# I-75 & KY 14 INTERCHANGE STUDY AND SIMULATION MODEL

## Boone County
## Project ID: 06-206.00

## Final Report


*Prepared for:*

Kentucky UNBRIDLED SPIRIT

KENTUCKY TRANSPORTATION CABINET

COMMONWEALTH OF KENTUCKY
KENTUCKY TRANSPORTATION CABINET

*Prepared by:*

PB PARSONS BRINCKERHOFF 100 YEARS

December 2006

# I-75 & KY 14 INTERCHANGE STUDY AND SIMULATION MODEL

## SUMMARY OF FINDINGS AND RECOMMENDATIONS

# *FINAL REPORT*

**BOONE COUNTY**
**ITEM NO. 06-206.00**

***Prepared for:***

*Kentucky Transportation Cabinet (KYTC) – Division of Planning*

*Kentucky Transportation Cabinet (KYTC) – District 6*

***Prepared by:***

*Parsons Brinckerhoff Quade & Douglas, Inc.*

December 2006

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# 1.0 INTRODUCTION

The Kentucky Transportation Cabinet (KYTC) initiated this I-75 / KY 14 Interchange Study to address various traffic operation and safety issues at the I-75 / KY 14 Interchange in Boone County, Kentucky. Currently, the interchange experiences a high volume of truck traffic as a result of several truck facilities in the study area, mainly the Flying J Travel Plaza. Truck traffic flow is continual throughout the day at the interchange and conditions worsen during the peak periods with the addition of high volumes of automobiles.

Another major concern is the close proximity of two intersections: KY14 / KY 1292 / KY 2954 (Stevenson Mill Road) and KY 14 / I-75 Southbound Ramps. The two intersections are less than 200' apart which causes inefficiencies for traffic moving through the intersections. The inefficiencies often cause vehicles to queue on the Southbound Off-Ramp near mainline I-75. Additional queued traffic could directly impact mainline I-75.

This study focuses on short-term (low-cost) recommendations, if any, that can be quickly and effectively implemented. This study also addresses long-term concerns by examining the future need for capacity and determining options for future improvements to accommodate the high volumes of trucks as well as the high volumes of new vehicle trips expected to occur as land use changes within and adjacent to the study area.

Members of the project team include: KYTC District 6, KYTC Central Office Division of Planning, Federal Highway Administration (FHWA), Ohio-Kentucky-Indiana Regional Council of Government (OKI), and the Kentucky Transportation Center (KTC). KYTC selected the consulting firm of Parsons Brinckerhoff (PB) to lead the study effort.

## 1.1 Study Area

The study area includes the I-75 / KY 14 interchange in southern Boone County as shown in **Figure 1**. The interchange lies to the west of Walton, Kentucky. Major routes within the study area include I-75, KY 14, and KY 1292.

An additional route, KY 2954, exists within the study area. At the initiation of this study, KY 2954 was maintained by KYTC. However, KY 2954 was recently transferred to county maintenance and referred to as Stephenson Mill Road. Since the route was state-maintained at the beginning of the project, data collected for the route as part of the existing conditions analysis was for KY 2954. Therefore, the KY 2954 nomenclature will be used throughout this report.


**Figure 1:**

**Study Area**

I-75 & KY 14 Interchange Study

## 1.2 Study Process

The study process used to evaluate potential alternates consists of five major elements:

1. Define the purpose and need of the study;
2. Review existing conditions;
3. Develop alternates;
4. Evaluate the alternates, and
5. Recommend an alternate(s).

The subsequent chapters in this report follow these steps, beginning with the development of the purpose and need for the study. The following chapters contain the technical analysis and documentation used to confirm the purpose and need and then develop the alternates. These chapters include an analysis of existing and future no-build highway conditions.

Next, the discussion of the alternate development procedure and initial screening is presented. An additional evaluation step was then performed to refine the remaining alternates and provide a more quantitative analysis in order to select the preferred alternate(s). The final stage in the study process was to provide a recommendation, which is also the final section in this report.

# 2.0 PURPOSE AND NEED

The Purpose and Need for a project defines the reason for doing the study and provides the basis for the development, evaluation, and comparison of alternates. According to current KYTC policy, there are three parts to a complete Purpose and Need statement:

1. The Purpose;
2. The Need; and
3. Goals and Objectives.

The Purpose identifies the problem to be solved by the study and is supported by the Need. Goals and Objectives are other elements of the study that go beyond the transportation issues in the study and should be considered and addressed as part of a successful solution to the problem.

The purpose for this project is to develop and evaluate alternates to improve traffic operations at the KY 14 / I-75 Southbound Ramps intersection and the KY 14 / KY 1292 / KY 2954 intersection, leading to a final recommendation improvement option. Supporting the project purpose is the project need. Based on issues identified in field reviews, the technical analysis, and deficiencies identified in the existing and future conditions analysis, a documented need exists for this project. The presence of a major truck stop and other trucking facilities south of these intersections, combined with overall traffic growth in the area, has led to a situation where these intersections do not operate adequately. The following items document the inadequate operations and form the need for this project.

**1) Reduce Vehicle Emissions / Improve Air Quality –** Due to the inefficiencies at the KY 14 / KY 1292 / KY 2954 intersection and the KY 14 / I-75 Southbound Ramps intersection, the increased delay increases vehicle emissions and decreases air quality. As the number of vehicles increase, the amount of vehicle emissions is expected to increase.

**2) Improve Safety –** The crash rate analysis showed that KY 14 between the gas station entrance and the I-75 northbound ramps has high crash rates. The section of KY 2954 leading up to the KY 14 / KY 1292 / KY 2954 intersection also has a high critical spot crash rate factor. The most common type of crash on KY 14 was angle crashes (18), of which three were injury crashes. Overall, the most common type of crash on all study area roads (including the I-75 ramps) were rear-end collisions (25). Almost half of these (12) occurred on KY 14. The rest of them except one occurred on the I-75 ramps.

**3) Improve Traffic Operations (LOS) –** With current peak period traffic volumes and existing geometrics, both intersections have movements which operate at a Level of Service F (the poorest level of service). At the KY 14 / KY 1292 / KY 2954 intersection, the northbound approach operates at a LOS D during the AM peak, which is below the desirable level of service threshold C. During the PM peak period, the westbound

shared left and through movement operates at a LOS F, which causes the whole intersection to operate at a LOS E. Both the turn movements at the KY 14 / I-75 Southbound Ramps intersection operate poorly. During the AM peak period, the left turn movement is LOS E and the right turn movement is LOS D. During the PM peak period, the left turn movement is LOS F and the right turn movement is LOS E. In the future analysis years of 2007 and 2030, the levels of service and delay for these movements will only degrade further.

**4) Reduce Queue Lengths –** The short distance between the KY 14 / KY 1292 / KY 2954 intersection and the KY 14 / I-75 Southbound Ramps intersection along KY 14 has inadequate storage and leads to queuing issues. Queue lengths in the eastbound direction are estimated between 240 – 280 feet based on current traffic volumes. This is much higher than the available estimated storage of 75 feet between intersections. In the westbound direction, this problem is much worse during the PM peak period. The queue length in this direction is estimated at 750 feet, exceeding the available storage of 100 feet in this direction between intersections. As traffic volumes increase, these queue lengths are likely to worsen in the future.

**5) Provide for the High Truck Volumes through the Interchange –** A substantial portion of the traffic through these intersections is truck traffic. In the vicinity of these two intersections, truck traffic percentages range from twenty-five percent to thirty-six percent. Potential improvements within the study area should accommodate for these high truck volumes from both a traffic and safety standpoint.

Goals and objectives for a project are developed to balance environmental and community issues with transportation issue. For this project, the goals and objectives should enhance the community through improvements to the interchange.

# 3.0 EXISTING CONDITIONS

The existing conditions analysis included data collection as well as an analysis of this data. Data collection for this study involved road tube counts, peak period turning movement counts and other field data collection and measurements. This information was critical to identifying any existing operational deficiencies as well as input for a microsimulation traffic analysis.

## 3.1 Average Daily Traffic

Existing average daily traffic information was obtained from the KYTC at the locations shown in **Figure 2**. The counts were conducted in Years 2004 and 2005.

## 3.2 Road Tube Counts

Due to the limited count information within the study area, additional road tube counts were necessary. PB conducted these counts at the following locations.

- I-75 Southbound Off-Ramp
- I-75 Southbound On-Ramp
- I-75 Northbound On-Ramp
- I-75 Northbound Off-Ramp
- KY 14 (over bridge)
- KY 14 (south of KY 1292 but north of the truck stop entrance)

At the time of the placement of the road tubes, there was concern about the ability to obtain accurate count volumes due the heavy truck volume as well as the slow-moving tendency of the vehicles. Both of these factors are common causes of inaccurate traffic counts. As a result, the counts were not used directly for volume information, but rather to analyze peaking characteristics and general truck percent information.

## 3.3 Peak Period Turning Movement Counts

Turning movement counts were used as inputs to the capacity analysis of the intersections within the study area as well as the microsimulation analysis. Both analyses required the identification and collection of data for the highest traffic period. A conversation with management of the Flying J Travel Plaza indicated that peak truck traffic exists between 10:00 AM on Tuesdays through 10:00 PM on Thursdays (Refer to **Appendix A** for details). Based on this information and the peaking trends obtained from the road tube counts, AM (7:00 AM – 9:00 AM) and PM (3:30 PM – 6:30 PM) peak period turning movement counts were conducted at each of the following locations:

- KY 14 / I-75 Southbound Ramps
- KY 14 / KY 1292 / KY 2954
- KY 14 / Flying J Travel Plaza Driveway (main car entrance)
- KY 14 & I-75 Northbound Ramps


**Figure 2:**

**Average Daily Traffic**

I-75 & KY 14 Interchange Study

**Figure 3** shows the AM turning movement counts for each intersection while **Figure 4** shows the PM turning movement counts.

### 3.4 Other Field Data and Measurements

Additional data was collected as necessary inputs to develop a microsimulation model. This included:

- Lane widths
- Lane configurations at each intersection
- Turn lanes and storage lengths
- Queue lengths during the manual count periods on:
    - I-75 Southbound Off-Ramp
    - KY 14 westbound over the bridge (approaching the I-75 Southbound Ramps)
    - KY 14 / KY 1292 / KY 2954 intersection approaches
- Traffic signal timings

### 3.5 Baseline VISSIM Simulation Model

Using the data collected in the previous sections, a baseline VISSIM microsimulation model was developed for the existing conditions (2006). VISSIM is a microscopic traffic simulation model software package used to analyze complex traffic engineering conditions. The software is behavior-based, which considers driver characteristics and routing decisions, and can be used to compare various alternates. Given the study objective of examining innovative intersection design options, it was determined that the use of VISSIM as the analysis tool for this study would be the most appropriate model platform. Following the initial model setup, the model was calibrated using observed traffic volumes, queue length data, and driver behavior.

### 3.6 Existing Conditions Capacity Analysis

The existing conditions capacity analysis was conducted using the baseline VISSIM model. From an intersection perspective, VISSIM can provide output for approach delays which can be used to calculate a Level of Service (LOS). LOS is a qualitative measure of expected traffic conflicts, delay, driver discomfort, and congestion. Levels of service are described according to a letter rating system ranging from LOS A (free flow, minimal or no delays – best conditions) to LOS F (stop and go conditions, very long delays – worst conditions). It should be noted that VISSIM does not produce Highway Capacity Manual (HCM) LOS output since the HCM uses a different set of criteria to calculate LOS. However, since intersection delay is the common denominator in both calculations, the same delay ranges from the HCM were used for LOS calculations for this study.

