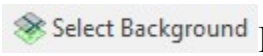
SYNCHRO INPUTS CHECKLIST

NOTE:

- **See Synchro User Guide for step-by-step instructions and detailed definitions of terms and settings**
- **Documentation shall be provided to NHDOT Bureau of Traffic for all traffic data collected**
    - **Support for all deviations from default values must be fully documented to receive approval**



BACKGROUND SETTINGS

- A scaled background should be included in every model
- Either Background image file or Bing Aerial may be used
- Add curvature to links to approximate the background image geometry
    - This is a right-click menu option once the links are drawn in the file

LANE SETTINGS

- **Movement Labels (Top Line) –** toggle selection to match direction of State road where feasible (may be different than map orientation and compass direction)
- **Lanes and Sharing** – Based on roadway geometry/lane use
- **Traffic Volume (vph)** – Based on traffic turning movement counts for peak hour of intersection or entire network if evaluating more than one intersection (vehicles per hour)
- **Street Name** – Enter Street Names for each direction of travel
- **Link Distance** – Automatically generated based on Map View drawing
    - This field allows the user to accurately designate the link distance
- **Link Speed** – Based on 85th percentile measured speed (preferred) or posted speed limit if speed data is unavailable
- **Travel Time** – Automatically generated based on speed and link distance
    - The value can be overridden by the user with documentation
- **Ideal Saturated Flow (vphpl)** – Typically 1900 vehicles per hour per lane (HCM 2000 recommended value)
    - This value is calculated assuming a 1.9 second headway
    - This value can be adjusted based on field observations of longer/shorter headways
    - Synchro will automatically adjust the saturated flow rate for lanes based on turning movement factors, heavy vehicles, bus stops, parking maneuvers, turning traffic, lane widths, grades, and area type
- **Lane Width (ft)** – Based on roadway geometry
- **Grade (%)** – Based on roadway geometry – slope of approach to intersection
    - (-)% for downgrade, (+)% for upgrade
- **Area Type CBD** – Typically unchecked for NHDOT signals
    - Based on surrounding land use (CBD = Central Business District or "downtown")
    - Check the box if the intersection is located in a urban "downtown" area (high parking turnover, high pedestrian volumes, short blocks)
- **Storage Length** – Length of turning bay (measured from stop bar to end of solid lane line)
    - Enter 0 to calculate demand when designing a turning bay (preliminary stage)
    - Enter 0 if storage bay extends back to previous intersection
- **Storage Lanes (#)** – Based on roadway geometry number of storage lanes available for queuing
    - Default value is 1

- **Right Turn Channelized** – Based on roadway geometry and existing/proposed traffic control for right-turn movement
    - None: No channelization
    - Yield: No phases are assigned, Saturated flow is the same as for RTOR
    - Free: Drivers continue into their own lane with no need to stop (100% Green Time), Permitted saturation flow value is used for calculation
    - Stop: Treated the same as Yield in model
    - Signal: The movement is controlled by the signal. Set the appropriate turn type and phase in the TIMING SETTINGS
- **Curb Radius (ft)** – Only applicable to channelized right turn, based on geometry
- **Add Lanes (#)** – Only applicable to channelized right turn, based on geometry
    - Enter 0 if the right-turning traffic must yield or merge with oncoming traffic
    - Enter 1 if the right-turning traffic enters into a continuation of the channelized lane (free movement)
- **Lane Utilization Factor** – Automatically Generated
    - This value may be adjusted based on field observations
- **Right Turn Factor** – Automatically generated based on HCM gap acceptance formula for right turns, Synchro-specific formula
- **Left Turn Factor (prot)** – Automatically generated based on HCM
- **Saturated Flow Rate (prot)** – Automatically generated
- **Left Turn Factor (perm)** – Automatically generated based on HCM
- **Right Ped Bike Factor** – Automatically generated based on HCM
- **Left Ped Factor** – Automatically generated based on HCM
- **Saturated Flow Rate (perm)** – Automatically generated based on HCM
- **Right Turn on Red?** – Check if right turn on red is permitted for that direction
- **Saturated Flow Rate (RTOR)** – Automatically generated based on turning volumes and signal timings
- **Link is Hidden** – Useful for nodes that require being evaluated as an intersection, but the dummy link has no lanes or volumes
    - Typically leave unchecked
- **Hide Name in Node Title** – Leave unchecked

