# **Vissim Coding Style Guide**

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| **Description:** | Coding Style Guide – Developed to maintain consistency in Vissim Model Coding. |
| **Date:** | December 16, 2019 |

This guide was developed to maintain consistency in Vissim model coding between partners at Kimley-Horn and Gorove/Slade for the K Street NW Traffic Analysis. This document should be referenced throughout the project. Any deviations from this document should be discussed in advance by the modeling team. This document is intended to be a living document that will be updated throughout the project and used to record project assumptions. Any additions or revisions should be recorded with a change log and an explanation for the update to the style guide.

# Study Area

The model study area is defined by the following elements:

* The extents of the study area are K Street NW, from 22nd Street to 9th Street.
* Additional intersections to either side of K Street are modeled at 21st Street, 17th Street/Connecticut Avenue, 16th Street, 15th Street (15th and L only), 14th Street.
* In total, the study area includes 25 intersections along K Street and the aforementioned side streets.
* Service lanes will be coded in as one (1) lane (i.e., the parking lane will not be included).
* Pedestrian crosswalks will be coded, and pedestrian volumes will be included as inputs according to collected data.
* All transit stops will be included in the model and coded according to available data from WMATA and field-collected data.
* Bicycle and scooter movements will not be included along K Street where dedicated cycle lanes are not present. If calibration cannot be achieved, these movements may be added into the model at that point (Reference: DDOT meeting 12/09/2019).
* The cycle track on the west side of 15th Street and the bi-directional bike lanes on 11th Street will be modeled.

# Vissim Elements

This section provides the agreed-upon style for coding Vissim elements. **This model will be developed using Vissim 11**.

## Basemap

* This study will use an aerial base map provided by Gorove/Slade because the Vissim default Bing base map image is not sufficient for model development.
* A design drawing will be imported as the background base map for the future build scenarios.

## Links/Connectors

This study area is comprised of an urban arterial network; therefore, no guidance on freeway link development is provided.

* **General Coding Principles**
  + Links should be split any time the number of lanes or lane restrictions change.
  + Spline points should be used to appropriately replicate lane geometries; however, excessive spline points are not recommended.
  + Links should extend approximately 5 feet into the intersection beyond the stop bars (at both approaches and departures).
    - Connectors should be used to connect intersection approach and departure links.
    - Left turning movements should be coded with 8-12 spline points.
    - Right turning movements should be coded with 6-10 spline points.
  + Connector length should be kept at a minimum.
* **Lane Width**
  + All links will be coded with a standard width of 11 feet.
  + Exception: Right and left dedicated turn bays will be coded with a 10 feet width.
  + Further adjustments to these may be made during calibration as needed.
* **Lane Drops/ Lane Addition**
  + Lane drops (e.g., travel lanes going from three lanes to two lanes) should be coded with a single connector from the upstream link to the downstream link. This enables typical merging behavior and prevents discrepancies in routing.
    - The upstream link (e.g., with three lanes) should extend through half of the taper zone, where the connector and downstream link (e.g., with two lanes) will begin.
  + The same principle should be followed for lane additions (e.g., travel lanes going from two lanes to three lanes).
  + *Note* – the only time multiple connectors should be used is when connecting to multiple downstream links (e.g., turning bays).
* **Intersection Turning Movements**
  + Dedicated turning pockets or turning bays should be coded as separate parallel links to ensure vehicles enter the turn bay at the beginning of the bay and that no unrealistic lane changing occurs between the through and turning vehicles.
    - Connectors from the mainline should start at the beginning of the taper and end at the point the bay reaches its full width (not necessarily where the striping begins).
  + Lanes with shared turning movements will not be coded as separate links.
  + Right Turn on Red (RTOR) movements at signalized intersections will be coded with a stop sign associated with the appropriate signal group and located at the stop bar where the signal head is placed.
    - RTOR stop signs will be coded by extending the turning connector upstream to cover the signal head on the link.
  + Pavement Markings should be included at all intersection approaches for all lanes to clearly indicate which movements are allowed from each lane.
  + Service Lane Interaction with the mainline at intersections should be coded carefully using Google Street View and videos collected during data collection.
* **Pedestrian Crosswalks**
  + Pedestrian crosswalks should be placed as close as possible to the actual crosswalks.
  + Crosswalks should be coded as two separate parallel links for movements in each direction.
  + Crosswalk lengths should be based on the extents of the intersection plus 20 feet of queueing length for pedestrians on either side of the intersection.
  + Crosswalk widths should be 7.5 feet per direction to match the approximate 15-foot width of the full crosswalks on K Street.
    - At intersections with a large number of pedestrians (e.g., K Street and Connecticut), crosswalk widths may be increased and overlapped to better replicate field conditions.
* **Bicycle lanes**
  + The two-direction cycle track on the west side of 15th Street will be modeled using two 4.5-foot links, separated from the vehicle travel way by approximately 1 foot.
  + The bi-directional bike lanes on 11th Street will be modeled using two 4.5 links—on the east and west side of 11th Street—directly neighboring the vehicle travel way.