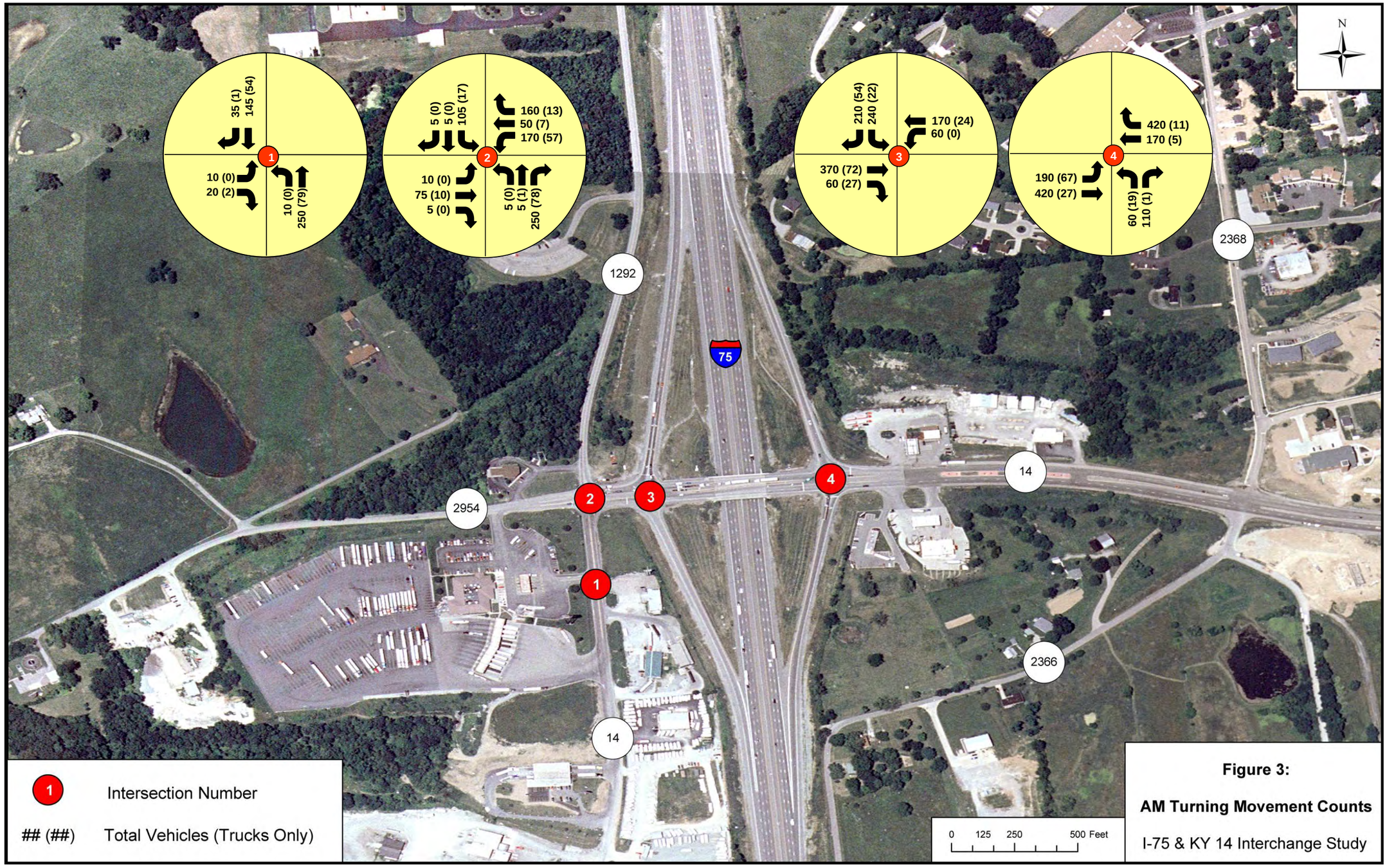



**Figure 3:**

**AM Turning Movement Counts**

I-75 & KY 14 Interchange Study

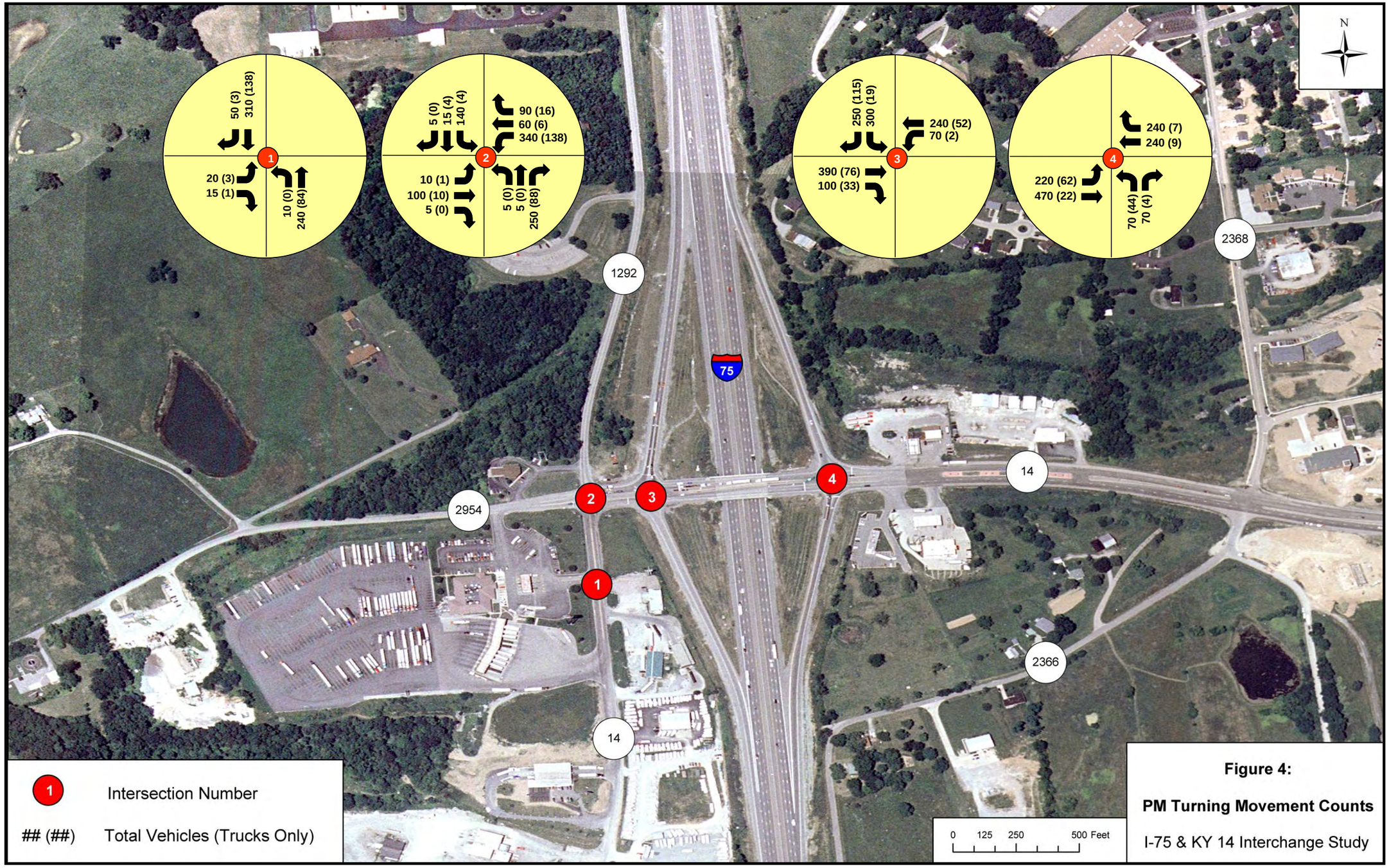



**Figure 4:**

**PM Turning Movement Counts**

I-75 & KY 14 Interchange Study

For intersections, the Highway Capacity Manual (2000) defines levels of service based on the average delay due to signal or STOP control as shown in **Table 1.**

**Table 1: LOS Criteria for Intersections**

| LOS | Signalized Intersections Control Delay (seconds vehicle) | Unsignalized Intersections Control Delay (seconds/vehicle) |
|---|---|---|
| A | ≤ 10 | ≤ 10 |
| B | >10 – 20 | >10 – 15 |
| C | >20 – 35 | >15 – 25 |
| D | >35 – 55 | >25 – 35 |
| E | >55 – 80 | >35 – 50 |
| F | >80 | >50 |

**Figure 5** displays the LOS for each of the four study area intersections.

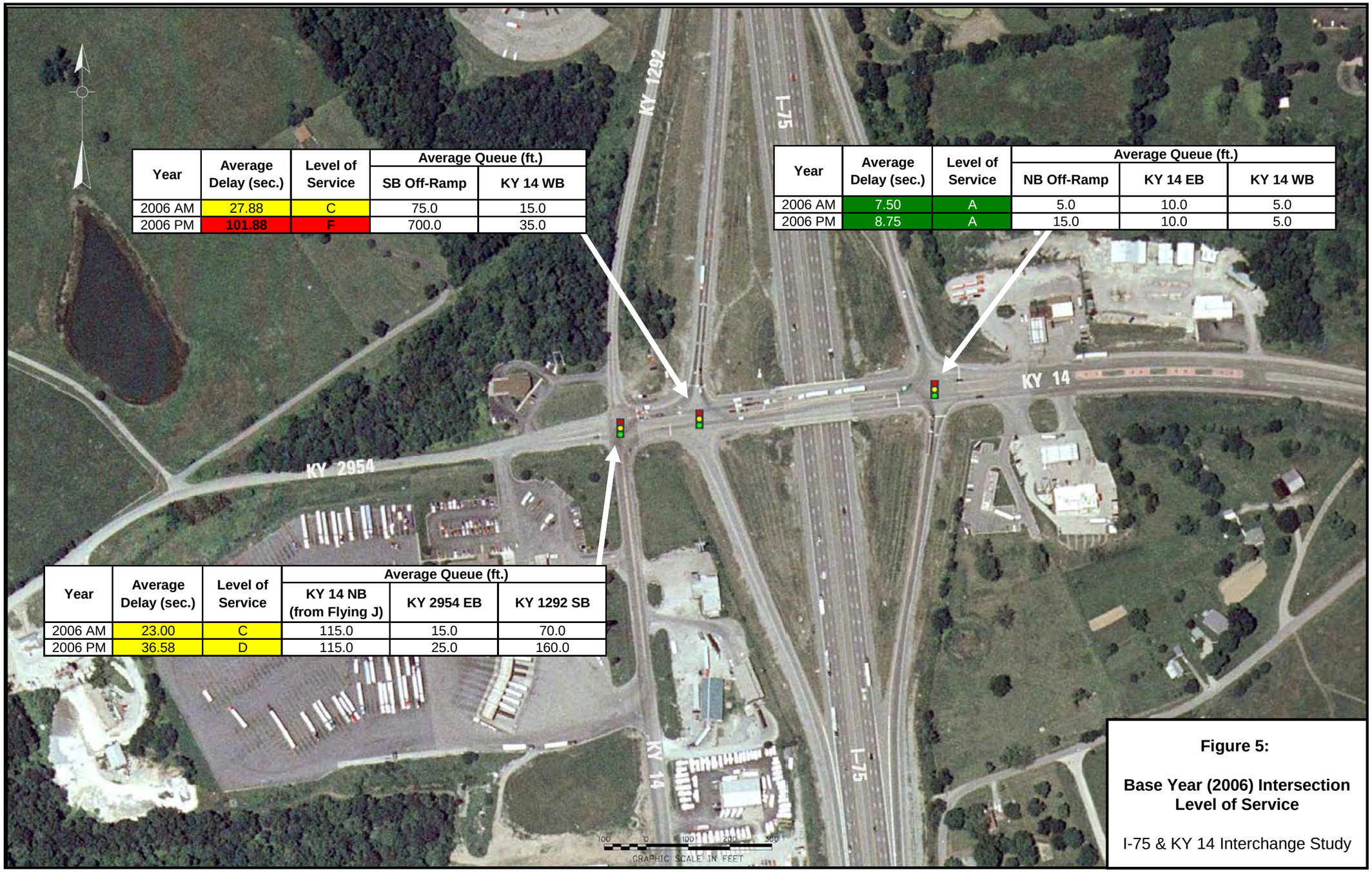
As shown in **Figure 5**, the KY 14 / KY 1292 / KY 2954 intersection and the KY 14 / I-75 Southbound Ramp intersection currently operates at LOS C during the AM peak period; however, in the afternoon peak period, the KY 14 / I-75 Southbound Ramp intersection currently operates at LOS F.

## 3.7 Crash Data

The Kentucky Transportation Cabinet provided crash data for a three-year period from January 1, 2003 through December 31, 2005. Crash rates were computed for specific spots of study area routes using the methodology provided in the crash analysis report periodically published by the Kentucky Transportation Center (KTC)[1]1. The spot crash rates are based on the number of crashes on a specified section, the average daily traffic on the roadway, the time frame of analysis, and the length of the section. They are expressed in terms of crashes per 1 million vehicle-miles. A spot's crash rate was then compared to a statewide critical crash rate[2] derived from critical crash rate tables for highway spots in the KTC crash report (Appendix E of KTC crash report). This comparison is expressed as a ratio of the spot crash rate to the critical crash rate and is referred to as the critical crash rate factor. Spots with a critical crash rate factor greater than one are considered high crash locations and are potential candidates for safety improvements.

[1] Analysis of Traffic Crash Data in Kentucky (2000 – 2004), Kentucky Transportation Center Research Report KTC-05-19/KSP2-05-1F.