VOLUME SETTINGS

- **Lanes and Sharing (#RL)** – Based on existing/proposed lane use
- **Traffic Volume (vph)** – Based on peak hour traffic turning movement counts (vehicles per hour)
- **Development Volume (vph)** – Automatically generated if using TIA module (not typically used by NHDOT)
- **Combined Volume (vph)** – Automatically generated if using TIA module (not typically used by NHDOT)
- **Future Volume (vph)** – Automatically generated if using TIA module (not typically used by NHDOT)
- **Conflicting Peds (#/hr)** – Number of pedestrians that will conflict with permissive left or right turning movements
    - Exclusive or No Pedestrian Phase: Enter a value of 0
    - Concurrent Pedestrian Phase: Enter vehicular peak hour pedestrian volume

- **Conflicting Bicycles (#/hr)** – Number of bicycles that will conflict with right turning movements
  - Bike lane on shoulder of roadway (to the right of right-turning vehicles): Enter vehicular peak hour bicycle volume
  - Pocket bike lane located between thru and right-turn lanes: Enter a value of 0
- **Peak Hour Factor** – $PHF = \frac{(Peak\ Hour\ Volume)}{4*(Peak\ 15-Minute\ Interval)}$
  - When calculating the PHFs, one weighted average of each PHF by movement should be used for entire approach to the intersection
    - For Existing conditions, and Opening Year No Build models
    - For Future year conditions when calculated PHF exceeds 0.90
  - PHF = 0.90 for all movements
    - For future Build scenarios when capacity is being increased with geometric improvements
    - For Future year conditions with calculated PHF under 0.90
  - If data is not available, PHF = 0.90 for all movements
  - If the upstream signal is at capacity (v/c ≥ 1.0), PHF = 1.0 for downstream approach
- **Growth Factor** – Background growth rate
  - Typically 1.0 because growth is included in the Traffic Volume value
  - Can be adjusted if solely background growth and no development to include
    - $GF = (1 + r)^Y\ where: r = growth\ rate; Y = number\ of\ years$
- **Adjusted Flow (vph)** – Automatically generated
- **Heavy Vehicles (%)** – Peak hour truck percentages
  - Should be based on peak hour turning movement count data
  - A weighted average should be used for each approach
    - If especially large heavy vehicle percentages (>8%) are measured for any movement, these percentages should not be averaged into the approach value.
  - If counts are not available, a default value of 2% may be assumed
- **Bus Blockages (#/hr)** – Number of buses blocking the lane per hour
  - Typically enter a value of 0
  - Enter the expected number of buses per hour if a bus stop is located on the approach without a pull-off
    - Example corridors that may be affected by bus blockages include Durham (UNH Wildcat Bus) and Lebanon on NH 120
- **Adj. Parking Lane?** – Used for parking lanes that are adjacent to the storage lanes on the approach
  - Check the box only if a parking lane extends beyond the solid lane line on the approach
- **Parking Maneuvers (#/hr)** – Number of parking maneuvers expected to be conducted adjacent to the storage lanes on the approach
  - Enter expected number of parking maneuvers (parking/exiting) per hour
- **Traffic from Mid-Block (%)** – Percentage of vehicles arriving from midblock sources between the current intersection and the next intersection upstream in Synchro.
  - A value of 50 indicates that 50% of the traffic originated from unmodeled driveways
  - A value of 0 (default value) indicates that 100% of the traffic originated from the next upstream modeled intersection
- **Link OD Volumes** – Automatically generated
- **Traffic in Shared Lane (%)** – Automatically generated
- **Lane Group Flow (vph)** – Automatically generated

