Executive Summary
Regional Traffic Signal Retiming Program

Prepared for:
North Central Texas Council of Governments

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March 2014
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Introduction

In 2010, the North Central Texas Council of Governments (NCTCOG) launched the Regional Traffic Signal Retiming Program (RTSRP), the goal of which has been to reduce vehicular emissions and improve mobility through traffic signal retiming. A team of consultants led by Kimley-Horn and Associates, Inc. was selected to complete approximately half of the program’s intersections. This summary covers 200 traffic signals operated by three cities – Arlington, Dallas, and Grand Prairie. Figure 1 illustrates the locations of these traffic signals. This project has achieved seamless progression along 25 miles of arterial streets without regard to jurisdictional boundaries.

Project Scope

The assigned intersections were grouped into designated corridors that ranged in size from 10 to 50 intersections. For each corridor, the scope included the following tasks:

- A baseline assessment to document the conditions as of the beginning of the project.
- Development, implementation, and fine-tuning of the new signal timing plans.
- An after assessment to quantify and document the project results.

Data Collection

The project included extensive data collection:

- For intersections, peak-hour turning movement counts were made by human observers who used electronic count boards to record the number of vehicles by approach direction and by movement (i.e., left turn, straight through, or right turn).

- Approximately 39 bi-directional machine counts were made with pneumatic tube-type counters that digitally record the number of vehicles in 15-minute increments, totaled on an hourly basis. These included 17 seven-day counts, 8 24-hour counts, and 14 vehicle classification counts.

- As one means of measuring the benefits of the project, approximately 2,300 miles of travel time runs were made with an instrumented vehicle. The software electronically recorded the vehicle’s speed, the distance traveled, and the number and elapsed time of each stop.

Signal Timing Plans

For all corridors, new timing plans were developed for four time periods – the weekday AM, Midday and PM peaks plus the Saturday peak. In many cases, separate versions of the AM and midday plans were required for times when school speed zones are in operation. Additionally:

- An off-peak/late night timing plan was developed for all of the Arlington and Dallas corridors; and

- A mid-afternoon plan, which had a cycle length longer than the midday plan but shorter than the PM peak plan, was developed for Coit corridor.
After the new timing plans were operational, extensive “fine-tuning” was performed to improve actual on-street performance.

Project Results

Travel Time Runs
The project results were measured quantitatively through travel time runs made with an instrumented vehicle traveling at the pace set by other traffic. The “before” runs were made at the start of the project, prior to any changes in the previous signal timing. Later, after the new signal timing plans had been installed and fine-tuned, the “after” runs were made. Averaging both directions for all corridors (total of 55 miles of test routes), a comparison of the before and after travel time runs determined that the following reductions had been attained in travel time and stops:

- Average travel time savings:
  - 7.3 percent overall reduction in travel time.
  - 1.65 vehicle-hours reduction per weekday.
- Reduction in stops:
  - 31.1 percent overall reduction in number of stops.
  - 165 vehicle-stops reduced per weekday

Synchro™ Measures of Effectiveness
The project results were also estimated from the Synchro™ models that were used in the development of the new traffic signal timing plans. For each corridor, the calibrated model of the before timing was compared with the calibrated model of the final timing. The measures of effectiveness (MOEs) that were compared included total signal delay and fuel consumption along with three categories of emissions (CO, NOx, and VOC). Averaging all corridors, the following improvement percentages were estimated by the Synchro™ comparison:

- Total signal delay was reduced by 5.4 percent
- Fuel consumption was reduced by 14.3 percent
  - Reduction of 10,899 gallons per weekday
- Emissions were reduced by 4.9 percent
  - CO reduction of 761 kilograms per weekday
  - NOx reduction of 148 kilograms per weekday
  - VOC reduction of 176 kilograms per weekday

Estimated Economic Benefits
The following rationale was used to estimate the daily user savings from the new timing plans:

- On each weekday there will be:
  - Two hours of benefit from the AM peak timing plan
  - Two hours of benefit from the PM peak timing plan
  - Five hours of benefit from the midday timing plan
  - To be conservative, no benefit is assumed from other hours of the day even though most of the corridors operate the new timing plans for at least 12 hours per day.
For the purpose of economic analysis of transportation improvements, the cost of delay was assumed to be $12.50 per vehicle-hour (as reflected in NCTCOG’s Mobility 2035 – 2013 Update).

For each corridor, the before and after Synchro™ models were compared for each of the three weekday timing plans. Considering the composite total signal delay for all corridors and using the above-described rationale, the estimated user benefit is $103,513 per weekday. Assuming 248 weekdays per year, this equates to an annual savings of $25.6 million.

The attached Table 1 shows the project benefits. The data provided include the following statistics per travel time route: route limits, number of signals, average daily traffic volume, and project benefits (reductions in travel time, stops, and delay). Also provided were the following statistics per corridor: number of signals, project benefits as derived from the Synchro™ models (reductions in total signal delay, stops, travel time, fuel consumed, and emissions), and daily user savings.