[2] The critical crash rate is the threshold above which an analyst can be statistically certain (at a 99.5% confidence level) that the section crash rate exceeds the average crash rate for a similar roadway and is not mistakenly shown as higher than the average due to randomly occurring crashes.




| Year | Average Delay (sec.) | Level of Service | Average Queue (ft.) | |
|---|---|---|---|---|
| | | | SB Off-Ramp | KY 14 WB |
| 2006 AM | 27.88 | C | 75.0 | 15.0 |
| 2006 PM | **101.88** | **F** | 700.0 | 35.0 |

| Year | Average Delay (sec.) | Level of Service | Average Queue (ft.) | | |
|---|---|---|---|---|---|
| | | | NB Off-Ramp | KY 14 EB | KY 14 WB |
| 2006 AM | 7.50 | A | 5.0 | 10.0 | 5.0 |
| 2006 PM | 8.75 | A | 15.0 | 10.0 | 5.0 |

| Year | Average Delay (sec.) | Level of Service | Average Queue (ft.) | | |
|---|---|---|---|---|---|
| | | | KY 14 NB (from Flying J) | KY 2954 EB | KY 1292 SB |
| 2006 AM | 23.00 | C | 115.0 | 15.0 | 70.0 |
| 2006 PM | 36.58 | D | 115.0 | 25.0 | 160.0 |

**Figure 5:**

**Base Year (2006) Intersection Level of Service**

I-75 & KY 14 Interchange Study

The spot crash rate is also compared directly to the statewide average crash rate presented in the KTC crash report. The statewide averages consider all crashes for a specified period that are listed in the Collision Report Analysis for Safer Highways (CRASH) database maintained by the Kentucky State Police and stratified by functional classification (Table B-2 in KTC crash report). Spot rates that exceed the statewide average crash rate but not the critical crash rate may be problem areas, but they are not statistically proven to be higher crash areas. Therefore, this second comparison is used to identify a second tier of highway sections that may have crash problems and could be considered for safety improvements if warranted based on further analysis.

It should be noted that some data was available for the ramps; however, in many cases, the data was not specific enough to determine on which ramps the crash occurred. As a result, crash rates were not computed for the ramps.

**Table 2** lists the crash rates by spot and **Figure 6** shows the crash analysis by segment on a map.

As shown, KY 14 within the study has crash rates which exceed the statewide critical rate and is therefore a high crash rate section. Similar, KY 2954, is considered a high crash rate section. Also, as shown on **Figure 6**, angle crashes are the most common type of crashes within the study area followed by rear-end crashes.

## Table 2: Spot Crash Analysis

| Route (Street) | Begin Description | End Description | Total Crashes | Average Daily Traffic | Exposure "M" (1 MVM) | Statewide Average Spot Crash Rate | Spot Crash Rate | Statewide Critical Spot Crash Rate | Critical Spot Crash Rate Factor |
|---|---|---|---|---|---|---|---|---|---|
| KY 14 | Just south of Gas Station Entrance/Exit | KY 14 / KY 1292 / KY 2954 Intersection | 12 | 2,730 | 2.989 | 0.72 | 4.014 | 1.837 | 2.19 |
| KY 14 | KY 14 / KY 1292 / KY 2954 Intersection | Just east of KY 14 / I-75 Northbound Ramps | 32 | 11,790 | 12.910 | 0.36 | 2.479 | 0.735 | 3.37 |
| Stephenson Mill Road | Beginning of State-Maintenance | KY 14 / KY 1292 / KY 2954 Intersection | 6 | 1,090 | 1.194 | 0.72 | 5.027 | 2.584 | 1.95 |
| KY 1292 | Just South of KY 14 / KY 1292 / KY 2954 Intersection | KY 14 / KY 1292 / KY 2954 Intersection | 2 | 4,020 | 4.402 | 0.72 | 0.454 | 1.651 | 0.28 |

Critical Crash Rate Factor >1, Spot Crash Rate Exceeds Statewide Critical Rate (High Crash Rate Section)
Critical Crash Rate Factor <1, Spot Crash Rate Exceeds Statewide Average Rate
Critical Crash Rate Factor <1, Spot Crash Rate Lower Than Statewide Average Rate

Notes:
Analysis Period: 3 Years (1/1/2003 to 12/31/2005)
Average Daily Traffic volumes are from the CTS database with a 1.5% per year growth rate factor applied as appropriate to provide current year (2005) volumes
Crash rates are expressed in crashes per 1 MVM (1 million vehicle miles traveled)
Exposure (M) = [(ADT) x (365) x (Time Frame of Analysis (Years))] / 1,000,000
Spot Crash Rate = Total Crashes / Exposure
Critical Spot Crash Rate Factor = Spot Crash Rate / Statewide Critical Spot Crash Rate

Sources:
Crash data for 1/1/2003 to 12/31/2005 from KYTC Data
Statewide Rates from KTC Research Report KTC-05-19/KSP2-05-1F, Analysis of Traffic Crash Data in Kentucky (2000 - 2004)

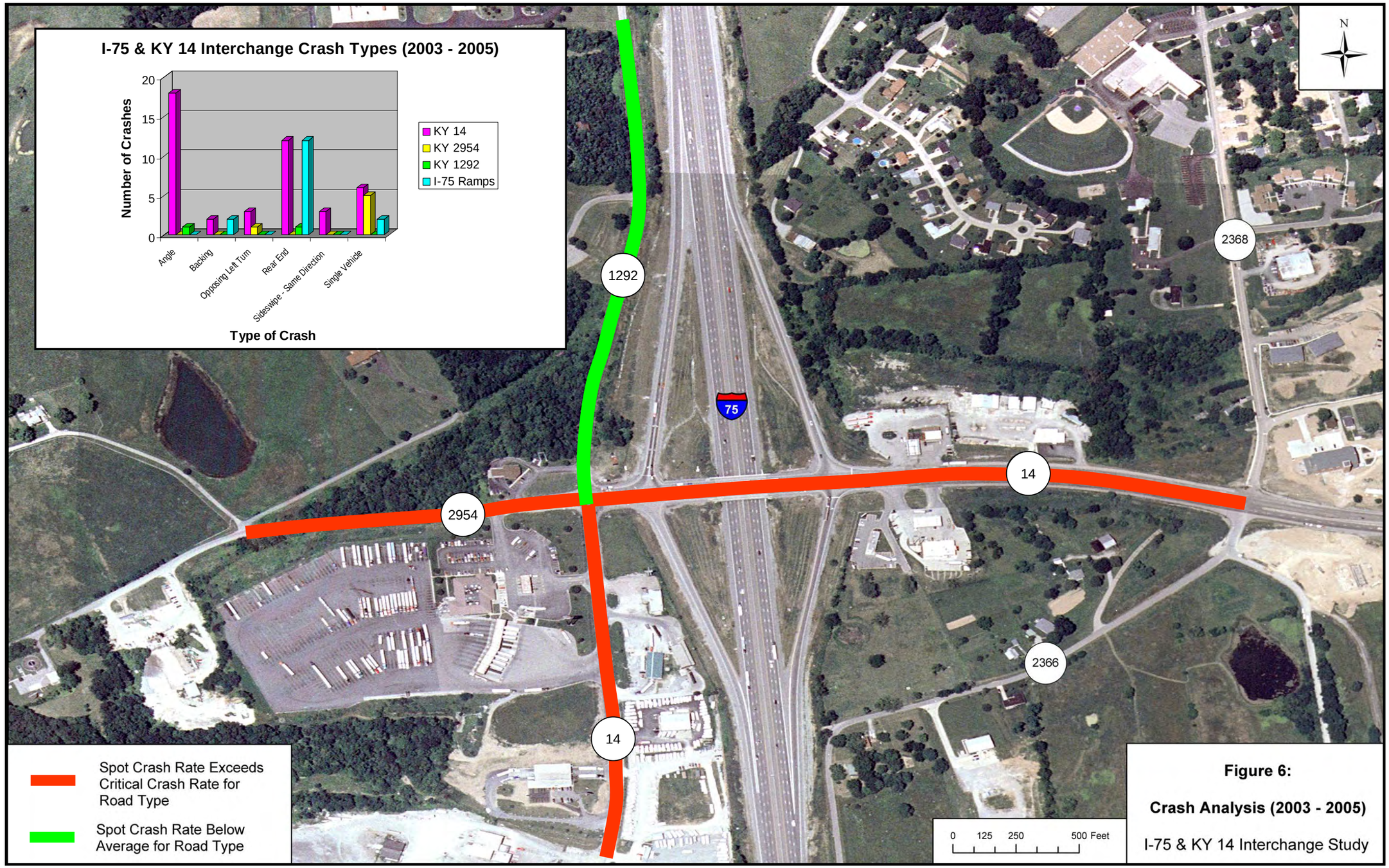



**Figure 6:**

**Crash Analysis (2003 - 2005)**

I-75 & KY 14 Interchange Study

# 4.0 FUTURE NO-BUILD CONDITIONS

Traffic forecasts for each of the four intersections were developed for the no-build scenario for the future years 2007 and 2030. The methodology and findings for the future no-build traffic forecasts are summarized below.

It should be noted that in a typical traffic forecast, separate forecasts are not conducted for cars and trucks. However, considering the high volume of truck movements within the study area, separate forecasts were prepared for this study.

## 4.1 Traffic Forecast Methodology

Growth rates for this study are based upon a historical traffic growth analysis along I-75, KY 14, and KY 1292 within the study area. The analysis utilized traffic counts obtained from the KYTC's 'CTS' traffic count program which includes counts from 1963 to 2006.

The historical counts were entered into a spreadsheet provided by KYTC. The spreadsheet calculates growth rates using both exponential and trendline analyses. The growth rates are then averaged for each count station.

In addition, two key assumptions were made with respect to growth within the I-75 / KY 14 Interchange study area:

1. The Flying J Travel Plaza currently operates at or near capacity during the peak periods for cars and trucks. Therefore, additional trucks attracted to this facility will be minimal in the future years.

2. The growth near Walton, KY is occurring to the east of the interchange. This includes a new commercial shopping center in the southeast corner of the study area. As a result, the growth in this area will be higher than historical growth.

Using this information, growth rates used for this project ranged from 1.0% (KY 2954) to 3.5% (I-75 northbound ramp). **Table 3** summarizes these values.

**Table 3: Growth Rates**

| Segment | Description | Growth Rate |
|---|---|---|
| KY 14 | South of Flying J | 1.5% |
| Flying J Car Entrance | West of KY 14 | 0.5% |
| KY 2954 | West of KY 14 | 1.0% |
| KY 1292 | KY 2954 | 2.0% |
| I-75 SB Ramp | North of KY 14 | 2.2% |
| KY 14 | From East | 2.5% |
| I-75 NB Ramp | From South | 3.5% |

The growth rates were applied to each intersection approach for both cars and trucks. These values were balanced since the growth rates varied by segment. Also, the turning movement percentages were adjusted to reflect the additional traffic generated from the developments to the east. It was assumed that a large portion of these new trips will go toward the commercial and employment attractors in Northern Kentucky and Cincinnati. In the afternoon, the new trips will return to their origin in the east.

**Figures 7** and **8** on the following pages provide a summary of the 2030 turning movement volumes within the study area.

## 4.2 Future Year No-Build Capacity Analysis

A capacity analysis was conducted for the future years 2007 and 2030 using the turning movement forecasts for the key intersections. The baseline VISSIM simulation model was modified to reflect the 2007 and 2030 conditions. From this new model, levels of service for each intersection were calculated for both future analysis years. **Figure 9** provides the 2007 and 2030 Level of Service Analysis. The 2006 levels of service are shown for reference.

As shown, conditions worsen for each of the intersections in the future years. In fact, the two critical intersections (KY 14 / KY 1292 / KY 2954 and KY 14 / I-75 Southbound Ramps) will experience LOS F conditions in the future year. The modeled queue lengths for the Southbound Ramps are over 1200 feet.