## Signal Control

* **Vehicle Signals**
  + Signal heads should be placed on stop bars or as close as possible.
  + Vehicle detectors will not be coded because all signals are operating on Max Recall, no detectors on network.
  + Leading Left Turn movements combined with permitted left turns will be modeled using the “OR” signal group.
    - The “OR” signal group is used over an Overlap because for the case of leading-left turns, it leads to more realistic slowing behavior from the “yellow” phase given before the “permissive” phase begins.
  + All other overlapping phases will be modeled using Overlaps coded into the RBC file.
    - This will ignore the “yellow” phase and allow consistent flow between shared phases.
* **Pedestrian Signals**
  + Pedestrian signals should be placed outside of the traveled right-of-way to avoid overlap with vehicle movements.
  + Pedestrian detectors will not be coded because Ped Recall is activated on all intersections in the corridor.
  + Leading pedestrian intervals should be coded as Leading pedestrian intervals (LPI) should be coded to add in an overlap associated with the parent signal group, and a “delay green” with the maximum split for the LPI (i.e., three seconds) is activated. Parent signal group splits are set to the total split of the vehicle phase plus the LPI.
    - *Note* – it is common for DDOT to have these leading pedestrian intervals and the reviewers pay close attention to these elements.
  + Rest on walk should be coded in RBC timing plan to allow pedestrians maximum walk time until the count down begins.
* Signal .RBC files will be generated from the Synchro files provided by DDOT.
  + Updated timing cards are not available from the most recent retiming efforts; therefore, Synchro timings will be used and verified from Gorove/Slade data collection efforts.
* .CSV exports from Synchro will be converted into .RBC files in Vissim.
  + Prior to export, the synchro file should be updated with the project-specific intersection numbers and “TS2 - First Green” should be set as the “Referenced to” field.
  + Once exported into an RBC file, the following elements should be validated/added as necessary:
    - Overlaps – often missing from Synchro Export
    - Vehicle Detectors (not necessary due to max recall)
    - Pedestrian Detectors (not necessary due to ped recall)
    - Leading Pedestrian Intervals
      * This is modeled as a vehicle phase with max recall checked under RBC timing plan. This is not a basic setting, and under non ped recall conditions, requires the addition of a vehicle detector that will be placed on the pedestrian crosswalk overlapping with the pedestrian detector.
    - Control Mode/Coordination
      * Max1 (Max Green Time) 🡪 If signal is running on fixed timing, not coordinated with other signals.
      * MaxInhibit (ignore Max1 and serve split in Pattern) 🡪 if signal is coordinated with neighboring intersections. Since all signals in the network are operating with max recall in coordination, all signals should be coded with MaxInhibit, and Max Recall should be activated for all phases.
    - All rings have an associated reference phase (note – export often misses reference phase for a third ring).
    - Pedestrian Max Recall (all signals should be in Ped Recall).
    - Pedestrian Walk-In-Rest
  + Once .RBC files are imported and edited, any changes to signal timing (e.g., optimization in future conditions) should occur in parallel in the Synchro and .RBC files, rather than re-exporting from Synchro.
    - This is critical to reduce the propensity for error in missing the manual updates needed for each .RBC file. We have discovered that in Vissim 11, the signal heads and detectors will be automatically deleted (i.e., no error as in previous versions) and stop signs/priority rules disassociated with their respective signal groups when the .RBC file is not coded correctly.
    - It is important to keep the Synchro file updated with changes to .RBC files as we will submit these to DDOT with each deliverable of the Vissim model.
    - The only exception to this rule would be in cases where major signal timing changes, and signal head associations/detectors/stop signs/other signal elements need to be updated.

