

Highway Capacity Software 2010

Version 6.50
April 8, 2014



Highway Capacity Software

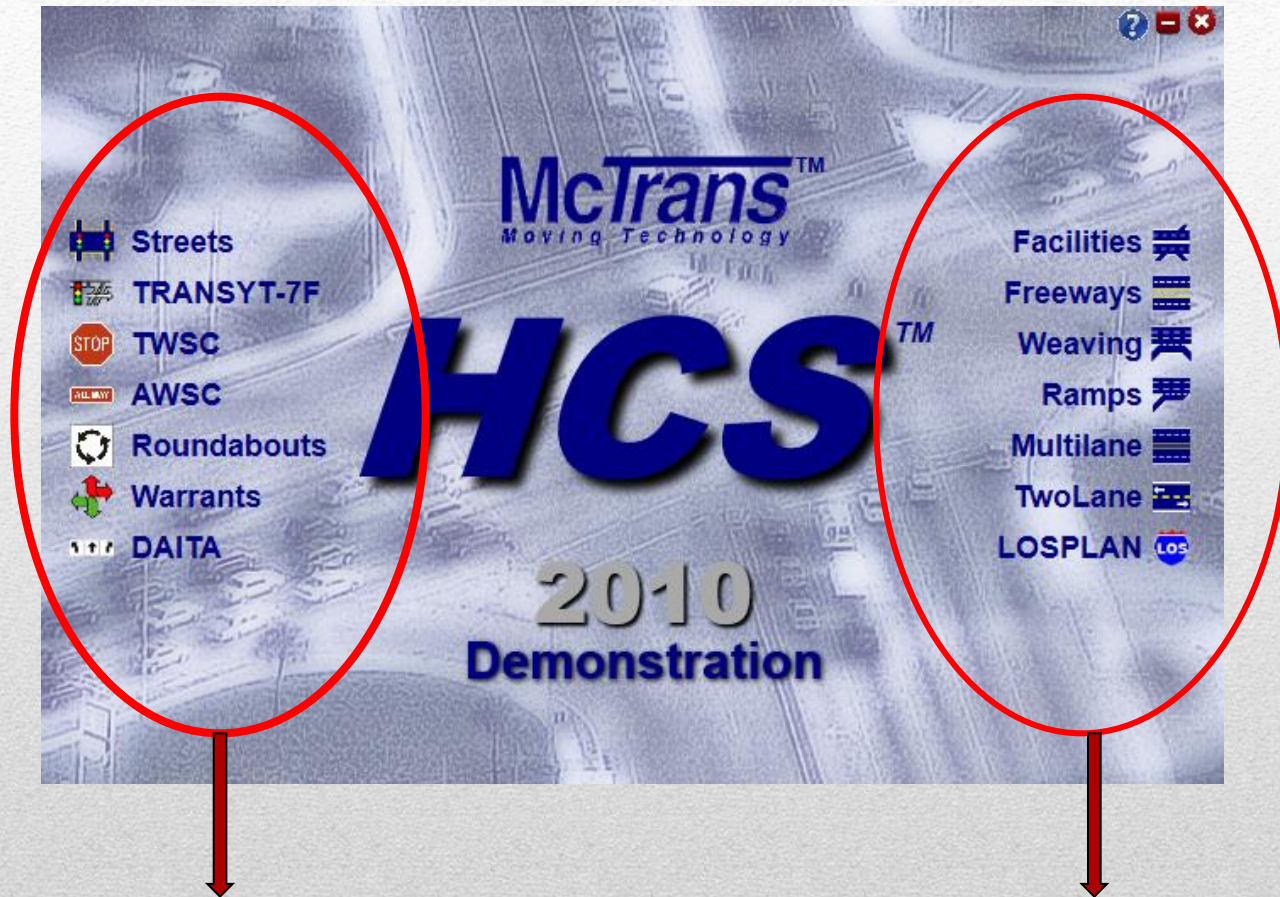
Developed and maintained by McTrans

- Originally founded by the FHWA in 1986 as the Center for Microcomputers in Transportation (McTrans)
- Now a full-service software support center, associated with the University of Florida

HCS 2010

- HCS 2010 implements the procedures defined in the Highway Capacity Manual (HCM) 2010 published by the Transportation Research Board (TRB)
 - This release includes the new Streets module that combines the Signalized Intersections with the Urban Streets Segments, Facilities and Multimodal procedures.
-

Fourteen Modules



Intersection Module

Highway Module

Street Module

Signalized Intersections

- Signal analysis
 - Interchange analysis
 - Multimodal analysis
 - LOS
-

Signalized intersections

■ Capacity

■ Defined for each lane group

- Lane group: one or more lanes that accommodate traffic and have a common stop-line and traffic move together

■ Lane group capacity: maximum rate of flow for the subject lane group that may pass through the intersection under prevailing traffic, roadway and signalized conditions

Signalized intersections

- Traffic Conditions
 - Approach volumes (left, through, right)
 - Vehicle type
 - Location of bus stops
 - Pedestrian crossing flows
 - Parking movement
-

Signalized intersections

- Roadway Conditions
 - Number and width of lanes
 - Grades
 - Lane use
 - Including parking lanes
 - Traffic Signal Characteristics
 - Signal phasing
 - Signal timing
 - Type of control
 - Signal progression
-

Signalized intersections

- Delay experienced by a motorist includes many factors:
 - Signal control
 - Geometrics
 - Incidents
-

Signalized intersections

- Total delay:
 - Difference between actual travel time and ideal travel time
 - In the absence of traffic control, delay due to roadway geometries, incidents and when there are no vehicles on the road
 - In HCS **control delay** is quantified
 - initial deceleration delay
 - Queue move-up time
 - Stopped delay
 - Final acceleration delay
-

Level of Service (LOS)

- Defined in terms of delay as a function of
 - driver discomfort
 - Driver frustration
 - Fuel consumption
 - Lost travel time
-

Level of Service (LOS)

