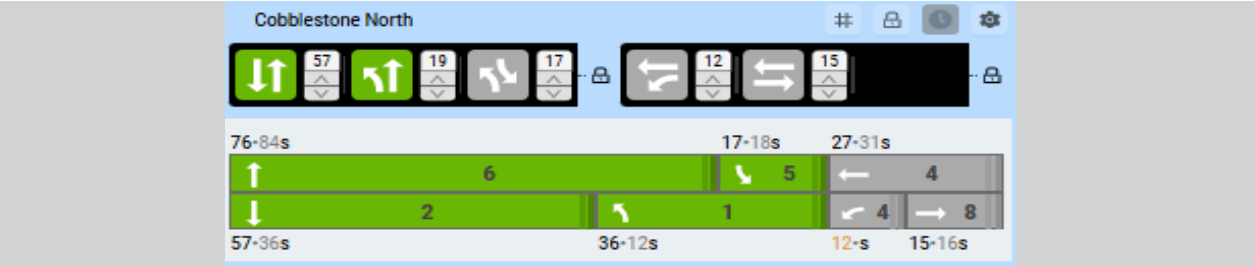
1. The Phase ***Tracks*** button  on the right of the phase row opens this view.



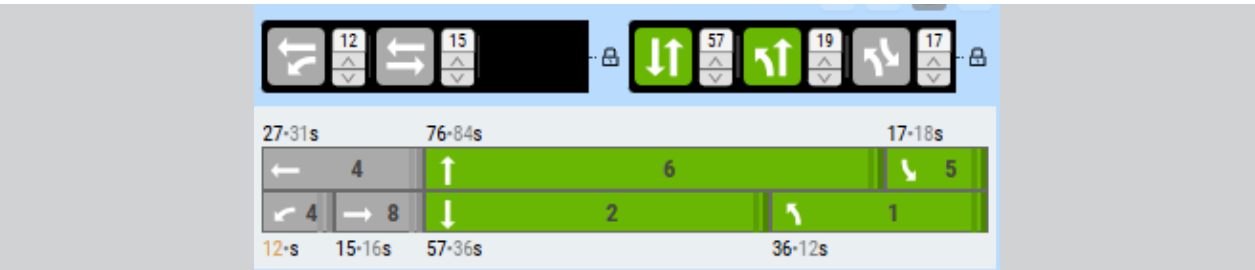
2. Select from the drop down of available options:

- **Remove** – Discard a phase from the ***Tracks View*** to see how this impacts the tunnel.
- **Swap Phases** – You can have the order of phases re-arranged in case that might optimize the throughput for either the coordinated corridor or the side streets. For

example, this option may be used when a lag phase needs to be avoided.



- **Swap Segments** – This swap changes the places of the coordinated and non-coordinated phases on the two sides of the barrier. This may help when you need to make sure that the platoon will hit the start of the green phase on arrival at the intersection.