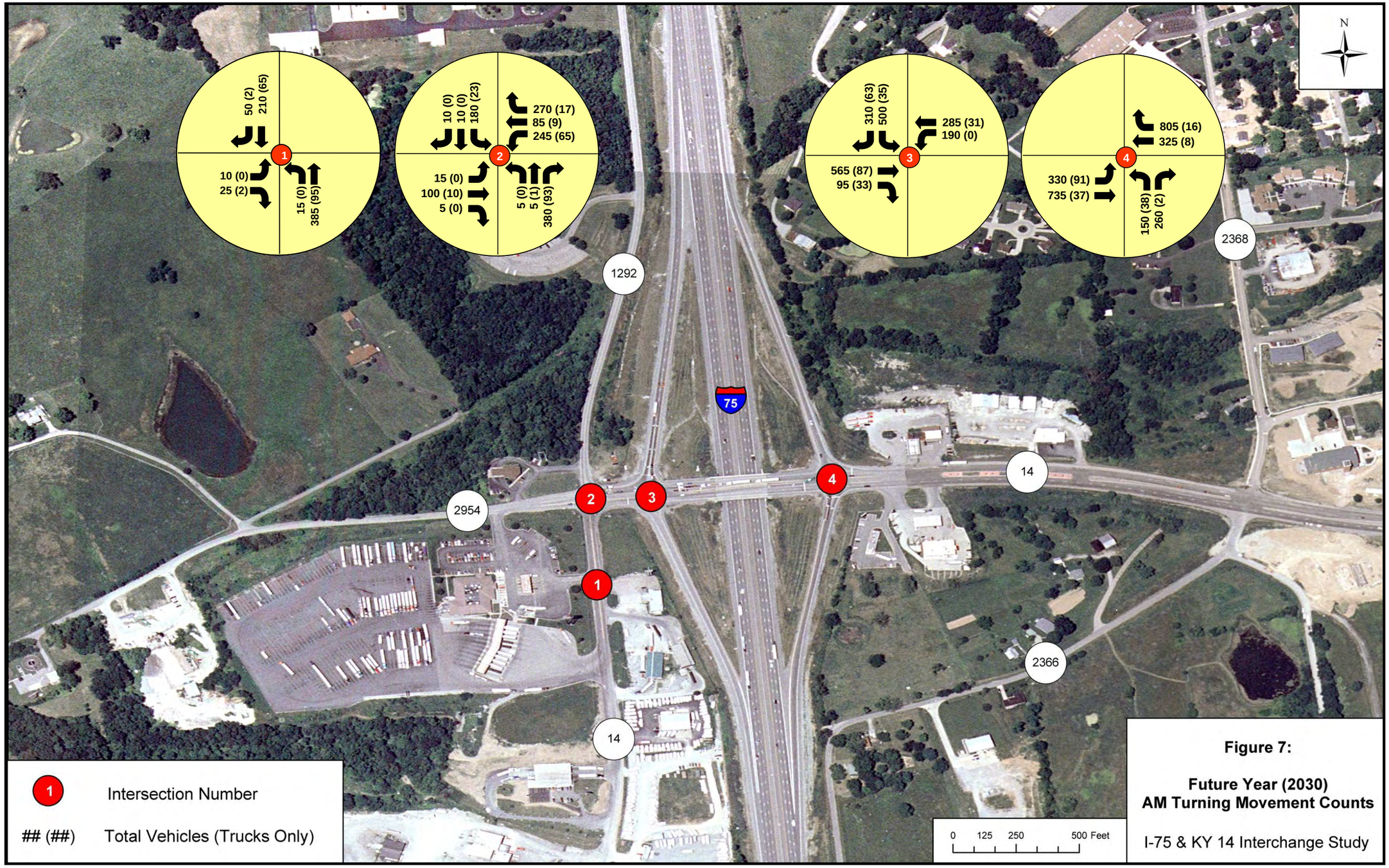



**Figure 7:**

**Future Year (2030)**
**AM Turning Movement Counts**

I-75 & KY 14 Interchange Study

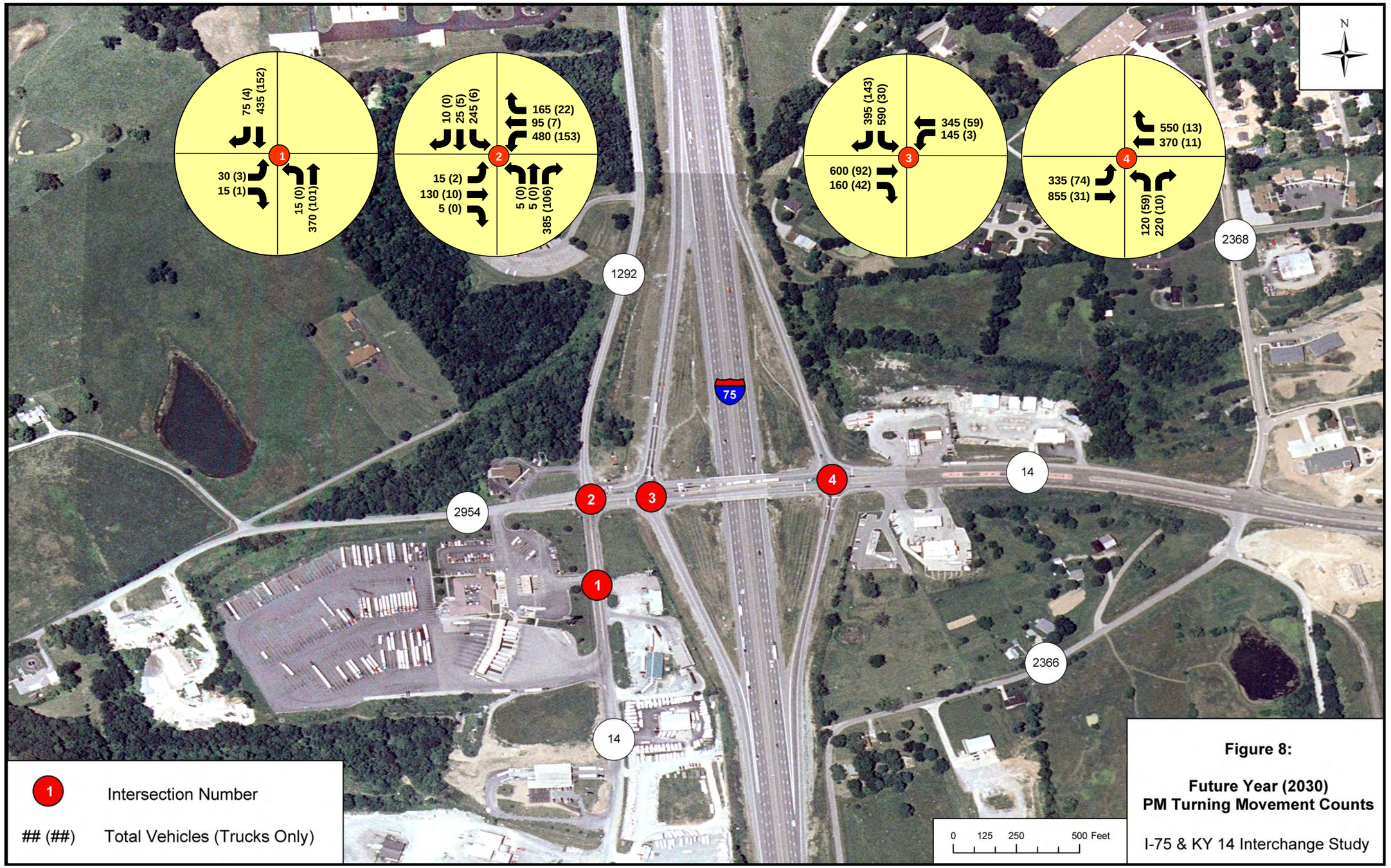
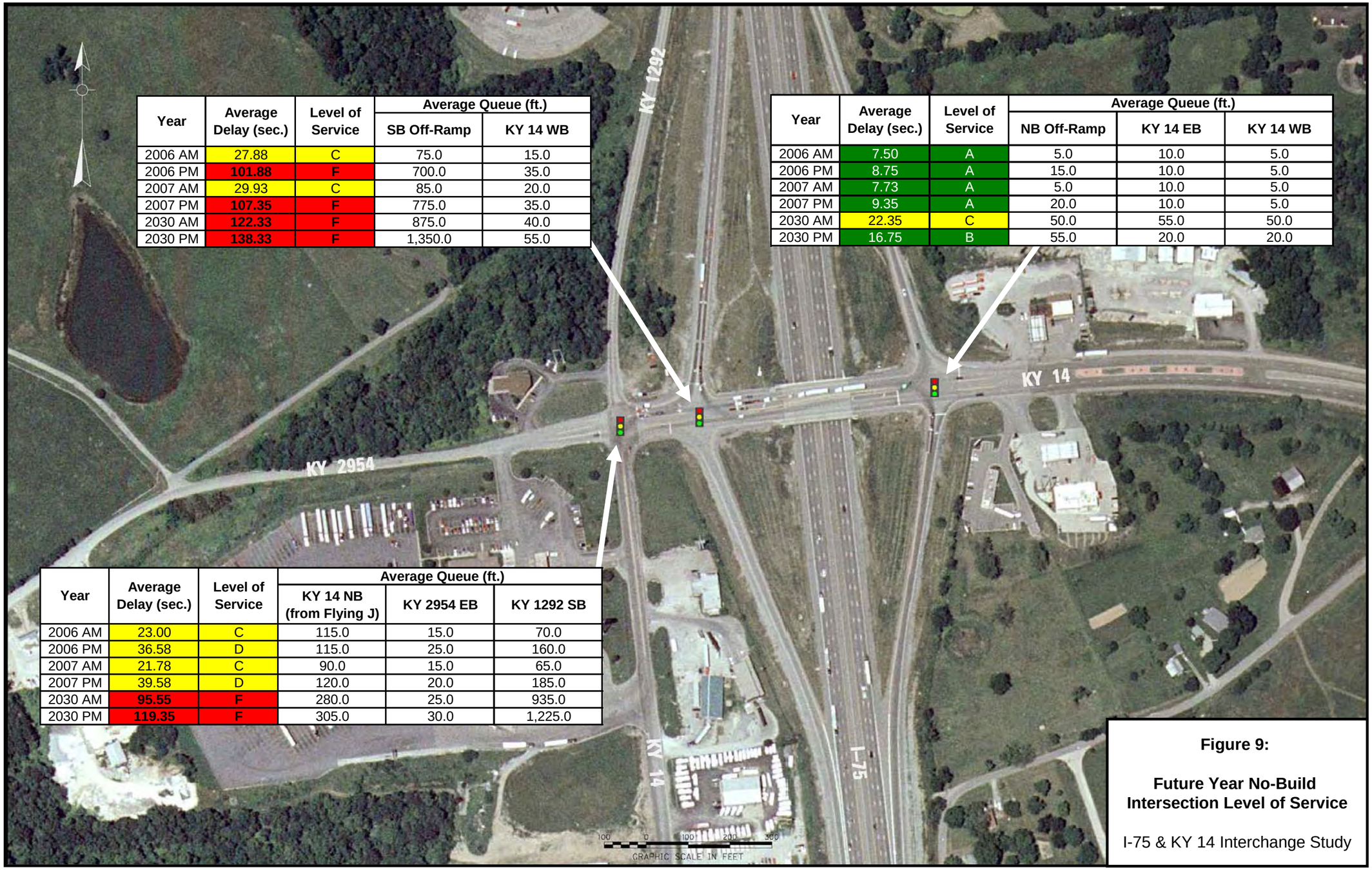



**Figure 8:**

**Future Year (2030)**
**PM Turning Movement Counts**

I-75 & KY 14 Interchange Study




| Year | Average Delay (sec.) | Level of Service | Average Queue (ft.) | |
|---|---|---|---|---|
| | | | SB Off-Ramp | KY 14 WB |
| 2006 AM | 27.88 | C | 75.0 | 15.0 |
| 2006 PM | **101.88** | F | 700.0 | 35.0 |
| 2007 AM | 29.93 | C | 85.0 | 20.0 |
| 2007 PM | **107.35** | F | 775.0 | 35.0 |
| 2030 AM | **122.33** | F | 875.0 | 40.0 |
| 2030 PM | **138.33** | F | 1,350.0 | 55.0 |

| Year | Average Delay (sec.) | Level of Service | Average Queue (ft.) | | |
|---|---|---|---|---|---|
| | | | NB Off-Ramp | KY 14 EB | KY 14 WB |
| 2006 AM | 7.50 | A | 5.0 | 10.0 | 5.0 |
| 2006 PM | 8.75 | A | 15.0 | 10.0 | 5.0 |
| 2007 AM | 7.73 | A | 5.0 | 10.0 | 5.0 |
| 2007 PM | 9.35 | A | 20.0 | 10.0 | 5.0 |
| 2030 AM | 22.35 | C | 50.0 | 55.0 | 50.0 |
| 2030 PM | 16.75 | B | 55.0 | 20.0 | 20.0 |

| Year | Average Delay (sec.) | Level of Service | Average Queue (ft.) | | |
|---|---|---|---|---|---|
| | | | KY 14 NB (from Flying J) | KY 2954 EB | KY 1292 SB |
| 2006 AM | 23.00 | C | 115.0 | 15.0 | 70.0 |
| 2006 PM | 36.58 | D | 115.0 | 25.0 | 160.0 |
| 2007 AM | 21.78 | C | 90.0 | 15.0 | 65.0 |
| 2007 PM | 39.58 | D | 120.0 | 20.0 | 185.0 |
| 2030 AM | **95.55** | F | 280.0 | 25.0 | 935.0 |
| 2030 PM | **119.35** | F | 305.0 | 30.0 | 1,225.0 |

**Figure 9:**

**Future Year No-Build Intersection Level of Service**

I-75 & KY 14 Interchange Study

# 5.0 ALTERNATES DEVELOPMENT

Six (6) alternates (and variations of the alternates) were developed as part of this study to address the existing and future problems within the study area. The alternates were based upon concepts suggested by the Project Team as well as other legitimate concepts based on attempts to address the problems at the interchange. These conceptual alternates comprise the initial set of alternates that were evaluated in the Level 1 screening process (described in the next chapter). Each alternate is described in the following text.