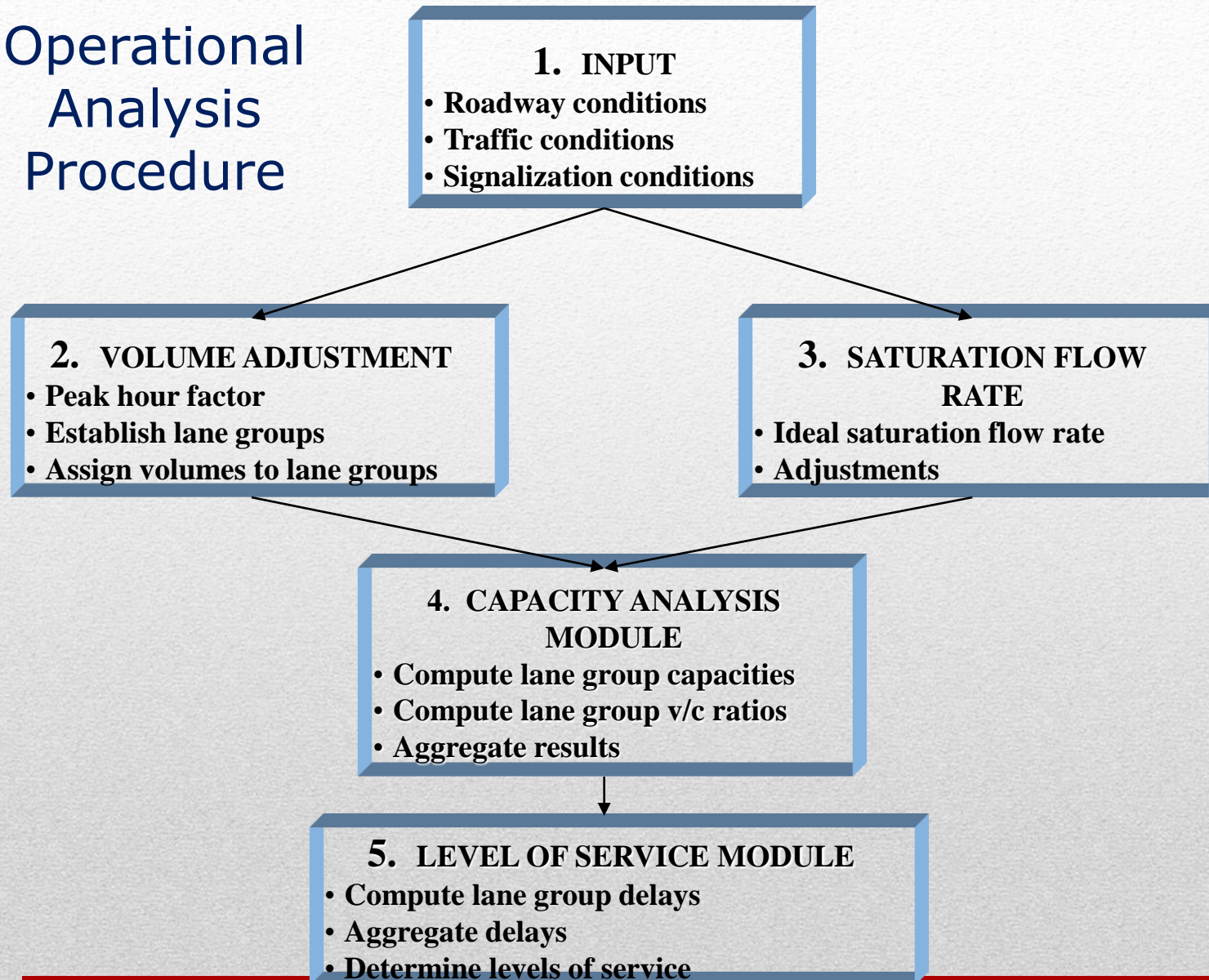
- LOS criteria are stated in terms of average control delay per vehicle
 - Delay on signal control depends on
 - Quality of progression
 - Cycle length
 - Green ratio
 - V/c ratio for lane group
 - Designated by letters A - F
-

Level of Service (LOS)

| LEVEL OF SERVICE | CONTROL DELAY PER VEHICLE (SEC/VEHICLES) |
|------------------|---|
| A | ≤ 10 |
| B | >10 and ≤ 20 |
| C | >20 and ≤ 35 |
| D | >35 and ≤ 55 |
| E | >55 and ≤ 80 |
| F | > 80 |

Source: Highway Capacity Manual 2010

Operational Analysis Procedure



Getting Started:

1. Open HCS 2010
2. Select the Streets *(handles signals and signalized corridors)*



Getting Started:

3. Complete The Quick Start Screen

Quick Start

Default Selections

| | | | |
|------------------------------|------|---------------------|-----|
| Number of Intersections | 1 | Cycle Length, s | 100 |
| Forward Direction | NB | Minimum Green, s | 5 |
| Number of Periods | 1 | Yellow Change, s | 4.0 |
| Analysis Duration, h | 0.25 | Red Clearance, s | 1.0 |
| Base Saturation Flow, pcphpl | 1900 | Passage Time, s | 2.0 |
| Speed Limit, mi/h | 45 | Detector Length, ft | 40 |