## Conflict Areas

* Conflict areas should be used anywhere in the network where two links/connectors overlap, are not grade separated, and the conflicts are not controlled by signals or priority rules.
  + Common areas in which conflict areas are necessary: intersection turning movements and branching (merge/diverge) conflicts.
  + Exception: Overlap between connectors and links should be minimized to reduce the conflict area between them; however, these conflict areas should be kept at no interaction (i.e., yellow-yellow).
* Parameters defining conflict areas for different purposes should be coded as provided in the table below.
  + These parameters may change during calibration.

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| --- | --- | --- | --- | --- | --- |
| Type of Conflict Area | Default? | Front Gap | Rear Gap | Safety Distance Factor | Anticpate Routing |
| Pedestrian Conflicts | *Use Priority Rules* | | | | **0%** |
| RTOR | No | 1.0 | 1.0 | 2.0 | 100% |
| Permitted Left Turns | No | 1.5 | 1.0 | 1.0 | 100% |
| Permitted Left vs. Right Turns | *Use Priority Rules* | | | |  |
| Branching Conflicts (Red-Red) | **Yes** | **0** | **0** | **1.5** | **100%** |
| Right-In-Right-Out Access to Service Lanes | No | 1.0 | 1.0 | 2.0 | 100% |

## Priority Rules

Priority rules may be used to supplement conflict areas to better replicate real-world conditions.

* Priority rules should be used for Permitted Left vs. Right Turn conflicts.
* Priority rules should be used to replicate intersection “Keep Clear” or “Clear the Box” behavior.
  + Not all intersections should have “Keep Clear” protocols. Coding of this behavior should be based on field observations where drivers respect this rule.
    - For K Street, this will likely be correlated with the locations with “Traffic Control Officers” enforcing traffic control at intersections. Please reference field notes.
    - These locations will be updated during calibration.
  + To Code – Place red bar slightly upstream of signal head and green bar at the further edge of the intersection box. Set a condition for the priority rule to only be activated during green times of the corresponding signal phase.
* The default parameters for priority rules are provided in the table below.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Type of Priority Rule | Association with Signal Controller | Min Gap Time [sec] | Min Headway [ft] | Max Speed [mph] |
| Permitted Left vs. Right Turns | Yes – When permitted left turn phase is green. | 3 | Set the first marker (red marker) at the stop bar for the left turn. Set the second marker (green marker at the end of the right turn connector.  The headway should be set to include the full distance of the right turning movement. | 111.8 mph (default) |
| Intersection “Keep Clear” or “Clear the Box” | Yes – Downstream Signal, Associated Phase when red.  Close intersection Spacing | 0 | Dependent on the distance the modeler is desiring to keep clear (e.g., intersection length). Set first marker (red marker) at the intersections stop bar, and second marker (green marker) at the downstream intersection departure.  Assign the headway to approximately half the length of the intersection. | Between 8-13 mph depending on traffic conditions.  Starting point: 12 mph |
| Zipper Merge | N/A | 2 | \*This behavior is modeled with two priority rules on each approach to the zipper merge.  Set first marker (red marker) at the yield location prior to the merge. Place the second marker (green marker) on the link with the opposing merge, downstream of the stop bar for that direction’s priority rule.  The headway should be set to not overlap with the stop bar of the opposing priority rule. | 111.8 mph (default) |
| Right turn conflicts with pedestrians (Parallel) | No. | 1 | Red marker at stop bar, green marker on both crosswalks (approx half of intersection) | Approx half of intersection. |
| RTOR with perpendicular peds | Yes | 1 |  |  |
| Permitted Left turn conflicts with peds | Yes | 1 |  |  |

## Lane Change Distance

For arterial links, lane change distance should be kept at default (i.e., 656 feet) during model coding. Adjustments to these distances will be made during calibration on a case-by-case basis.

## Reduced Speed Areas

Reduced speed areas should be used to realistically represent speed selections based on roadway curvature.

* Right turns at intersections: linear distribution between 9-13 mph (Use Right Turn distribution in Template).
* Left turns at intersections: linear distribution between 13-17 mph (Use Left Turn distribution in Template).
* In cases with a non-standard turning radius, use AASHTO Exhibit 3-16.