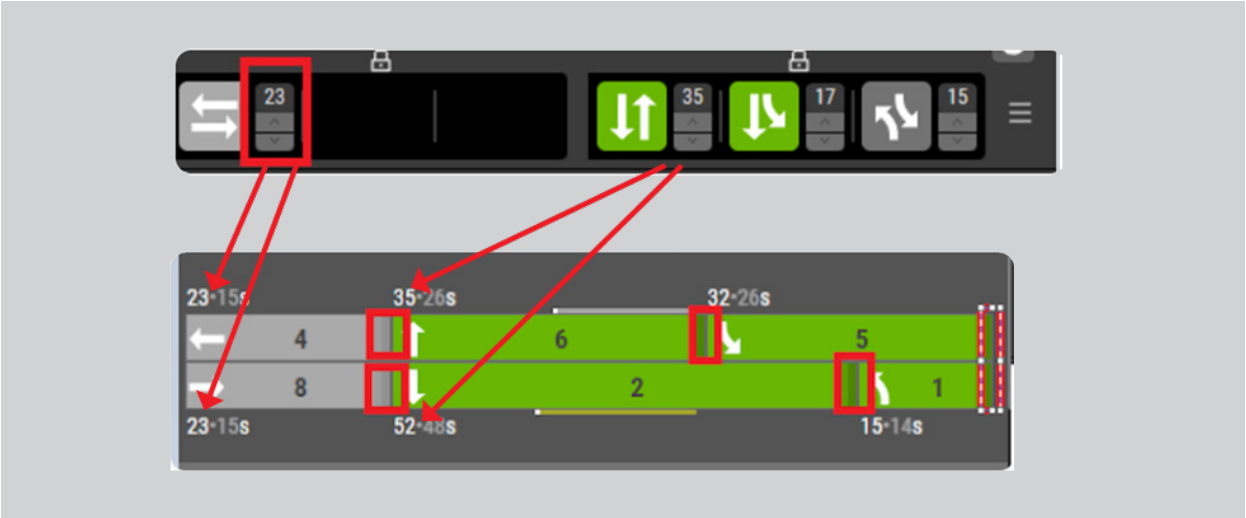
3. Manipulate a phase and state duration.

A State is a pair of concurrent phases that can be green simultaneously without conflict. The figure next to the state icon depicts the duration of the state i.e., summed up for both concurrent phases. State (Phase pair) duration can be changed from the up and down arrows but will also be reflected in the tracks of the individual phases.

You can adjust the tracks, but that will also impact the state duration. For example, if one phase duration is made longer, other phase durations may need to be decreased to maintain the cycle length.

Note that the state icon shows the common duration of the two concurrent phases. For instance, phases 6 and 2 (both Through movement) are calculated to run for 35s and 52s, respectively. Phase Duration for NT 6 and ST 2 is 35 and 52 seconds respectively. The State Duration for NT/ST is 35. State duration for ST/SL is 17.

Refer to the image below. State duration is show in the top next to the State. Phase duration is down in the bottom near each Phase.



Use Case: Prohibiting a Lag Phase

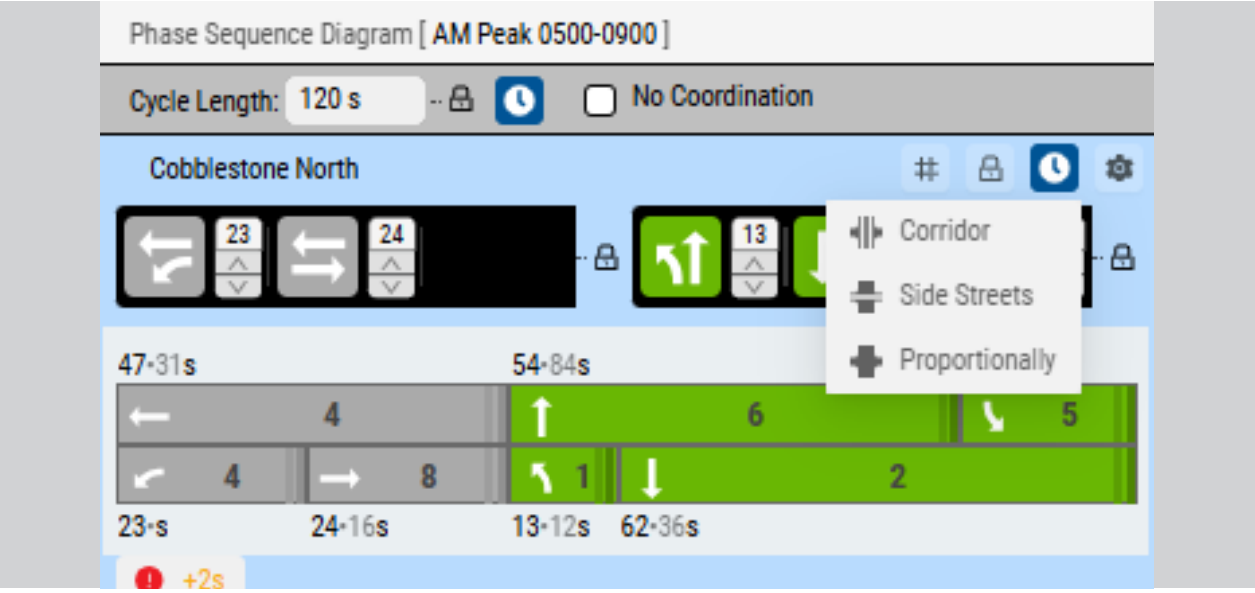
This can be achieved by either defining appropriate settings in the ***Intersections*** tab for Left Turn Position and Left Turn Type, or by manually adjusting the phasing in the ***Tracks View***.