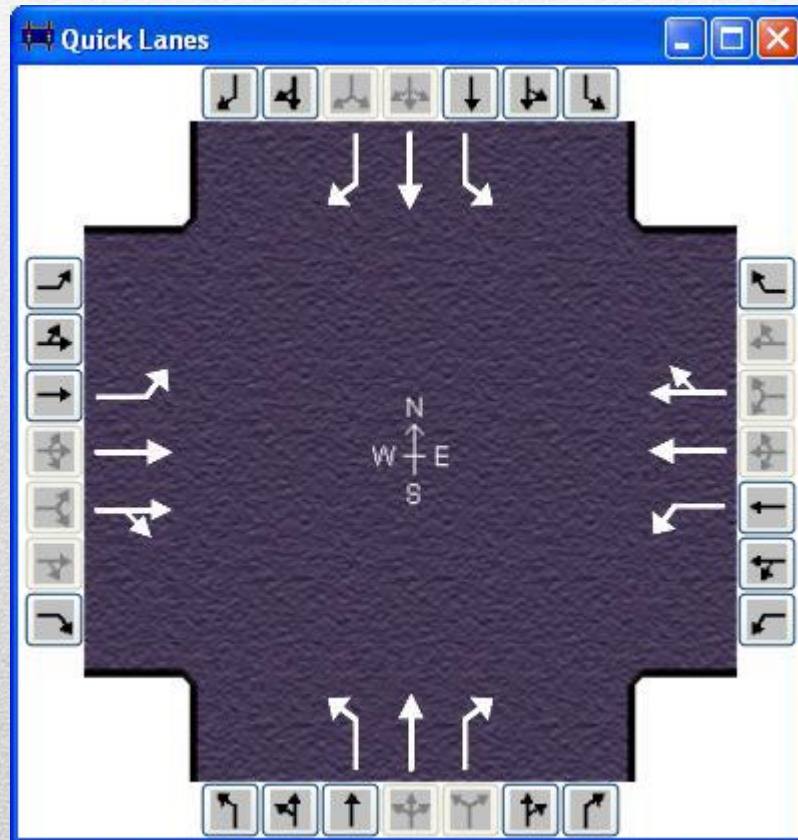
Template Help ?

4. Enter Information in the **General** Section

The screenshot shows the 'HCS 2010 Streets - [Streets2.xus *]' application window. The menu bar includes File, View, Edit, Windows, Reports, and Help. The toolbar contains icons for file operations, a traffic light, a street segment, a pencil, an eraser, and an information icon. The 'Classic Mode' tab is selected. The 'PRIMARY INPUT DATA' section is expanded, showing the 'General' sub-section. The 'Urban Street' field is set to 'SR 42', the 'Intersection' field is 'SR 42 @ Forest Pkwy', and the 'Description' field is 'Existing Geometry Design Year Traffic'. The 'Data File' field is 'Streets2.xus'. The 'Forward Direction' is 'NB' and the 'Area Type' is 'Other'. The 'Segment Length, ft' field is empty, and the 'Duration' field is '0.25'. The 'All Segment Lengths' button is visible, and the 'PHF' field is '0.92'.

| PRIMARY INPUT DATA | |
|---------------------|---------------------------------------|
| General | |
| Urban Street | SR 42 |
| Intersection | SR 42 @ Forest Pkwy |
| Description | Existing Geometry Design Year Traffic |
| Data File | Streets2.xus |
| Forward Direction | NB |
| Area Type | Other |
| Segment Length, ft | |
| Duration | 0.25 |
| All Segment Lengths | PHF |
| | 0.92 |