- Level 1 – Alternate 1 – Add an actuator on the Southbound Off-Ramp that would help clear the right turn of the intersection when the queue reaches the detector.

- Level 1 – Alternate 2 – Re-phase the signals into a 4-phase cycle and each phase would have an extended red clearance to clear vehicles from both intersections. The two intersections would operate as one.

- Level 1 – Alternate 2A – This is similar to Level 1 – Alternate 2 with the exception that the two existing signal controllers would be replaced with one controller and the two intersections would operate as one with one set of signal heads.

- Level 1 – Alternate 3 – Construct a roundabout for vehicles on all 6 legs.

- Level 1 – Alternate 4 – Construct a spur ramp off of the Southbound Off-Ramp that would intersect KY 1292 and be primarily for trucks heading toward the Flying J and for trucks heading back north to the landfill. The Southbound Off and On-Ramps would be reconstructed and shifted to the east to provide more room between the intersections. A slip ramp to the Southbound On-Ramp would also be constructed for trucks and other vehicles leaving the Flying J.

- Level 1 – Alternate 5 – Align KY 14 that runs east and west with the KY 14 that runs to the south and then realigning KY 2954 to intersect with KY 14. KY 1292 would be realigned to intersect with KY 2954 further to the west. The Southbound On and Off-Ramps would be reconstructed and shifted to the east.

- Level 1 – Alternate 5A – This is the same as Level 1 – Alternate 5 except that the Southbound On and Off-Ramps would not be reconstructed toward the east.

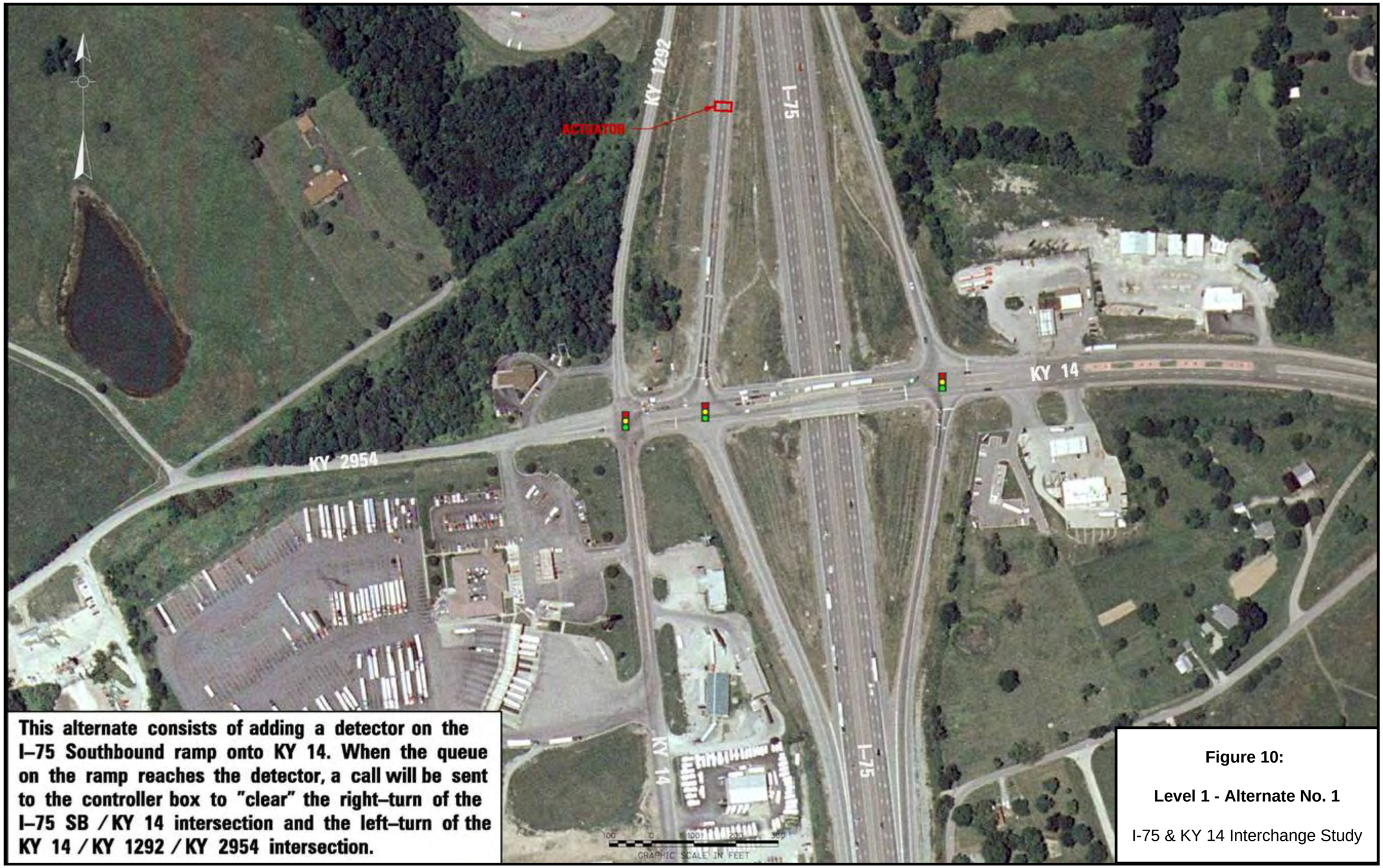
- Level 1 – Alternate 6 – Align KY 14 that runs east and west with KY 14 that runs to the south and then realigning KY 1292 to intersect with KY 14. KY 2954 would intersect with KY 1292. The Southbound On and Off-ramps would be reconstructed and shifted to the east.

- Level 1 – Alternate 6A – This is the same as Level 1 – Alternate 6 except that the Southbound On and Off-ramps would not be reconstructed toward the east.

**Figures 10 – 18** present each of the alternates in a graphic format with a brief description of each.

- Figure 10: Level 1 – Alternate 1
- Figure 11: Level 1 – Alternate 2
- Figure 12: Level 1 – Alternate 2A
- Figure 13: Level 1 – Alternate 3
- Figure 14: Level 1 – Alternate 4
- Figure 15: Level 1 – Alternate 5
- Figure 16: Level 1 – Alternate 5A
- Figure 17: Level 1 – Alternate 6
- Figure 18: Level 1 – Alternate 6A

These Level 1 alternates were presented at the first Project Team Meeting. Minutes from this meeting can be found in **Appendix B**.

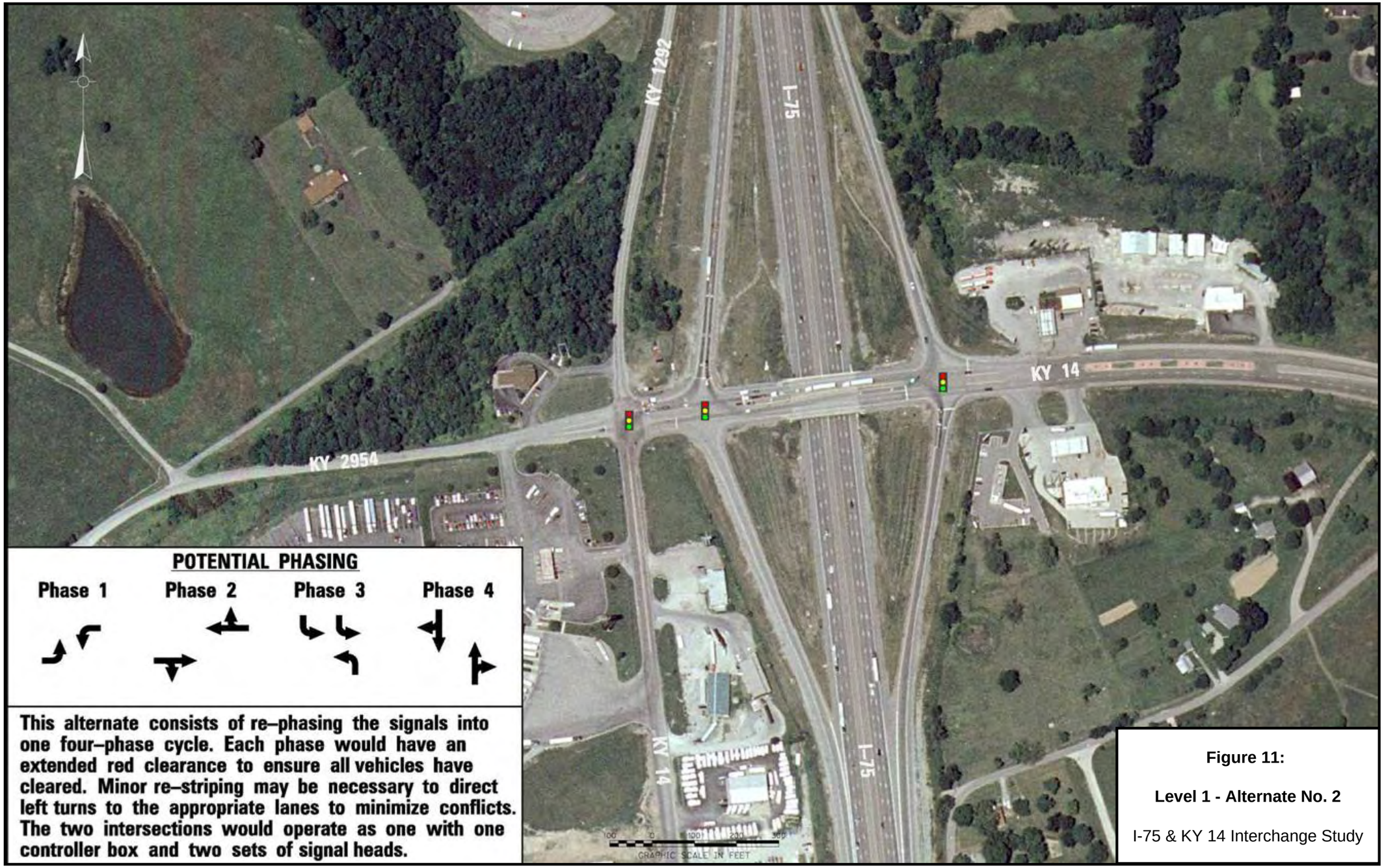



This alternate consists of adding a detector on the I–75 Southbound ramp onto KY 14. When the queue on the ramp reaches the detector, a call will be sent to the controller box to "clear" the right–turn of the I–75 SB / KY 14 intersection and the left–turn of the KY 14 / KY 1292 / KY 2954 intersection.