1. Define the Left-turn Position on the Intersections tab to be different from Laggable i.e. Lead. To further reduce risk, set the Left Turn Type to be Protected or Protected-Permissive.
2. If the above setup is not possible or if you so prefer, you can reshuffle the phases directly on the Phase Sequencing diagram e.g., place phase 6 (EBT) to start before phase 7 (WBL) - to avoid it running simultaneously with another left turn in the EBL phase.

Cycle Length Clock

Whenever there is excessive or insufficient cycle time that needs to be reconciled, the Cycle Length clock at both intersection and arterial level is highlighted in blue. When the cycle length is balanced, the clock will be off and its color will be white. This feature allows quickly visualizing whenever the clock needs corrections for consistency.

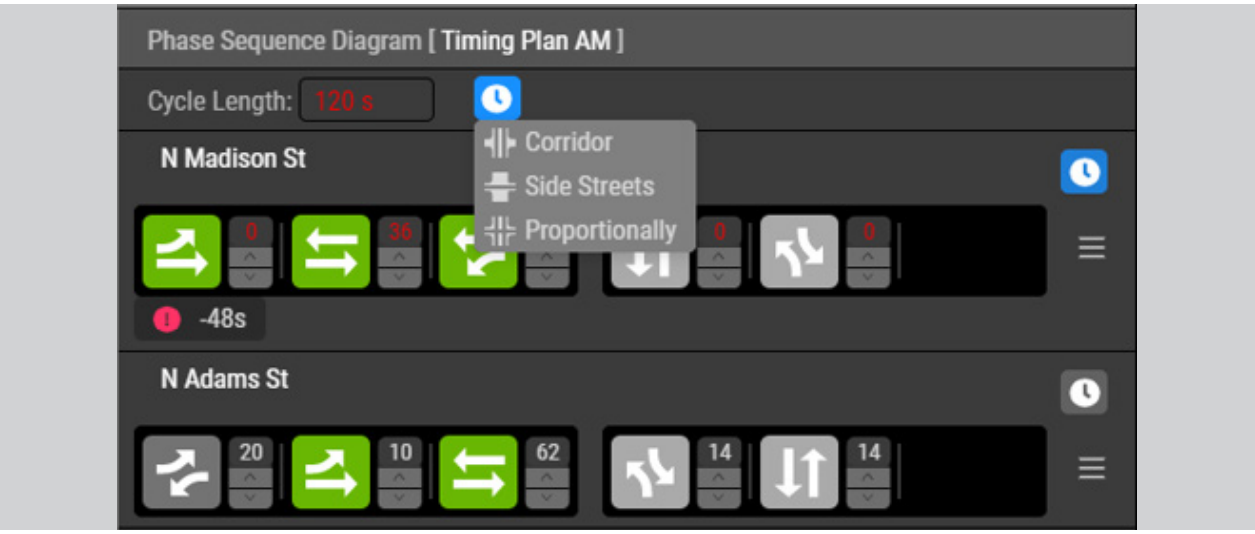
- **Intersection Clock** – The system will display a red alert under the intersection phasing row that indicates the exact time delta. This will require to either distribute the outstanding time across phases or cut down on phase duration, where necessary. To balance the cycle length, choose a delta distribution model from the drop-down menu of the clock (i.e., Corridor, Side Streets or Proportionally).