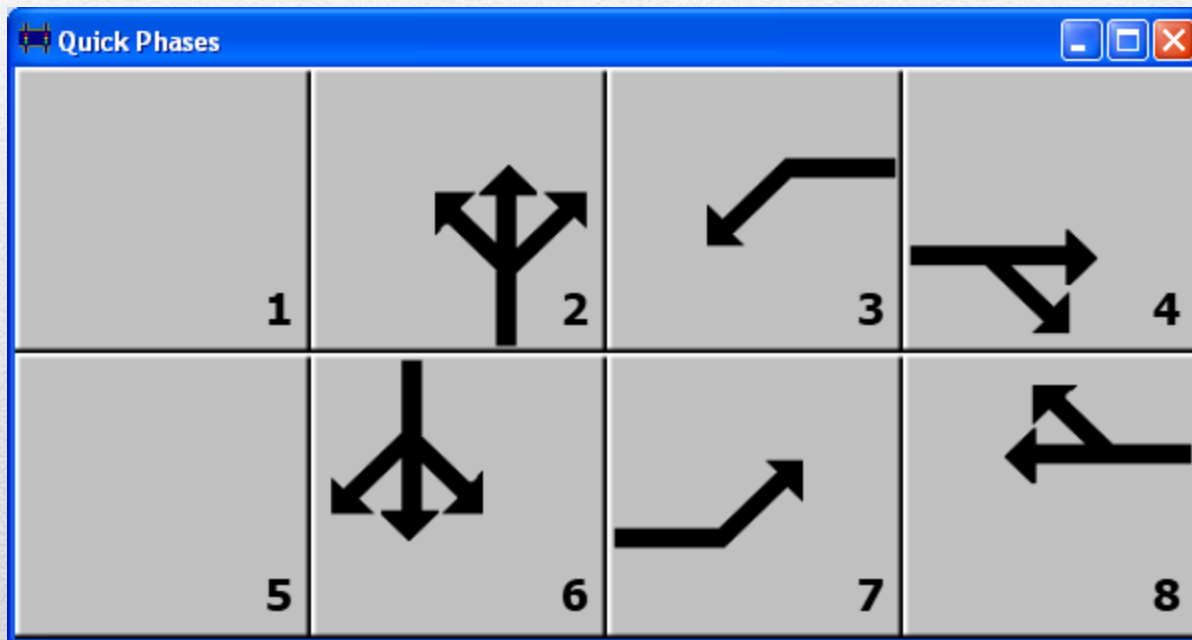
5. Enter **Lane Configuration**



6. Enter Traffic Data

| Traffic | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|------------------------|------|------|------|------|------|------|------|------|------|------|------|------|
| Demand, veh/h | 350 | 1315 | 285 | 385 | 740 | 125 | 130 | 320 | 240 | 225 | 780 | 310 |
| Lane Width, ft | 12.0 | 12.0 | 12.0 | 12.0 | 12.0 | 12.0 | 12.0 | 12.0 | 12.0 | 12.0 | 12.0 | 12.0 |
| Storage Length, ft | 350 | 0 | 0 | 300 | 0 | 0 | 190 | 0 | 300 | 200 | 0 | 370 |
| Saturation, pc/h/ln | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Heavy Vehicles, % | 10 | 10 | 0 | 10 | 10 | 0 | 10 | 10 | 10 | 10 | 10 | 10 |
| Grade, % | | -2 | | | 1 | | | 6 | | | -2 | |
| Buses, per h | | | 0 | | | 0 | | | 0 | | | 0 |
| Parking, per h | 0 | N | 0 | 0 | N | 0 | 0 | N | 0 | 0 | N | 0 |
| Bicycles, per h | | 0 | | | 0 | | | 0 | | | 0 | |
| Pedestrians, per h | | 0 | | | 0 | | | 0 | | | 0 | |
| Arrival Type | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Upstream Filtering (I) | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Initial Queue, veh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Speed Limit, mi/h | | 45 | | | 45 | | | 45 | | | 45 | |
| Detector, ft | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 |
| RTOR, veh/h | | | 0 | | | 0 | | | 0 | | | 0 |

7. Enter **Phasing** data



8. Enter Timing

| Timing | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|------------------|---|--|------|------|-----|------|-----|------|
| Phase Split, s | 15.0 | 40.0 | 15.0 | 40.0 | 0.0 | 45.0 | 0.0 | 45.0 |
| Yellow Change, s | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Red Clearance, s | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Minimum Green, s | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Lag Phase | <input type="checkbox"/> EL <input type="checkbox"/> ET <input type="checkbox"/> WL <input type="checkbox"/> WT <input type="checkbox"/> NL <input type="checkbox"/> NT <input type="checkbox"/> SL <input type="checkbox"/> ST | | | | | | | |
| Passage Time, s | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Recall Mode | Off | Off | Off | Off | Off | Mir | Off | Mir |
| Dual Entry | <input type="checkbox"/> EL <input checked="" type="checkbox"/> ET <input type="checkbox"/> WL <input checked="" type="checkbox"/> WT <input type="checkbox"/> NL <input checked="" type="checkbox"/> NT <input type="checkbox"/> SL <input checked="" type="checkbox"/> ST | | | | | | | |
| Dallas Phasing | <input type="checkbox"/> E/W <input type="checkbox"/> N/S | Simultaneous Gap <input checked="" type="checkbox"/> E/W <input checked="" type="checkbox"/> N/S | | | | | | |

| | | | | | | |
|--------|------|------|------|-----|-----|-----|
| | | | | | | |
| Green | 40.0 | 10.0 | 35.0 | 0.0 | 0.0 | 0.0 |
| Yellow | 4.0 | 4.0 | 4.0 | 0.0 | 0.0 | 0.0 |
| Red | 1.0 | 1.0 | 1.0 | 0.0 | 0.0 | 0.0 |

9. Enter the **Detailed** Data

DETAILED INPUT DATA

General

Analyst

Agency/Co

Date

Time Period

Analysis Year

Jurisdiction

General

Number of Calculation Iterations

Critical Merge Gap, s

Stored Vehicle Lane Length, ft

Length of Detected Vehicle, ft

Stored Heavy Vehicle Length, ft

Queue Length Percentile

Acceleration Rate, ft/s²

Stop Threshold Speed, mi/h

Pedestrians Pushing Button, prop

Speed Limit to Base FFS Ratio

Sneakers per Cycle, veh

Platoon Minimum Headway, s/veh

Platoon Maximum Headway, s/veh

Platoon Dispersion Factor

Demand Growth, %

Intersection

Lanes

Shared Lane

Percent Turns in Shared Lane

Percent Unopposed Left Turns

Heaviest Lane Volume, veh/h

Start-Up Lost Time, s

Extension of Effective Green, s

Walk Interval, s

Pedestrian Clear Interval, s

Receiving Lanes

Heavy Vehicle Equivalency Factor

Bus Blockage Time, s

Parking Maneuver Time, s

Opposing Right-Turn Lane Influence

Access Point

Critical Headway (left from major), s

Follow-Up Headway (left from major), s

Right-Turn Equivalency Factor

Maximum Turn Bay Length, ft

Deceleration Rate, ft/s²

Right-Turn Speed, ft/s

Access Points

Active

PHF

Demand, veh/h

Lanes

Name

Signal

Exclusive Pedestrian Phase Time, s

Right-Turn Equivalency Factor



Left-Turn Equivalency Factor

Deceleration Rate, ft/s²

Critical Headway (permitted left turn), s

Follow-Up Headway (permitted left turn), s

10. Run **Full Optimization**

 **Full Optimization** 




^ Input Parameters

Global Optimization

| | | | | | |
|--------------------|-------------------------------------|----------------------|-----|--------------------------|-------|
| Objective Function | Overall Delay | Minimum Cycle, s | 60 | Number of Generations | 50 |
| | | Maximum Cycle, s | 120 | Population Size | 10 |
| Cycle Length | <input checked="" type="checkbox"/> | Cycle Increment, s | 10 | Crossover Probability, % | 30 |
| Splits | <input checked="" type="checkbox"/> | Master Intersection | 1 | Mutation Probability, % | 4.0 |
| Offsets | <input type="checkbox"/> | Forward Weighting, % | 50 | Convergence Threshold, % | 0.010 |
| | | Reverse Weighting, % | 50 | Random Number Seed | 7781 |

Phasing Sequence ☒ Dallas Phasing ☐

Optimization Status
Diagnostic Messages

 Start
 Info
 Stop

Save Cancel

11. Optimization Results

The image shows a software window titled "Full Optimization". It contains two main sections: "Optimization Status" and "Diagnostic Messages".

Optimization Status

Overall Delay

| | |
|-------------|---------------|
| Original | 263.7 sec/veh |
| Optimum | 169.1 sec/veh |
| Average | 175.0 sec/veh |
| Improvement | 35.9% |

Run Status

| | |
|--------------------|----------------|
| Generation Number | 200 out of 200 |
| Generation Optimum | 101 |
| Total Time Elapsed | 43 sec |

Termination via max number of generations

Diagnostic Messages

No messages to report at this time.