## Desired Speed Decisions

Desired speed decisions are commonly used to associate vehicles with the posted speed limit at network entry points and any location in which the posted speed limit changes. However, the K Street NW network has a consistent speed limit of 25 mph throughout the corridor. Therefore, desired speed distributions will be associated with vehicle classes and desired speed decisions will not be used.

## Nodes

Nodes will be used to collect intersection MOEs throughout the network.

* Nodes should remain “polygon” style unless they are required to be converted to “segment” style (e.g., may be necessary for overlapping nodes or removal of specific links).
* Nodes should be numbered according to the pre-defined numbering system assigned during data collection, volume balancing, and all count databases.
* Node descriptions should be made with the mainline and crossing street, matching the descriptions used during data collection, volume balancing, and all count databases.
* Nodes should be drawn to include all intersection movements, and should cut through links (i.e., avoiding connectors).
  + Nodes will not be drawn at service lane access points.
* Nodes should only include links/connectors of interest; therefore, if the node overlaps links/connectors at different locations (e.g., overpass), the node should be converted from “polygon” to “segment” and the non-relevant links/connectors should be removed.
  + The non-relevant links/connectors can be removed from the .HTML file (opened in a text editor by searching for the node and deleting them from the list).

## Unsignalized Intersections

The K Street study area does not include any unsignalized intersections. The service lane midblock access points are not modeled with a stop sign, rather with conflict areas to replicate observed behavior in the field.

## Vehicle 2D & 3D Models

The project template will be developed with the *North American Vehicle Classifications*, considering DDOT’s truck length restriction of 55 feet. Truck 2D/3D models will be updated based on 48-hour classification counts. Bus 2D/3D models will be updated to match the bus fleet observed in the field. This bus fleet included WMATA buses, DDOT Circulator buses, and Corporate Buses from MTA and Loudon county.

## Project Specific Considerations

### Service Lanes

* Service lanes will be modeled as one-lane in each direction (i.e., not considering the second lane used for parallel parking/loading zones). Areas with heavy parking density will be identified during volume balancing and will be represented as driveways in the Vissim model.
* Midblock access points to service lanes will be modeled as “right-in-right-out”.
  + Due to a noticeable number of left turn entry and exit movements, this may be adjusted during model calibration.
* Interaction between conflicting mainline and service lane movements at intersections will be modeled with conflict areas on a case-by-case basis based on the intersection configuration. Special care should be taken in how the intersections are coded, where turning movements are allowed (e.g., right turns from mainline onto crossing streets or through movements from service lanes to mainline).

# Vehicle Inputs and Routing

Vehicle inputs and routing will be incorporated into the Vissim model in the following manner:

* An Inputs spreadsheet will be created to pull in the balanced peak hour volumes, as well as the 15-minute volume fluctuations at each network input location.
  + This inputs spreadsheet should contain all vehicle, pedestrian, and bicycle inputs for the network.
  + This spreadsheet will produce a \*.TXT file that can be used to automatically generate vehicle inputs in VHelper.
* Vehicle inputs will be added into the network using VHelper.
* Vehicle routes will be manually coded in at each intersection using a pre-defined numbering scheme for each route and each movement.
  + This numbering scheme will be used to correlate the balanced volumes with the routes, so that the volumes can be automatically updated as needed.
  + The vehicle routes should start as far upstream of the intersection as possible.
  + The “combine vehicle routes” parameter should be selected to allow vehicles to see ahead to their next route.
* Once inputs and routes are incorporated into the network, volumes should be QC’d in VHelper to ensure volumes were correctly loaded.

# Summary Calibration Adjustments

The following are a list of pre-defined elements and parameters that may need adjustment during calibration. Further discussion of calibration protocol will be discussed and documented once reaching that project stage.

* Lane change distances.
* Driving behavior parameters.
* “Keep Clear” Priority Rules at intersections.
* Conflict area parameters.
  + Shorten min gap for Priority Rules (peds)
* Priority rule parameters.
* Lane width adjustments (note – Synchro file has lane widths included).
* Left-turning into and out of service lane mid-block access points.
* Bicycle and scooter movements in crosswalks and service lanes.
* Lane blockages or construction activities identified during the field observations.