- **Corridor** – Choosing that option will distribute the time evenly across each of the coordinated phases (green). On the example below, the system has added 16 seconds to each of the coordinated states.

- **Side Streets** – Choosing this option will split the time evenly between the non-coordinated phase pairs (gray).
- **Proportionally** – Choosing this option will distribute the time across all existing states on the intersection. In the example below, the system has added 10 seconds to the first coordinated and the two non-coordinated phase pairs and 9 seconds to two of the coordinated phase pairs. The delta distribution is based on the proportions of turning movement volumes.

- **Arterial Clock** – Choosing to reconcile the time delta at an overall level will trigger a bulk update for all intersections where there is discrepancy.



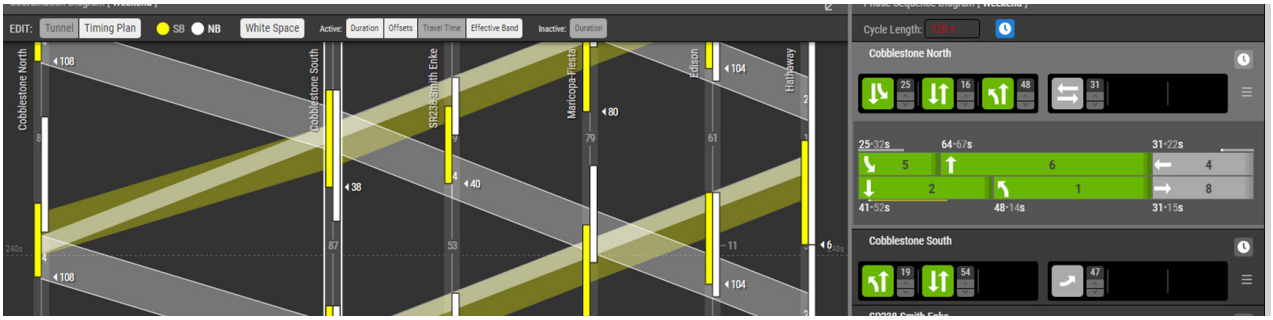
Corridor Distribution

Side-street Distribution

IMPACTS

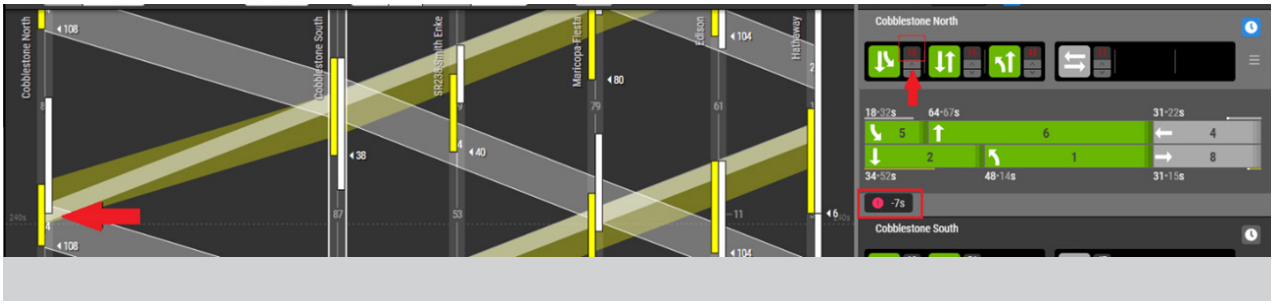
Changes on the Phase Sequence diagram will be reflected in the Coordination Diagram when it is in a Timing Plan mode. To illustrate this, the example below will change the optimal state duration, calculated by the system.