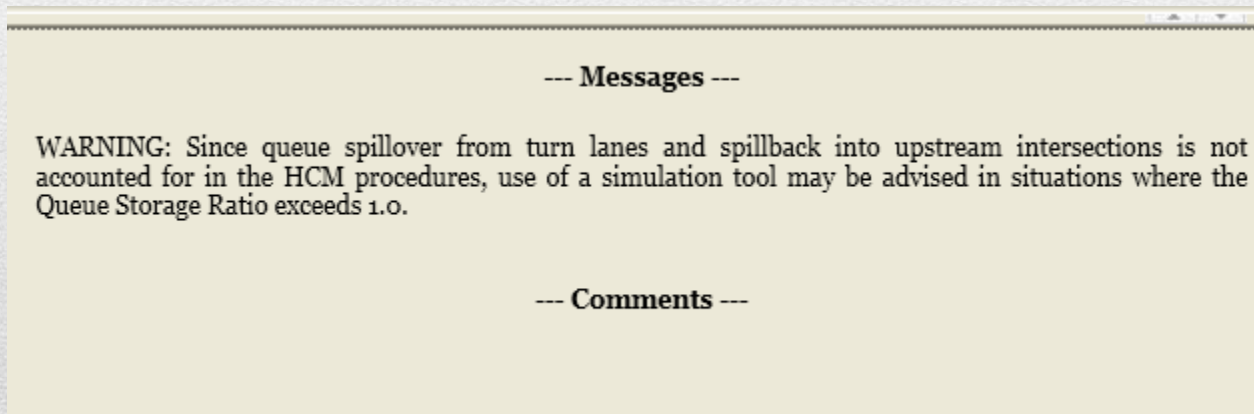
Buttons: Start (green circle), Info (yellow circle), Stop (red circle), Save, Cancel.

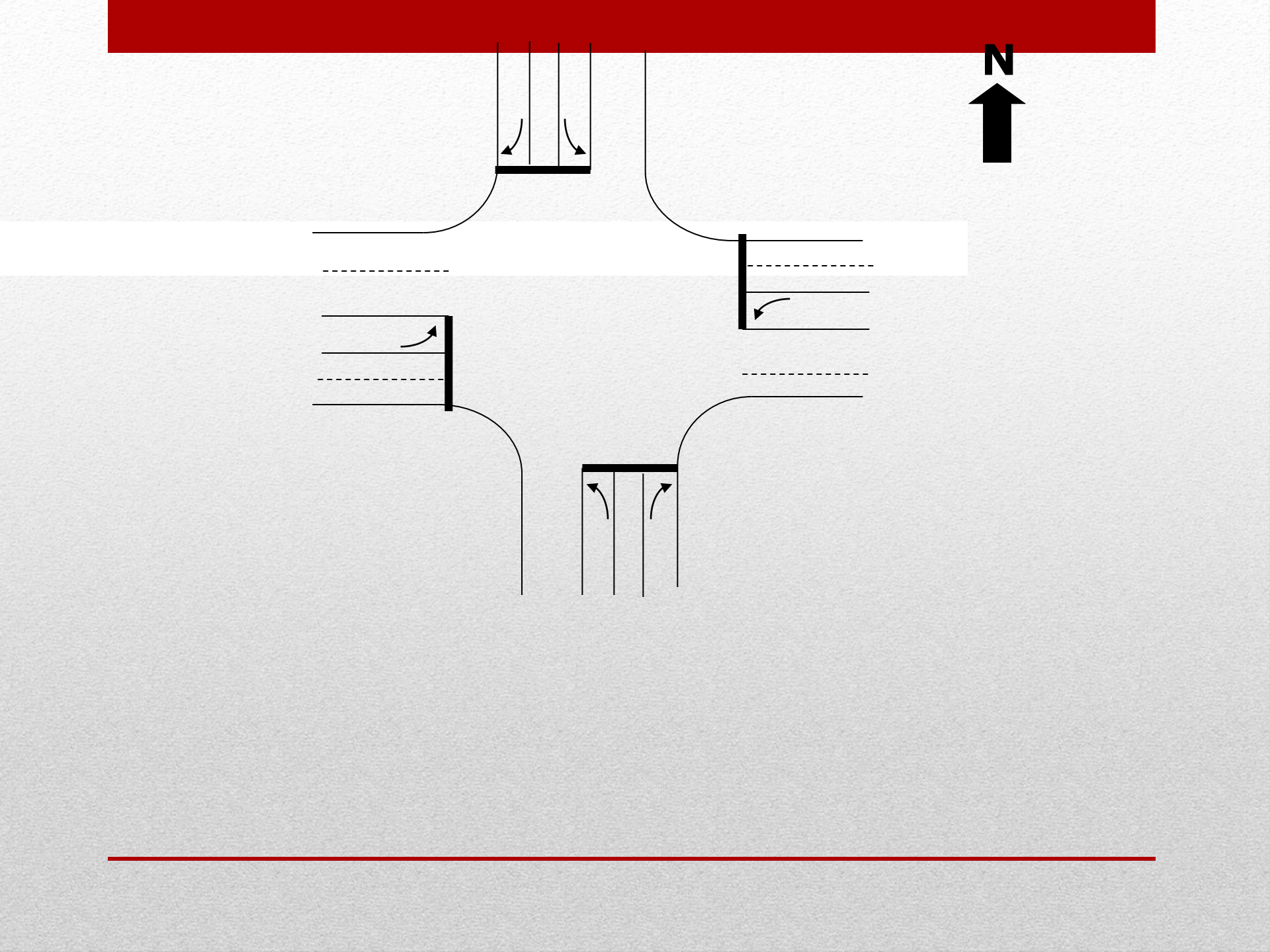
12. View/Print **Results** Summary Report