**Figure 10:**

**Level 1 - Alternate No. 1**

I-75 & KY 14 Interchange Study




**POTENTIAL PHASING**

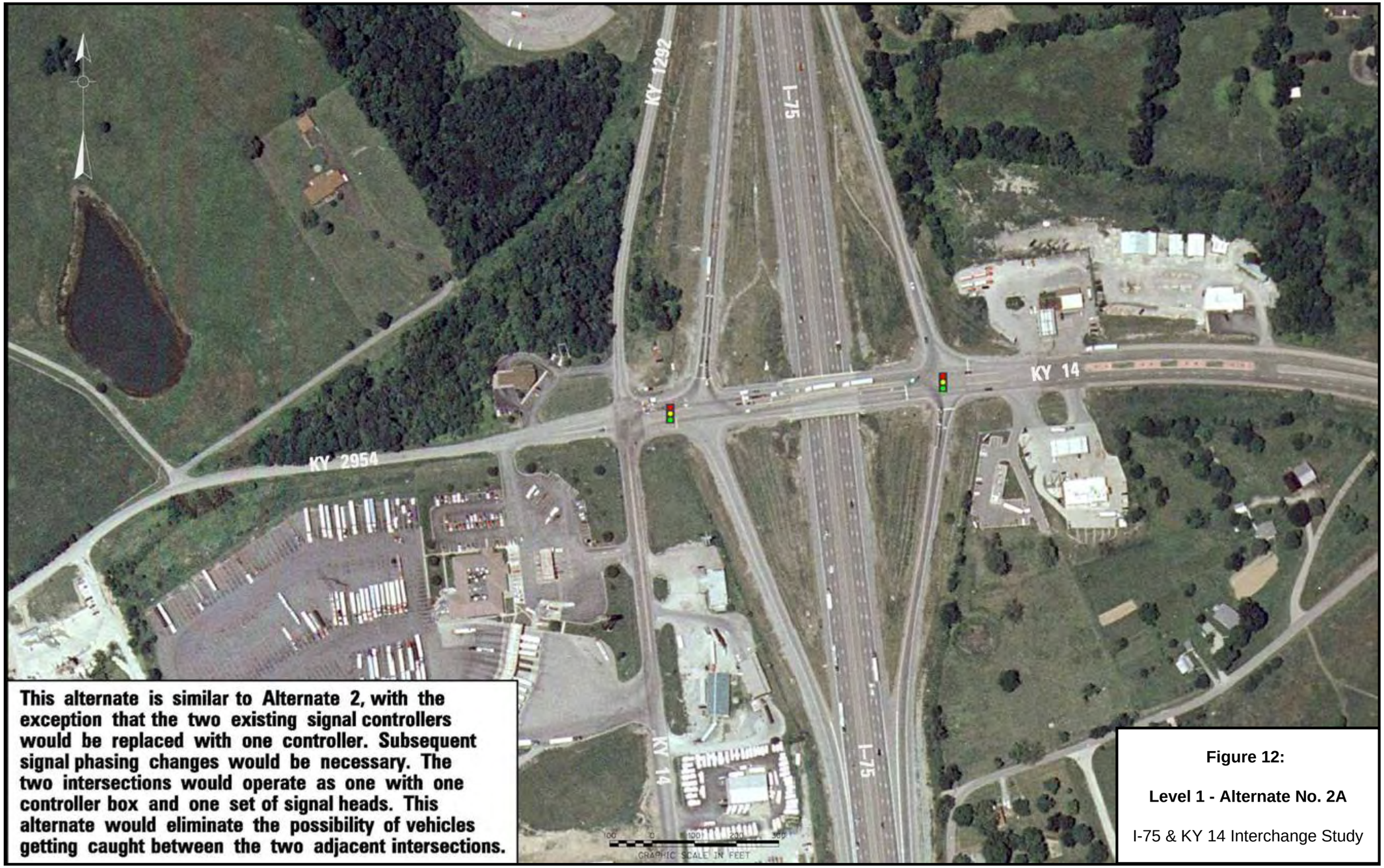
Phase 1 Phase 2 Phase 3 Phase 4

**This alternate consists of re–phasing the signals into one four–phase cycle. Each phase would have an extended red clearance to ensure all vehicles have cleared. Minor re–striping may be necessary to direct left turns to the appropriate lanes to minimize conflicts. The two intersections would operate as one with one controller box and two sets of signal heads.**

**Figure 11:**

**Level 1 - Alternate No. 2**

I-75 & KY 14 Interchange Study




This alternate is similar to Alternate 2, with the exception that the two existing signal controllers would be replaced with one controller. Subsequent signal phasing changes would be necessary. The two intersections would operate as one with one controller box and one set of signal heads. This alternate would eliminate the possibility of vehicles getting caught between the two adjacent intersections.