- The State Duration for 5 and 2 or ST/SL is computed as 25 sec. You can see this in the STSL State block at the top as 25. The next picture shows what happens when you decrease this State Duration from 25 to 18. This results in being 7 seconds under the cycle length (-7s).



- If you decrease the state duration to 18 seconds, the vertical tunnel bars on the Coordination Diagram also change, because they are being re-calculated in real time.

- The update also results in seven seconds over the default cycle duration. This delta has to be redistributed among other phases.



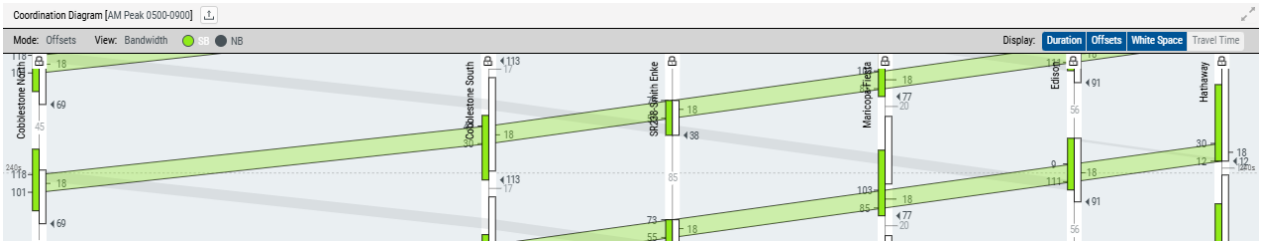
Time-Space Coordination Diagram

The TS Coordination diagram is generated after completion of the three steps described so far: Arterial Setup, TMC Import and Phase Sequencing. It illustrates the relationship between time and space when moving along the arterial, with offsets for riding the green tunnel. The diagram also suggests a plan for non-coordinated movements, which get a green in between the coordinated phases. The diagram is generated when you click the ***Calculate*** button in the upper right corner.

- **Command Bar** - The Command Bar features the option for viewing and modifying the coordination diagram:

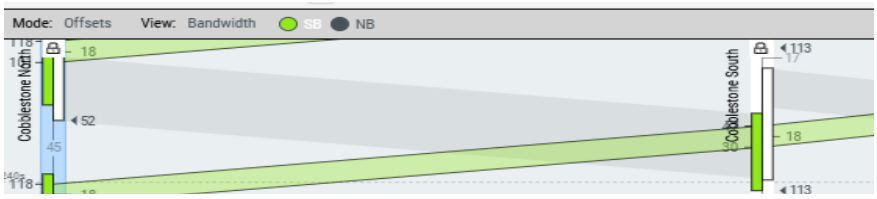
- **Approach** – The amber and white radio buttons indicate each of the approaches on the coordinated tunnels.
- **White Space** – You can choose to highlight the time between tunnels, a.k.a. the white space so that you can inspect how the non-coordinated movements are being served.
- **Active** – The active tunnel has a number of settings that you can switch on and off: duration, offsets, travel time, effective band. This allows you to inspect them separately or interconnectedly.
- **Inactive** – The only setting you can highlight and inspect for the inactive tunnel is the duration.

- **X axis** – Represents the distance between intersections and direction of travel.
- **Y axis** – Represents the time.



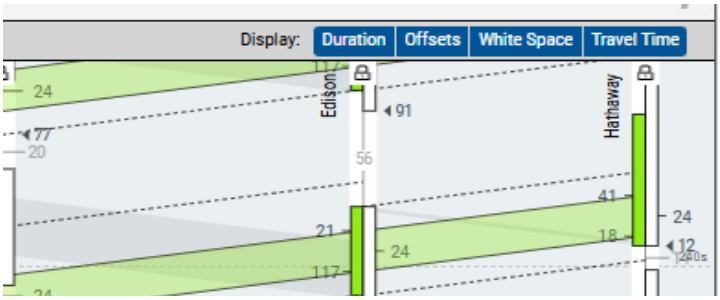
The diagram displays a number of parameters, for customizing the view, as explained below:

- **Forward and opposite direction** – In this case EB stands for the forward direction and is highlighted in yellow. WB is the opposite direction and is colored in gray.
- **White Space** – The time between tunnels is shown in small white figures.