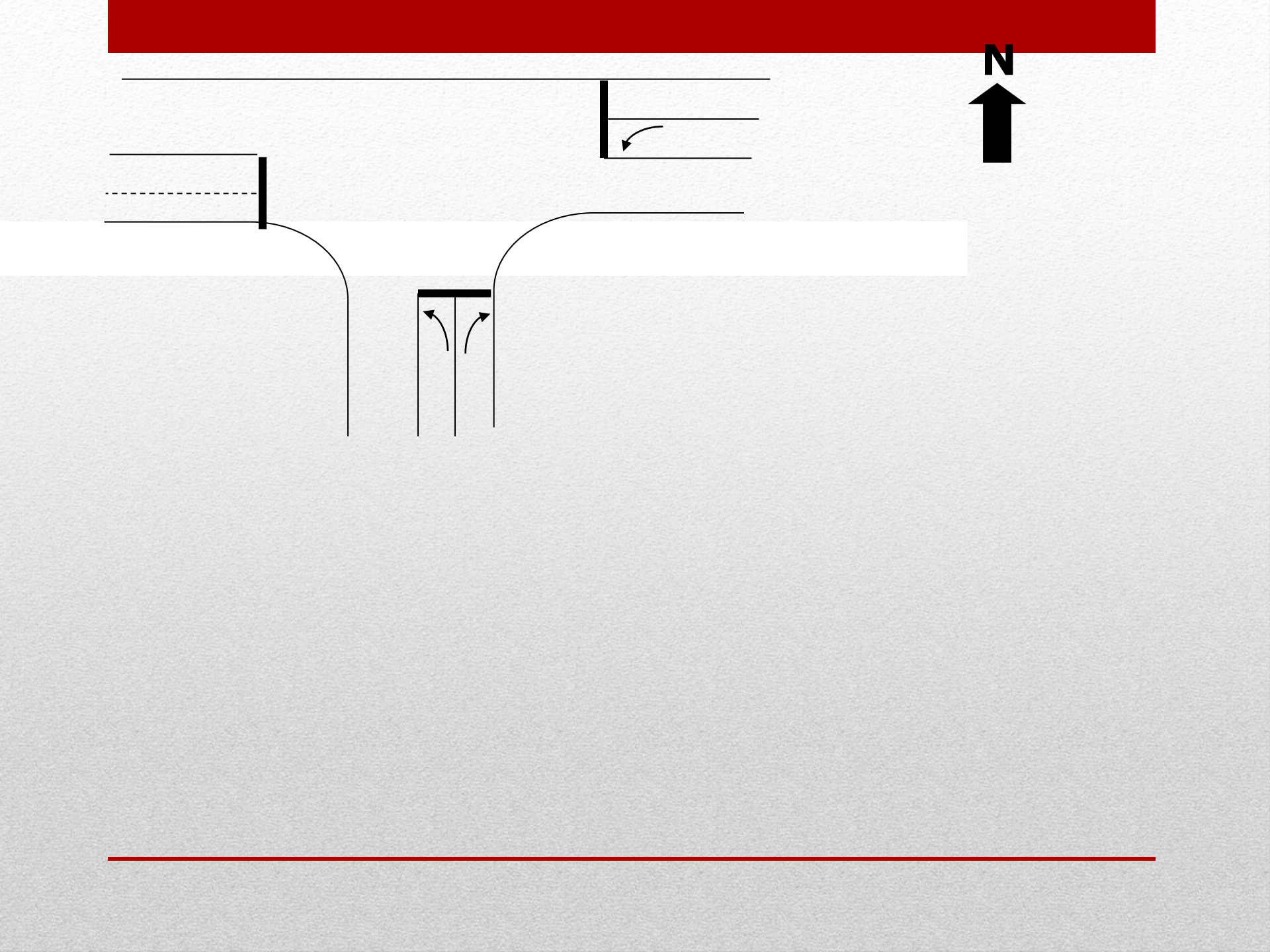
| HCS 2010 Signalized Intersection Results Summary | | | | | | | | | | | | | | | | | | | |
|--|---------------------------------------|-----------------|---------------|-------|--------------|--------------------------|---------|-------|-------|-------|-------|-------|-------|-----|------|-----|------|-----|--|
| General Information | | | | | | Intersection Information | | | | | | | | | | | | | |
| Agency | GDOT | | | | | Duration, h | 0.25 | | | | | | | | | | | | |
| Analyst | Design Engineer | | Analysis Date | | Apr 12, 2012 | Area Type | Other | | | | | | | | | | | | |
| Jurisdiction | Clayton County | | Time Period | | 2032 PM | PHF | 0.62 | | | | | | | | | | | | |
| Intersection | SR 42 @ Forest Pkwy | | Analysis Year | | 2012 | Analysis Period | 1> 7:00 | | | | | | | | | | | | |
| File Name | pdt example.xus | | | | | | | | | | | | | | | | | | |
| Project Description | Existing Geometry Design Year Traffic | | | | | | | | | | | | | | | | | | |
| Demand Information | | | | EB | | | WB | | | NB | | | SB | | | | | | |
| Approach Movement | | L | T | R | L | T | R | L | T | R | L | T | R | | | | | | |
| Demand (v), veh/h | | 350 | 1315 | 285 | 385 | 740 | 125 | 130 | 320 | 240 | 225 | 780 | 310 | | | | | | |
| Signal Information | | | | | | | | | | | | | | | | | | | |
| Cycle, s | 110.0 | Reference Phase | 2 | | | | | | | | | | | | | | | | |
| Offset, s | 0 | Reference Point | End | | Green | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | |
| Uncoordinated | No | Simult. Gap E/W | On | | Yellow | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | |
| Force Mode | Fixed | Simult. Gap N/S | On | | Red | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | |
| Timer Results | | | | EBL | | EBT | | WBL | | WBT | | NBL | | NBT | | SBL | | SBT | |
| Assigned Phase | | | 7 | 4 | 3 | | 8 | | | | NBL | | NBT | | SBL | | SBT | | |
| Case Number | | | 2.0 | 4.0 | 2.0 | | 4.0 | | | | 5.0 | | 5.0 | | 5.0 | | 5.0 | | |
| Phase Duration, s | | | 32.2 | 50.0 | 21.0 | | 38.8 | | | | 39.0 | | 39.0 | | 39.0 | | 39.0 | | |
| Change Period, (Y+R), s | | | 5.0 | 5.0 | 5.0 | | 5.0 | | | | 5.0 | | 5.0 | | 5.0 | | 5.0 | | |
| Max Allow Headway (MAH), s | | | 0.0 | 0.0 | 0.0 | | 0.0 | | | | 0.0 | | 0.0 | | 0.0 | | 0.0 | | |
| Queue Clearance Time (g _q), s | | | 0.0 | 0.0 | 0.0 | | 0.0 | | | | 0.0 | | 0.0 | | 0.0 | | 0.0 | | |