TIMING SETTINGS

- **Lanes and Sharing (#RL)** – See **LANE SETTINGS**
- **Traffic Volume (vph)** – See **LANE SETTINGS**
- **Future Volume (vph)** – See **LANE SETTINGS**
- **Turn Type** – Based on geometry and preferred signal phasing
    - Typically mainline left-turns will be protected (Prot)
    - For permissive turns, product of the hourly left-turning volume and the opposing thru volume should be less than 100,000 (4-lane roadway) or 50,000 (2-lane roadway) per ITE guidance
- **Phasing**
    - Match existing phasing (obtain from NHDOT Bureau of Traffic)
        - Green times shown are max green, not splits
        - Cycle lengths at isolated intersections typically will not equal a round number
    - **Phases 1, 2, 5, 6** always assigned to major roadway
        - Phases 1 & 6 are assigned to either the Northbound or Eastbound approach (depending on major roadway orientation)
    - **Protected Phases** – The phases during which the movement is protected (no conflicting movements)
    - **Permitted Phases** – The phases during which the movement is permissive (conflicting with other movements)
- **Permitted Flashing Yellow** – Check off if FYA is to be used for the left-turn movement
    - Checkbox becomes available if **Turn Type** field is changed to *pm+pt* (permissive and protected)
- **Detector Phases** – The detector phases that will call the phase for that traffic movement
    - Typically not overridden, leave as default
- **Switch Phase** – Secondary phase that extends the entered phase when it is green. Can be used for the permitted phase under protected/permitted
    - Typically not overridden, leave as default
- **Leading Detector** (ft) – Typically 46 feet
- **Trailing Detector** (ft) – Typically (-4) feet
- **Minimum Initial (s)** – Minimum green interval
    - Major Approaches = 10 seconds
    - Minor Approaches = 5 seconds
    - Steep approaches require different values (steep upgrade requires higher min green, steep downgrade may allow for lower min green)
- **Minimum Split (s)** – Minimum Initial + Yellow Time + All-Red Time
    - Major Approaches = 16 seconds
    - Minor Approaches = 11 seconds
    - Minimum splits would change depending on grade, speed, and size of intersection
- **Total Split (s)** – Maximum Green + Yellow Time + All-Red Time
- **Yellow Time (s)** – Yellow change interval
    - The Yellow Time shall be calculated using: $Y = 1 + \frac{1.47v}{2(10+32.2G_{\%})}$ *(ITE yellow clearance formula)*
    - Minimum = 4 seconds

- **All-Red Time (s)** – All-Red change interval
  - The All-Red Time shall be calculated using: $R = \frac{w+20}{1.47v} - 1$ *(ITE red clearance formula)*
  - Minimum = 2 seconds
- **Lost Time Adjust (s)** – Equal to -2 seconds when Y = 4 and R = 2
  - Start-Up Lost Time is typically 4 seconds: $LTA = 4\ seconds - (Y + R)$
- **Lagging Phase?** – Not typically used for NHDOT signals for left-turn movements
  - NHDOT will consider if significantly improves operations
- **Allow Lead/Lag Optimize** – Lag phasing not typically used for NHDOT signals for left-turn movements
  - NHDOT will consider if significantly improves operations
- **Recall Mode** – Manner by which the phase will automatically be recalled by the controller, regardless of whether or not a call has been made
  - None: The phase can be skipped
    - Typically used for Minor Approaches
  - Min: The controller will always serve the Minimum Split and never skip the phase
    - Typically used for Major Approaches
  - Ped: The controller will always call the pedestrian phase (or phase concurrent with pedestrian movement) and the phase cannot be skipped or gap out until W+FDW/DW have timed out
  - Max: The controller will always call the Total Split and never skip the phase
  - C-Max: Not typically used by NHDOT for coordinated signals
  - C-Min: Typically used by NHDOT for coordinated signals
- **Speed Limit (mph)** – See **LANE SETTINGS**

NODE SETTINGS *(Yellow/White Panel on Left in Timings Windows)*

- **Control Type** – Manner by which timings are set in the controller
  - Pretimed: No detection necessary, Total Split for all phases called each cycle
    - Not typically used by NHDOT
  - Actd-Uncrd: Actuated uncoordinated, signal operates as isolated with full detection
    - Typically used by NHDOT for uncoordinated intersections
  - Semi Act-Uncrd: Semi-Actuated uncoordinated, Minor Approaches have detection, Major Approaches do not have detection
    - Not typically used by NHDOT
  - Actd-Coord: Actuated coordinated, signal operates in coordination along a corridor with detection
    - Typically used by NHDOT for coordinated signal systems
- **Cycle Length (s)** – Typically Max 120 seconds (4-leg intersection); Typically Max 90 seconds (3-leg intersection)
- **Lock Timings** – Prevents changing timing values for that intersection
- **Optimize Cycle Length** – Uses Synchro algorithm to optimize cycle length
  - A better result can sometimes be achieved by manually selecting cycle length
- **Optimize Splits** – Uses Synchro algorithm to optimize splits
  - A better result can often be achieved by manually changing splits
- **Offset (s)** – For coordinated systems, the number of seconds that the reference phase lags behind the Master reference point (or arbitrary reference if no Master is specified)
- **Reference to** – Beginning of Yellow for NHDOT
- **Reference Phase** –Typically Phases 2 & 6

- **Master Intersection** – Check if the intersection is part of a coordinated system, and is the master controller driving the coordination
- **Yield Point** – Default Single
- **Mandatory Stop on Yellow** – Not used by NHDOT