**Figure 12:**

**Level 1 - Alternate No. 2A**

I-75 & KY 14 Interchange Study

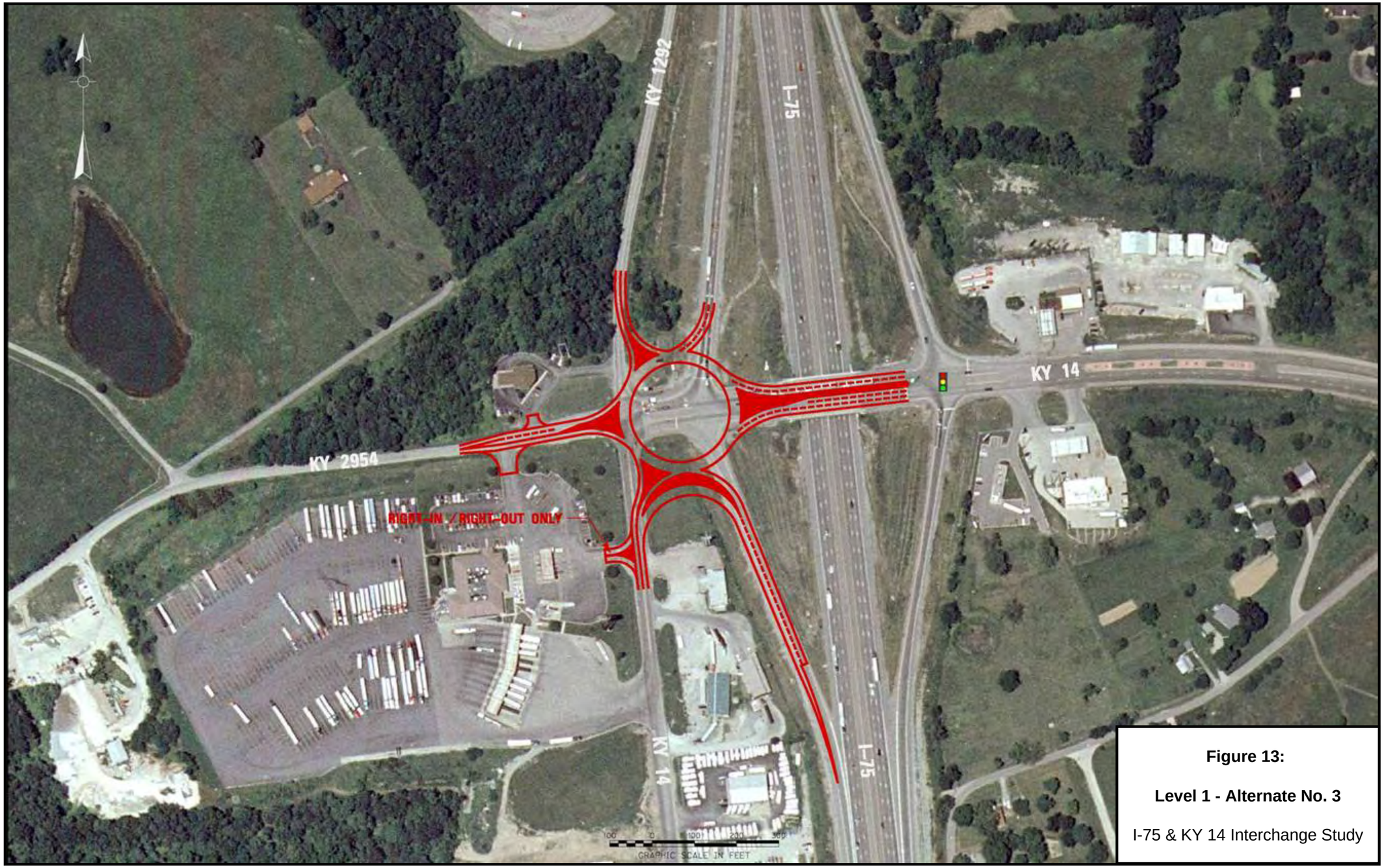



**Figure 13:**

**Level 1 - Alternate No. 3**

I-75 & KY 14 Interchange Study

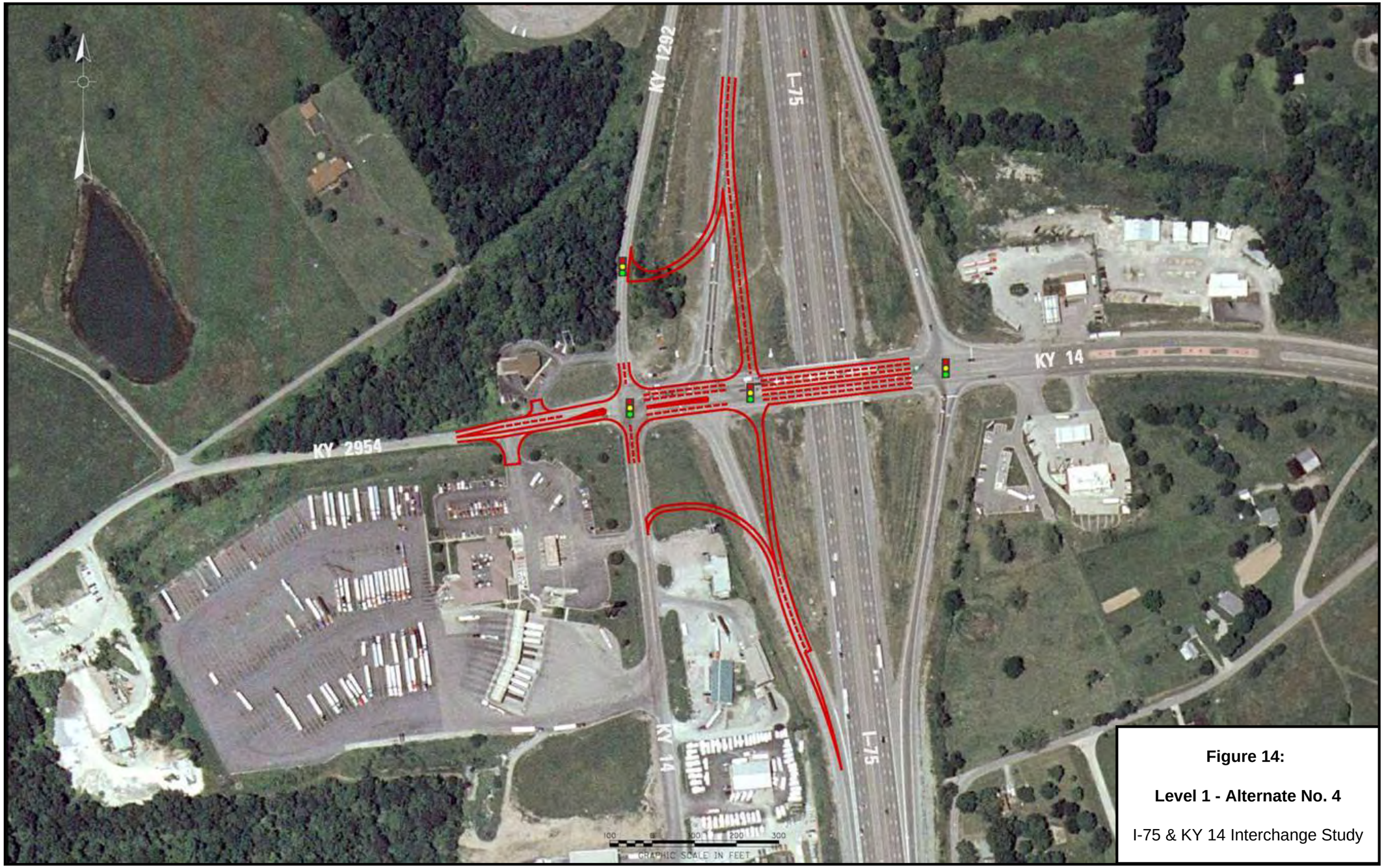



**Figure 14:**

**Level 1 - Alternate No. 4**

I-75 & KY 14 Interchange Study

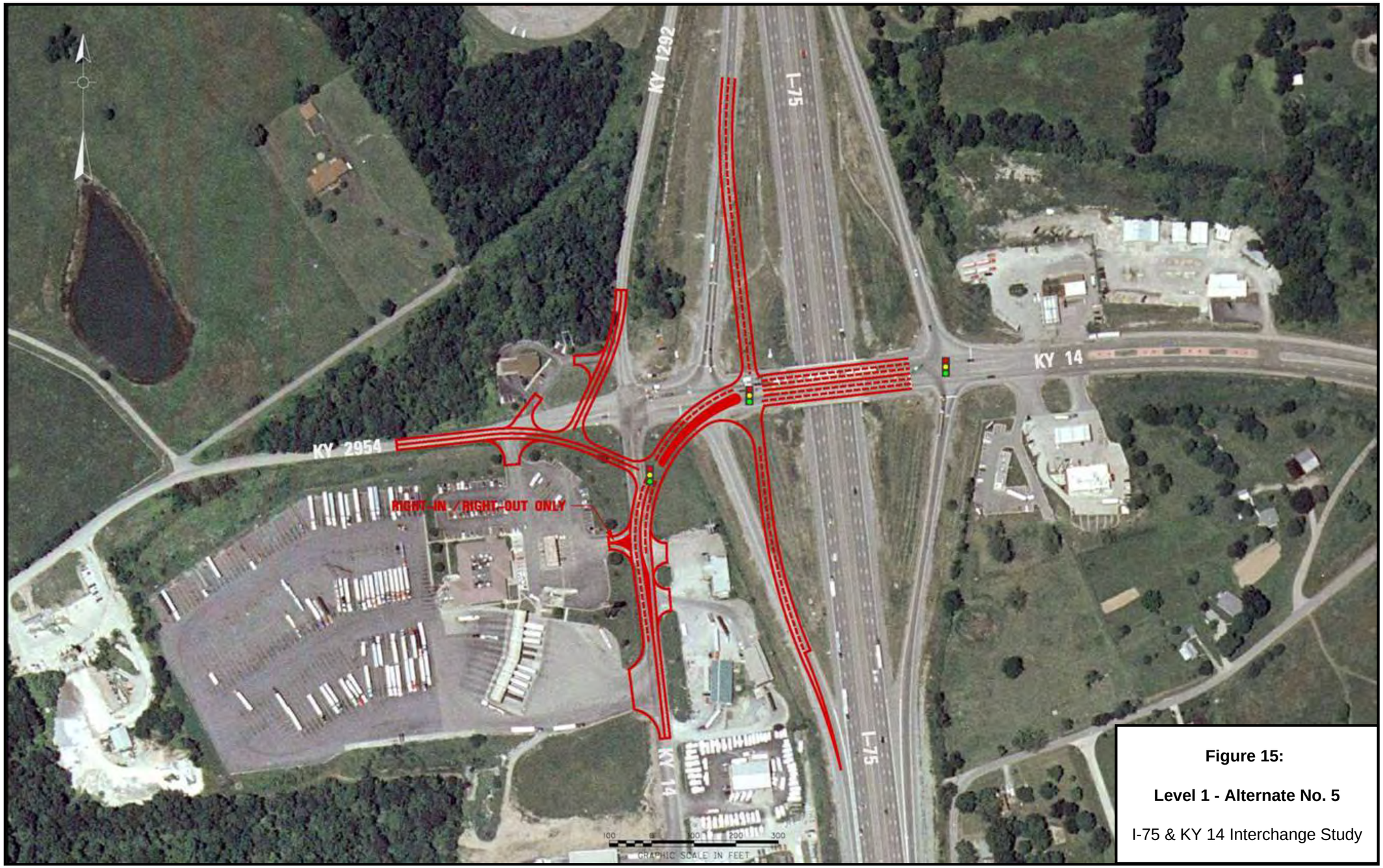



**Figure 15:**

**Level 1 - Alternate No. 5**

I-75 & KY 14 Interchange Study

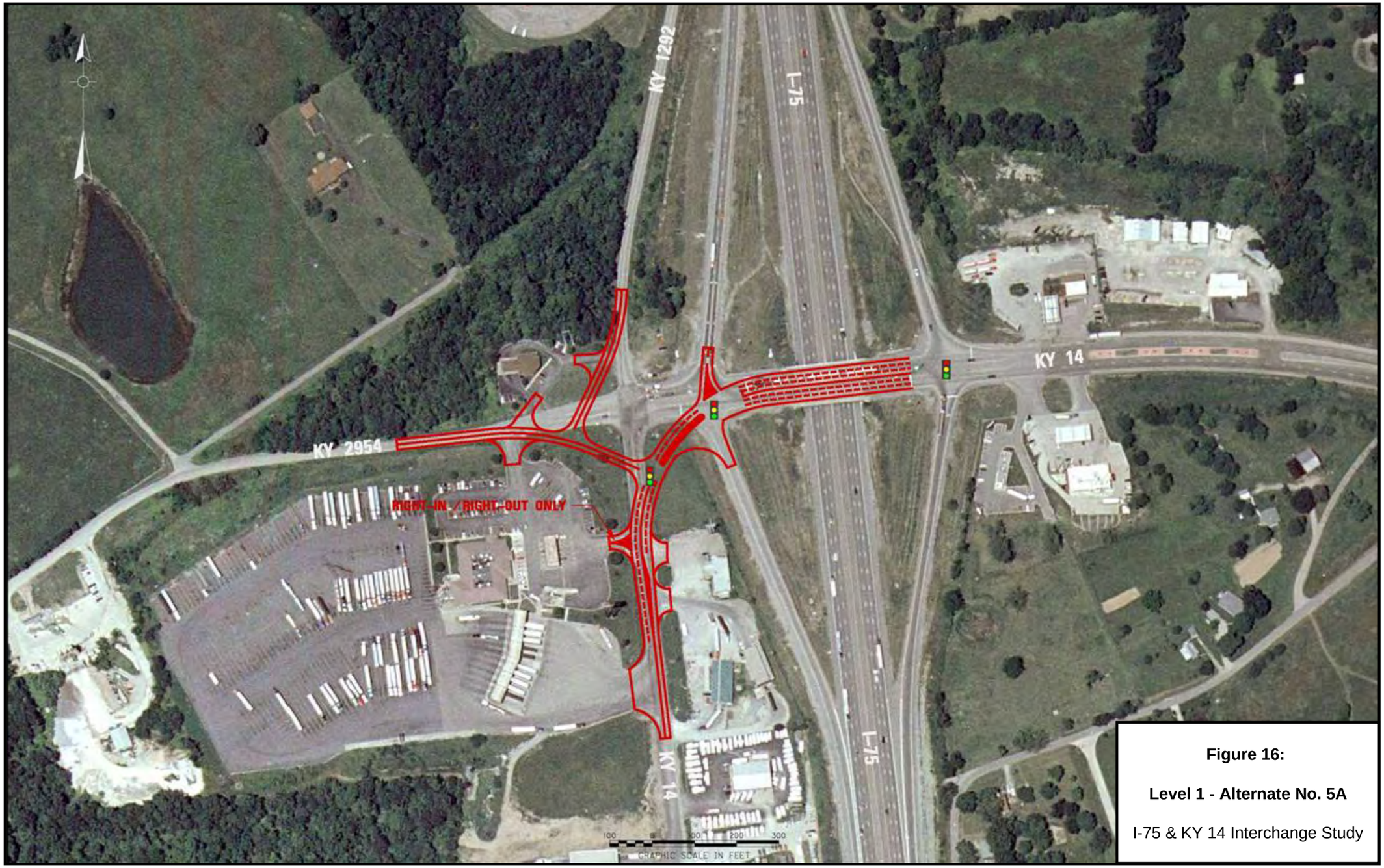



**Figure 16:**

**Level 1 - Alternate No. 5A**

I-75 & KY 14 Interchange Study

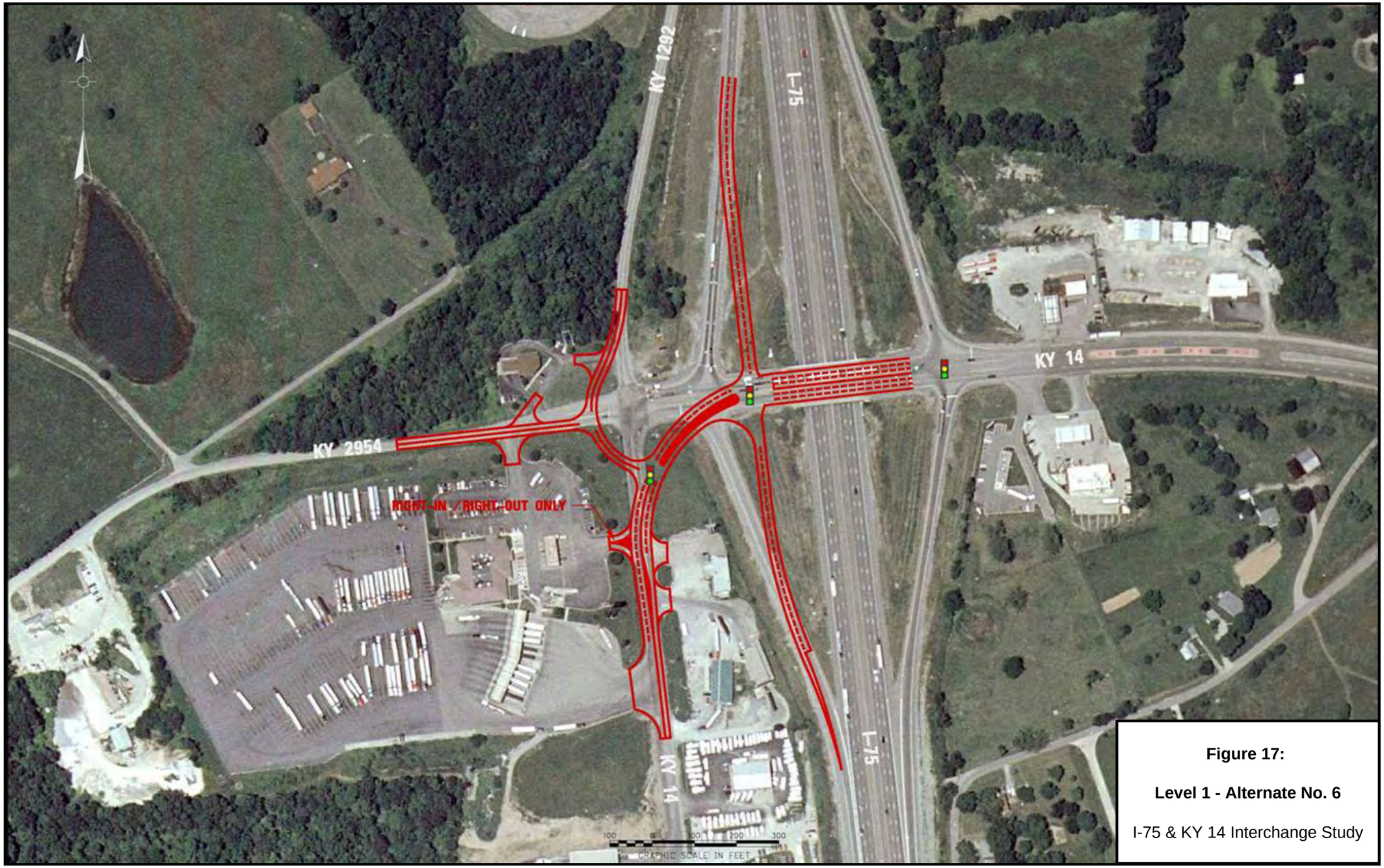



**Figure 17:**

**Level 1 - Alternate No. 6**

I-75 & KY 14 Interchange Study

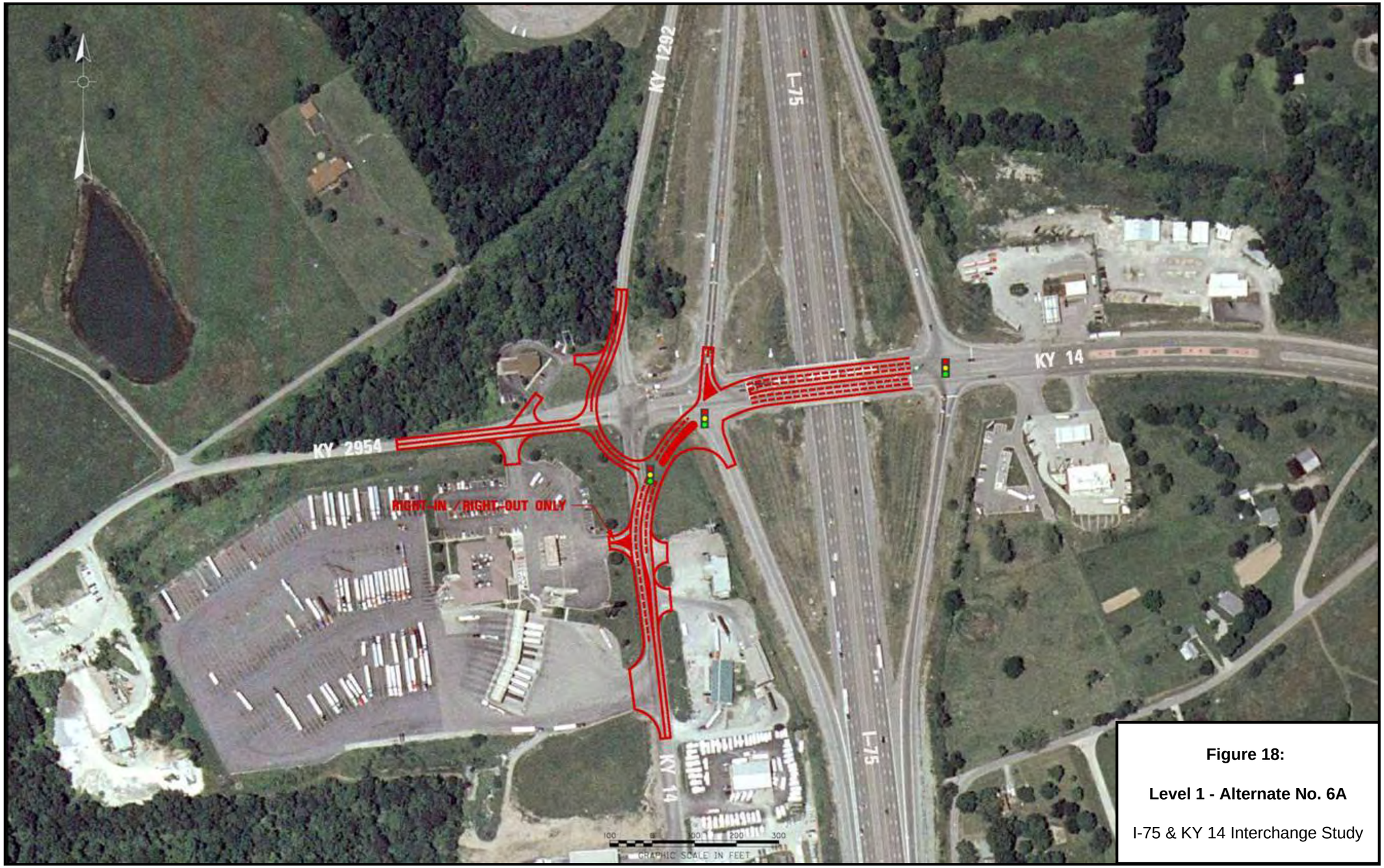



**Figure 18:**

**Level 1 - Alternate No. 6A**

I-75 & KY 14 Interchange Study

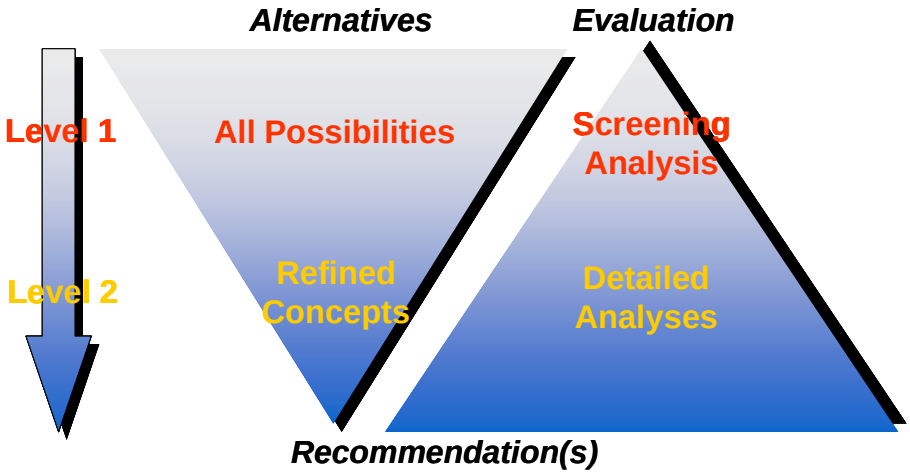
# 6.0 ALTERNATES EVALUATION

## 6.1 Evaluation Methodology

The alternate evaluation procedure used in this study was a two-step process. The first level consists of a general analysis designed to highlight major drawbacks as well as differences between alternates. The goal of this level is to set aside alternates that do not appear to warrant further study, while retaining (and refining) the more promising alternates. Following the initial evaluation is a more extensive analysis. This second level of analysis included detailed analytic results that are sufficient to select one or more recommended alternates.

Initially, a few pertinent and important details were identified for a broad array of possible alternates. As the analysis progressed, the range and depth of information increased and the number of alternates being studied decreased as shown in **Figure 19**.

**Figure 19: Two-Level Evaluation Procedure**




Both evaluation levels considered the critical issues of how well a particular alternate addressed the project goals and how well it met the defined project need. In addition, the evaluation included an assessment of impacts for each proposed alternate, both positive and negative, as well as other key evaluation criteria. In the Level 1 analysis, this assessment was primarily qualitative. As the analysis progressed, more detailed information was known, which led to a full quantitative assessment of the key evaluation areas. The evaluation criteria included examining traffic operations, cost and potential impacts.

## 6.2 Level 1: Initial Screening Analysis

As described in the meeting minutes in **Appendix B**, the Project Team discussed the benefits and potential problems with each alternate. This included:

- Level 1 – Alternate 1 – Due to its low-cost potential, this alternate was deemed to be worth further development and evaluation.

- Level 1 – Alternate 2 – Concern was expressed regarding potential conflicts of simultaneous left turns that would have to be made by KY 1292 and Southbound Off-Ramp vehicles. A review of this alternate with KYTC District 6 Traffic staff after the Project Team Meeting yielded the same concerns. This alternate was deemed to be unfavorable for further evaluation.

- Level 1 – Alternate 2A – This alternate was deemed to be unfavorable with respect to having only one set of signal heads. The extension of the all red phases as well as the potential confusion was also deemed unfavorable. As a result, this alternate will not be retained for further evaluation.

- Level 1 – Alternate 3 – The concept of a roundabout was deemed favorable with the Project Team due its potential for moving traffic efficiently through the intersections. This alternate was determined to be desirable for further development and evaluation.

- Level 1 – Alternate 4 – Concern was expressed regarding the tie-in of the spur ramp to KY 1292 and that this may push the queue problem to this area. Due to its closer proximity to mainline I-75, the available storage would be reduced. In addition, the potential need for a signal at this intersection was also considered undesirable. Therefore, this alternate will not be retained for further development and evaluation.