| Green Extension Time (g _e), s | | | 0.0 | 0.0 | 0.0 | | 0.0 | | | | 0.0 | | 0.0 | | 0.0 | | 0.0 | | |
| Phase Call Probability | | | 0.00 | 0.00 | 0.00 | | 0.00 | | | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | |
| Max Out Probability | | | 0.00 | 0.00 | 0.00 | | 0.00 | | | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | |
| Movement Group Results | | | | EB | | | WB | | | NB | | | SB | | | | | | |
| Approach Movement | | L | T | R | L | T | R | L | T | R | L | T | R | | | | | | |
| Assigned Movement | | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 | | | | | | |
| Adjusted Flow Rate (v), veh/h | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | |
| Adjusted Saturation Flow Rate (s), veh/hln | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | |
| Queue Service Time (g _s), s | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | |
| Cycle Queue Clearance Time (g _c), s | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | |
| Capacity (c), veh/h | | 412 | 714 | 670 | 238 | 527 | 501 | 65 | 518 | 439 | 188 | 539 | 457 | | | | | | |
| Volume-to-Capacity Ratio (X) | | 0.924 | 1.233 | 1.282 | 1.758 | 0.915 | 0.915 | 2.159 | 0.672 | 0.594 | 1.303 | 1.572 | 0.737 | | | | | | |
| Available Capacity (c _a), veh/h | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | |
| Back of Queue (Q), veh/ln (95th percentile) | | 15.2 | 58.8 | 61.9 | 47.3 | 21.1 | 20.3 | 21.8 | 13.5 | 10.4 | 22.9 | 82.4 | 13.9 | | | | | | |
| Overflow Queue (Q _o), veh/ln | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | |
| Queue Storage Ratio (RQ) (95th percentile) | | 1.17 | 0.00 | 0.00 | 4.25 | 0.00 | 0.00 | 3.09 | 0.00 | 0.94 | 3.09 | 0.00 | 1.01 | | | | | | |
| Uniform Delay (d ₁), s/veh | | 40.4 | 32.5 | 32.5 | 47.0 | 36.7 | 36.7 | 55.0 | 33.1 | 32.2 | 50.4 | 38.0 | 34.0 | | | | | | |
| Incremental Delay (d ₂), s/veh | | 3.9 | 116.9 | 138.0 | 357.7 | 20.2 | 21.0 | 568.5 | 6.8 | 5.8 | 169.7 | 288.4 | 10.2 | | | | | | |
| Initial Queue Delay (d ₃), s/veh | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | |
| Control Delay (d), s/veh | | 44.2 | 149.4 | 170.5 | 404.7 | 56.9 | 57.7 | 623.5 | 39.9 | 38.0 | 220.1 | 304.4 | 44.2 | | | | | | |
| Level of Service (LOS) | | D | F | F | F | E | E | F | D | D | F | F | D | | | | | | |
| Approach Delay, s/veh / LOS | | 139.1 | | F | 164.3 | | F | 149.2 | | F | 228.6 | | F | | | | | | |
| Intersection Delay, s/veh / LOS | | 169.1 | | | | | | F | | | | | | | | | | | |