- **Travel Time Lines** – Visualizes a dotted line that indicates the travel time computed by

the system in comparison with the effective band and offsets duration. To play with the Travel Time lines you can drag one of the green reference points up or down.

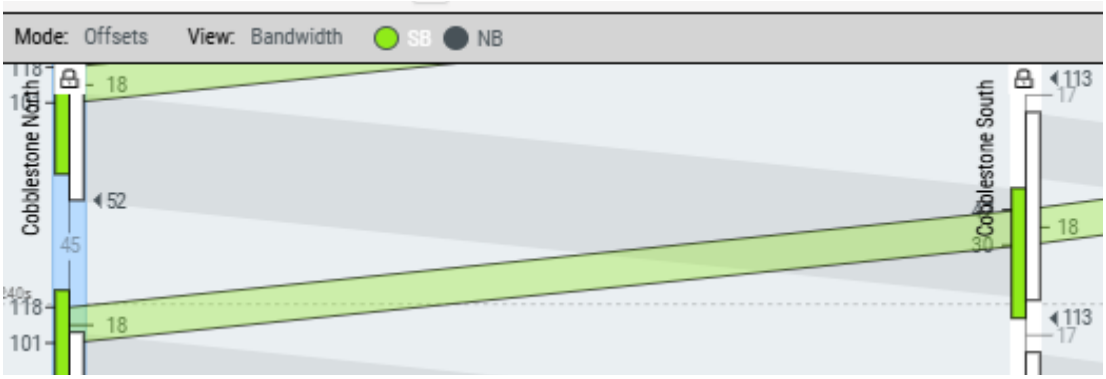


- **Effective Band** – The optimal duration of a tunnel that will allow the motorist to hit the green light at all intersections without stopping, provided that they were driving with the speed defined in the Arterial setup.

Adjusting the Offsets

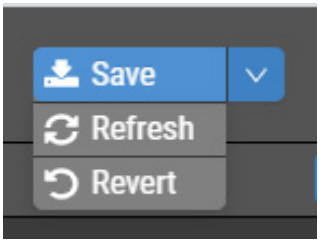
The interface allows adjusting the offsets manually. The system allows selecting the intersection and dragging the offset up/down to visualize the impact of progression and bandwidth..

1. Place the cursor on the highlighted intersection until it shapes into a double-pointing arrow.



2. Drag the line slowly and notice that the offset changes along with the effective green band.

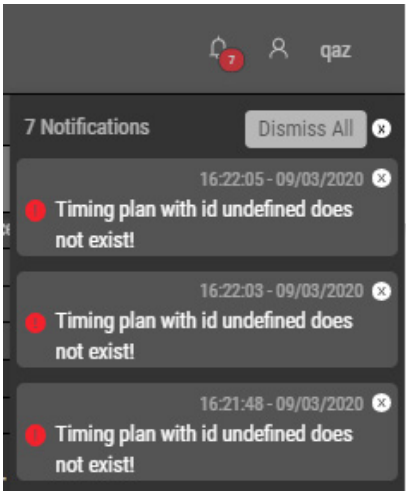
3. When you are done with the adjustments, save the changes.



- **Save** – Once you hit the ***Save*** button, changes are saved permanently.
- **Revert** – Retrieve the previous settings if you do not want to save your changes.
- **Refresh** – Refreshes the data values in case the system is stuck.

Alarms

The alarm icon, located in the upper right corner of the screen, displays warnings on errors with intersection settings, system incidents, lack of data, and other issues. A small figure overlaying the icon will indicate how many new alarms are there. Those are viewable in a drop-down list.



If you have any further questions or require further support please don't hesitate to reach out to us.

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