PHASING SETTINGS

- **Minimum Initial (s)** – See **TIMING SETTINGS**
- **Minimum Split (s)** – See **TIMING SETTINGS**
- **Maximum Split (s)** – See **TIMING SETTINGS**
- **Yellow Time (s)** – See **TIMING SETTINGS**
- **All-Red Time (s)** – See **TIMING SETTINGS**
- **Lagging Phase?** – See **TIMING SETTINGS**
- **Allow Lead/Lag Optimize?** – See **TIMING SETTINGS**
- **Optimize Phs Weights-Delays** – Typically use default 1.0
- **Vehicle Extension** – 3 seconds (coordinated); 5 seconds (isolated)
- **Minimum Gap (s)** – 3 seconds (coordinated); 5 seconds (isolated)
- **Time Before Reduce (s)** – Under volume-density operation, the amount of time before gap reduction begins
    - Not typically used by NHDOT
    - Has recently been successfully implemented on the Seacoast in congested areas to improve operations
- **Time to Reduce** – Under volume-density operation, time used to reduce the Vehicle Extension to the Minimum Gap value
    - Not typically used by NHDOT
    - Has recently been successfully implemented on the Seacoast in congested areas to improve operations
- **Recall Mode** – See **TIMING SETTINGS**
- **Pedestrian Phase** – Check if pedestrian phase runs concurrent with the phase
    - Exclusive pedestrian phase is typically assigned Phase 9
    - Pedestrian phasing is typically not used for TIAS
- **Walk Time (s)** – Pedestrian Walk time: Min = 4.0 seconds; Max = 7+ seconds
- **Flash Don't Walk (s)** – Pedestrian Clearance Interval
    - Measured from top of curb ramp to opposite curb, walking speed = 3.5 feet/second
    - If exclusive pedestrian phase: 3 seconds Don't Walk after FDW (can be taken from the overall pedestrian clearance time value)
- **Pedestrian Calls (#/hr)** – Number of pedestrian pushbutton calls per hour
    - If a value of 0 is entered for exclusive pedestrian phase, the phase will never appear in the analysis – A minimum of 5 peds/hour should be assumed for conservative analysis
- **Dual Entry** – On: The phase will appear when a phase is showing in another ring and no calls/recalls are present within the ring and barrier.
    - Typically Odd Phases are set to OFF, Even Phases are set to ON
    - Exception: split phasing

- **Fixed Force Off** – For actuated-coordinated systems only. The green time will be forced to terminate at a fixed point in the cycle
    - If Fixed Force Off is not checked, the green time will terminate whenever the phase gaps/maxes out, regardless of where in the cycle that time falls

SYNCHRO INPUTS CHECKLIST

SIMULATION SETTINGS

- **Lanes and Sharing (#RL)** – See **LANE SETTINGS**
- **Traffic Volume (vph)** – See **LANE SETTINGS**
- **Future Volume (vph)** – See **LANE SETTINGS**
- **Storage Length (ft)** – See **LANE SETTINGS**
- **Storage Lanes (#)** – See **LANE SETTINGS**
- **Taper Length (ft)** – Based on field conditions or proposed layout
- **Lane Alignment** – Default right for right-turns and left for thru/left-turns
    - L-NA and R-NA for (N-1) lanes coming into N lanes with no option lanes
- **Lane Width (ft)** – See **LANE SETTINGS**
- **Enter Blocked Intersection** – Based on field observations of drivers
    - Typically unchecked
- **Median Width (ft)** – By project
- **Link Offset (ft)** – Offset distance from centerline—can be used to model dog-leg intersection
- **Crosswalk Width (ft)** – Typically 6 feet
- **TWLTL Median** – By project, check box if applicable to the approach
- **Headway Factor** – Automatically generated
- **Turning Speed (mph)** – Default 15 mph (left) and 9 mph (right)
    - Increase values for intersections with wide turning radii

OUTPUT FORMAT

- **Preferred Formats**
    - Roundabouts: HCM 6
    - Unsignalized: HCM 6, HCM 2010, HCM 2000
    - Signalized: HCM 2000
- **Alternate Formats**
    - Synchro 8, 9, 10, or 11 (Lanes, Volumes, Timings) with justification documented
- **In Rare Cases, or In Conjunction with Other Analyses**
    - SimTraffic with justification and documentation of calibration procedures and adjustments
        - Use peaking/antipeaking
        - 30 minute seed
        - 1 hour run
        - Average 10 runs