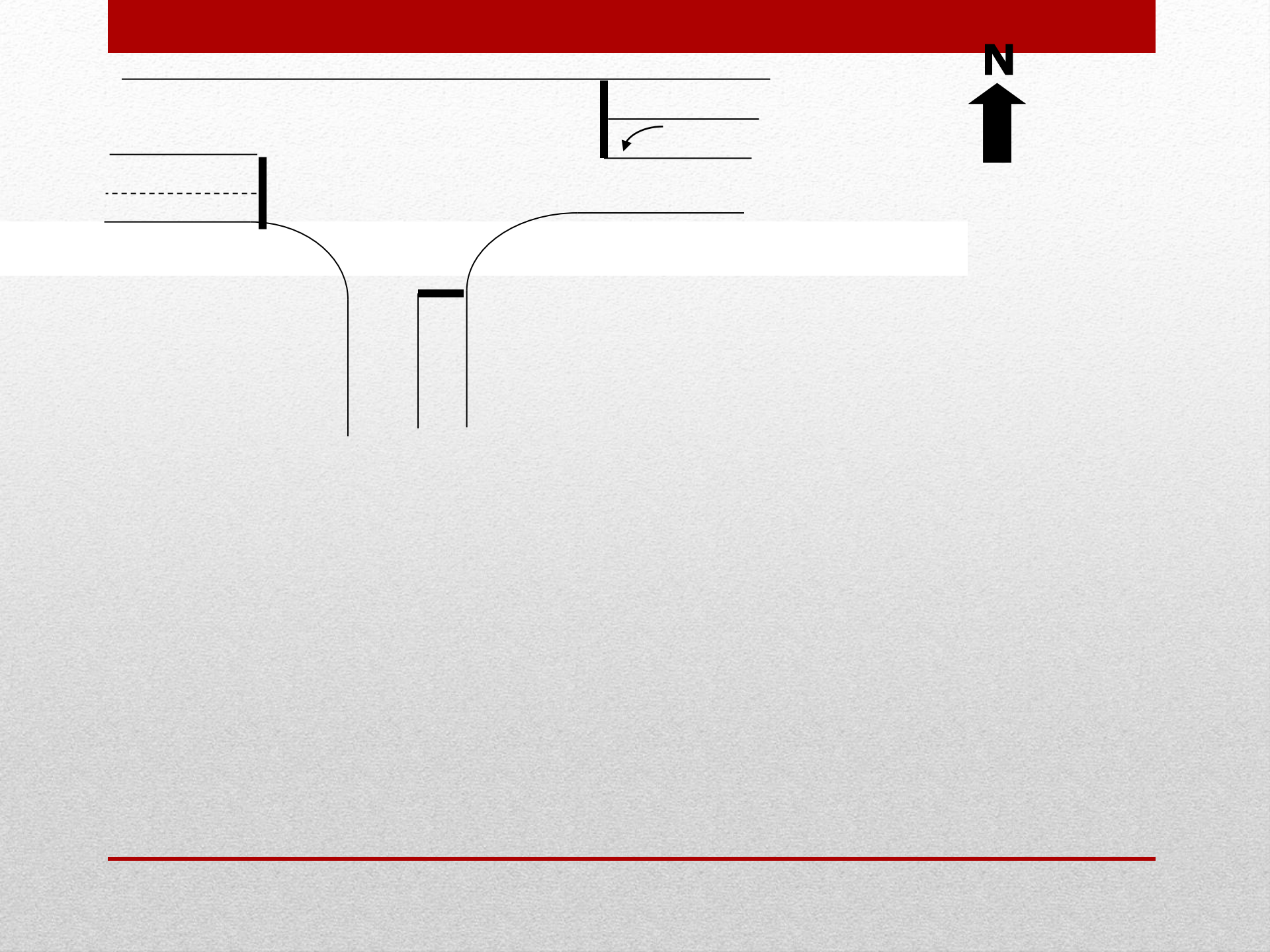
13. View Messages Report

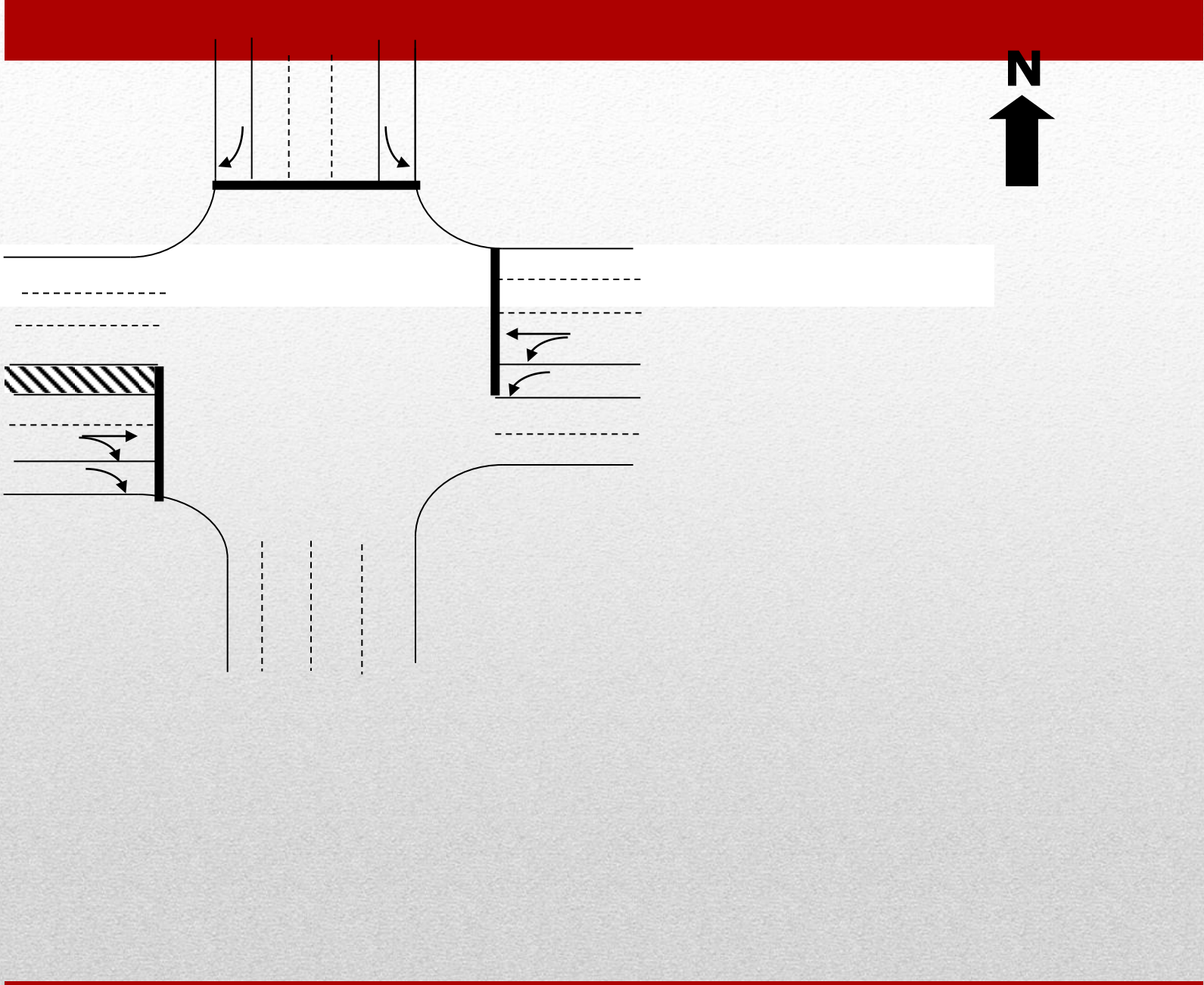
- Look for any warnings











RESULTS