Based on total signal delay as modeled in Synchro™ Version 7, the greatest per-intersection improvements were attained in the Coit Corridor in Dallas, which had delay reductions of over 100 vehicle-hours per day per intersection. The four Arlington corridors saw delay reductions of 47 vehicle-hours per day per intersection. These benefits were realized through adjusted cycle lengths and phase sequences and improved coordination between intersections.
Figure 1: Regional Traffic Signal Retiming Program (RTSRP) - Phase 1
| Corridor       | Travel Time Route(s)       | From               | To                 | Number of Signals | Average Daily Traffic | Total Time (seconds) | Stop Time (seconds) | Total Delay (veh-hrs) | Total Emissions (kg) | Fuel Consumed (gal) | CO Emissions (kg) | NOx Emissions (kg) | VOC Emissions (kg) | Per Intersection |
|---------------|---------------------------|--------------------|--------------------|-------------------|----------------------|----------------------|---------------------|----------------------|----------------------|------------------|----------------|----------------|----------------|----------------|------------------|
| Arlington     |                          |                    |                    |                   |                      |                      |                     |                      |                     |                  |                |                |                |                  |
| Collins St    | Collins St*               | North Green Oaks Blvd | Caplin Dr          | 27                | 28000 to 38,000      | -520 -16.4 -501      | -4,311              | -228,867 -3,675      | -6,130 -428.25       | -83.14 -99.29      | $53,888         | $92             |                |                  |
| Cooper St     | Cooper St                 | Lamar Blvd         | Turner Warnell Rd  | 34                | 34,000 to 51,000     | -1,711 -32.8 -1,711  | -7,111              | 321,116              | 48,612              | -215.7 -35.92       |                   |                |                |                  |
| Division St   | Division St               | Collins St         | Great Southwest Pkwy | 8                | 16,000 to 22,500     | -114 -4.0 -114       | -114                | 2,324                | 157,875             |                  |                |                |                |                  |
| Pioneer Pkwy  | Pioneer Pkwy              | Oak Ridge Sch      | Susan Dr           | 20                | 19,500 to 40,000     | -1,364              | -32.2               | -1,363               | -32.2               | -1,363           |                |                |                |                  |
|                |                           |                    |                    |                   |                      |                      |                     |                      |                     |                  |                |                |                | $2,688          |
| Total Signals in Arlington Corridors | 91
| Spur 303 (Gr. Prairie) | Spur 303           | Great Southwest Pkwy | SE 14th St      | 10                | 22000 to 31,000      | -576 -10.7 -179      | -215 -7,197 -166     | -501 -35.00           | -6.77 -8.14        | $2,688          | $269           |
| Dallas        |                          |                    |                    |                   |                      |                      |                     |                      |                     |                  |                |                |                |                  |
| Collin St     | Sh 190 WIFR               | Churchill Way      |                    | 20                | 34000 to 52,000      | -706 -20.6 -690      | -2,729              | -35,918              | -2,672 -185.28       | -36.00 -42.96      | $14,113         | $1,365         |
| Abrams Rd     | Whitehurst Dr             | Lamar Dr           |                    | 7                 | 16,000 to 20,000     | -245 -9.8 -124       | -245                | 2,032                | -156,110            |                  |                |                |                | $2,494          |
| Forest Ln     | Walnut Hill Ln            |                    |                    | 7                 | 22,000 to 33,000     | -57 -6.0 -55         | -57                 | 2,025                | 103,496             |                  |                |                |                | $2,494          |
| Royal Ln/Miller Rd | Greenville Ave     | Sanden Dr          |                    | 10                | 21,000 to 26,000     | -259 -4.0 -188       | -259                | 2,113                | 157,154             |                  |                |                |                | $2,494          |
| Walnut Hill Lk | Fair Oaks Blvd            | Plane Rd           |                    | 10                | 14,000 to 21,000     | 337 2.0 217          | 337                 | 2,025                | 103,496             |                  |                |                |                | $2,494          |
| Total Signals in Skillman Corridor | 50
| Lancaster-Kiest | Corinth St/Lancaster Rd | Eighth St         | Cherry Valley Blvd | 23                | 11,000 to 23,000     | -349 -20.0 -352      | -349                | -24,076             | -838 -413           | -28.74 -5.57      | $1,313          | $39            |
| Lancaster Rd  | Lancaster Rd              | Rugged Dr          |                    | 10                | 14,000 to 27,000     | -223 -9.0 -224       | -223                | 2,025                | 103,496             |                  |                |                |                | $2,494          |
| Total Signals in Lancaster-Kiest Corridor | 44
| GRAND TOTAL FOR RTSRP |                    |                    |                    |                   |                      |                     |                      |                     |                  |                |                |                | $2,494          |

Note A: Based on the following hours of benefit per weekday from the three timing plans: 2 hours per weekday for AM Peak plan, 5 hours per weekday for the Midday plan, and 2 hours per weekday for PM Peak plan.

Note B: The Collin corridor included two (2) other signals – Collin & Mosier Valley (at the extreme north end) and Collin & S Green Oaks (at the extreme south end). It was decided during the project that these two intersections should remain in free operation mode. As such, the travel time results exclude the segments from Mosier Valley to N. Green Oaks and from Collin to S. Green Oaks.

Note C: The Collin corridor officially included ten (10) City of Dallas signals on Coll Road. Four (4) are north of the City of Richardson and the other six (6) are south of the City of Richardson. Concurrently with RTSRP, the staffs of the cities of Dallas and Richardson also retimed the ten (10) Coll Road signals that are within the City of Richardson. To capture the benefits of the collective effort, the travel time runs and the Synchro modeling included all twenty (20) of these Coll Road signals (i.e. 10 RTSRP signals in Dallas plus 10 non-RTSRP signals in Richardson). Additionally, the RTSRP corridor included five (5) other signals along the US 75 Frontage roads in Dallas.

Note D: The negative travel time results on Walnut Hill Lane were inconsistent with the design of the new timing plans, which should be providing improved performance. The probable cause was controller coding issues that were subsequently corrected.

Note E: Based on $12.50 per hour of Synchro total signal delay.