- Level 1 – Alternate 5 – The Project Team discussed that it is more desirable to have KY 1292 intersect KY 14 as in Level 1 – Alternate 6. This is due to the higher volume of traffic utilizing KY 1292 and the desire to accommodate this higher volume. Therefore, this alternate will not be retained for further evaluation in favor of keeping Level 1 – Alternate 6.

- Level 1 – Alternate 5A – Similar to Level 1 – Alternate 5, it is more desirable to have KY 1292 intersect KY 14 as in Level 1 – Alternate 6. This alternate will not be retained for further evaluation in favor of keeping Level 1 – Alternate 6.

- Level – Alternate 6 – This alternate re-configures the intersection so that KY 1292 intersects with KY 14. In addition, the ramps in this alternate are shifted to the east to allow additional distance between intersections. As a result, this alternate was deemed to be desirable for further development and evaluation.

- Level 1 – Alternate 6A – In this alternate, the Southbound On and Off-ramps would not be reconstructed. Also, concern was expressed regarding the short distance between the two signalized intersections. Therefore, this alternate will not be retained for further evaluation in favor of keeping Level 1 – Alternate 6, in which the ramps were reconstructed to the east.

Based on the discussion, the following alternates were carried forward to the Level 2 screening analysis:

- Level 1 – Alternate 1
- Level 1 – Alternate 3
- Level 1 – Alternate 6

## 6.3 Level 2: Detailed Screening Analysis

The alternates selected for the Level 2 screening were further analyzed to determine whether the alternate would be a legitimate solution to the problems at the I-75 / KY 14 interchange. This additional analysis included refinements to the geometrics to accommodate both horizontal and vertical curvature conditions within the study area. In addition, each was tested in the VISSIM microsimulation model to determine if the improvements would accommodate the base year traffic volumes as well as the future year forecasted volumes.

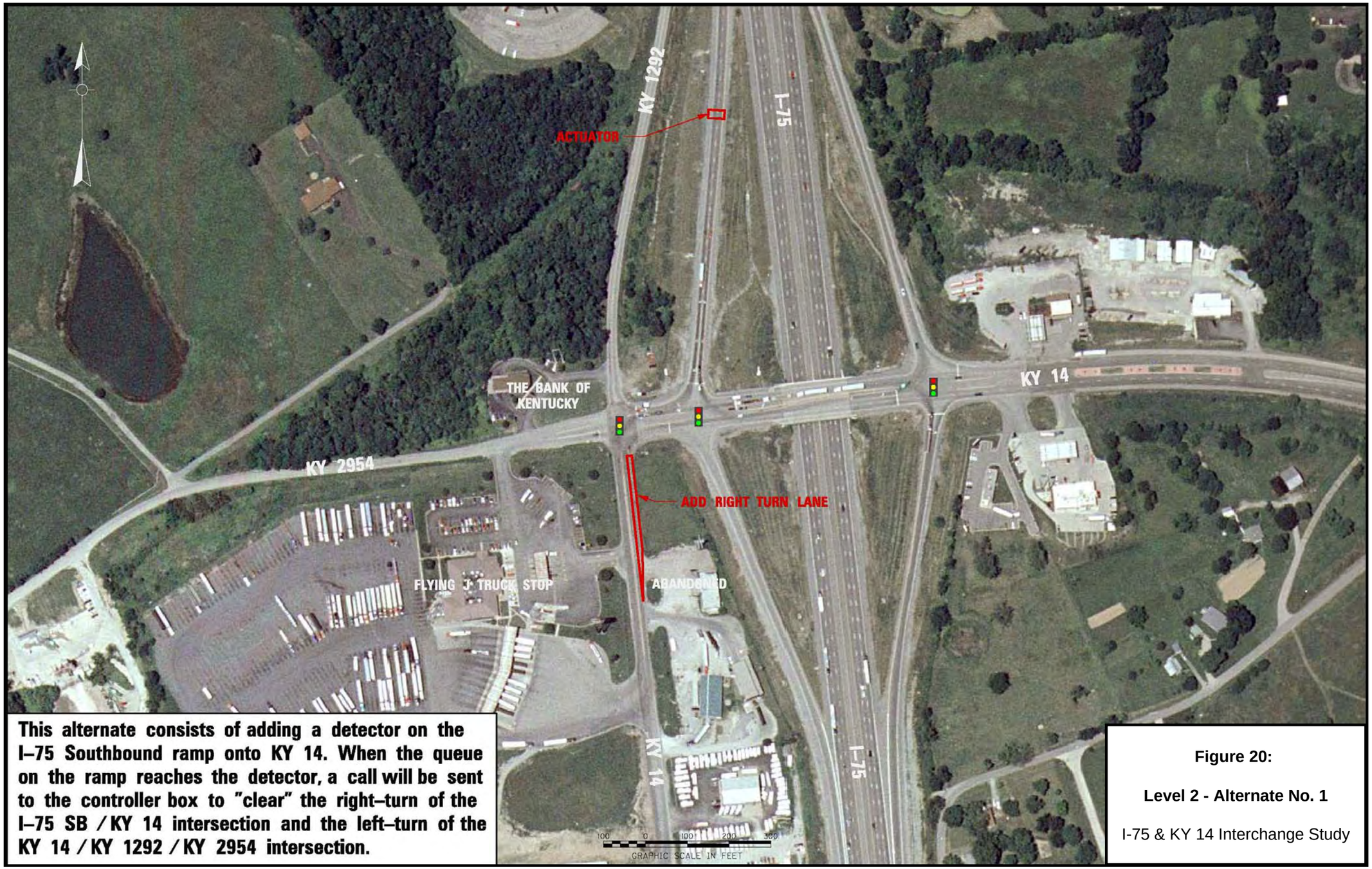
The refinements to the alternates as well as the analysis for each were presented at the second Project Team Meeting. The minutes from this meeting can be found in **Appendix C**.

Level 2 Alternate Descriptions

*Level 2 – Alternate 1* – An actuator on the Southbound Off-Ramp would be added to help clear the right turn of the intersection when the queue reaches the detector as shown in **Figure 20**. While not affecting traffic operations on the ramp, the actuator would serve as a safety measure to prevent queuing onto mainline I-75. In addition, a northbound right turn lane would be added along KY 14 just south of the KY 14 / KY 1292 / KY 2954 intersection. The signal phasing would be adjusted to allow for a simultaneous right turn onto KY 14 toward I-75 while vehicles were making the westbound left turn on KY 14.

The VISSIM model presented a similar scenario as the No-Build scenario. While slightly reduced, the queuing remained on the Southbound Off-Ramp. In addition, queues on the other approaches were slightly longer than in the No-Build scenario.

*Level 2 – Alternate 3* – Construct a roundabout for vehicles on all 6 legs as shown in **Figure 21**. Special consideration was given to the diameter of the roundabout as well as the approach radii in order to accommodate six legs as well as the large volume of trucks entering / exiting the roundabout. The software package AutoTURN was used to verify the requirements for trucks. **Figure 22** displays the AutoTURN results.




**This alternate consists of adding a detector on the I–75 Southbound ramp onto KY 14. When the queue on the ramp reaches the detector, a call will be sent to the controller box to "clear" the right–turn of the I–75 SB / KY 14 intersection and the left–turn of the KY 14 / KY 1292 / KY 2954 intersection.**

**Figure 20:**

**Level 2 - Alternate No. 1**

I-75 & KY 14 Interchange Study

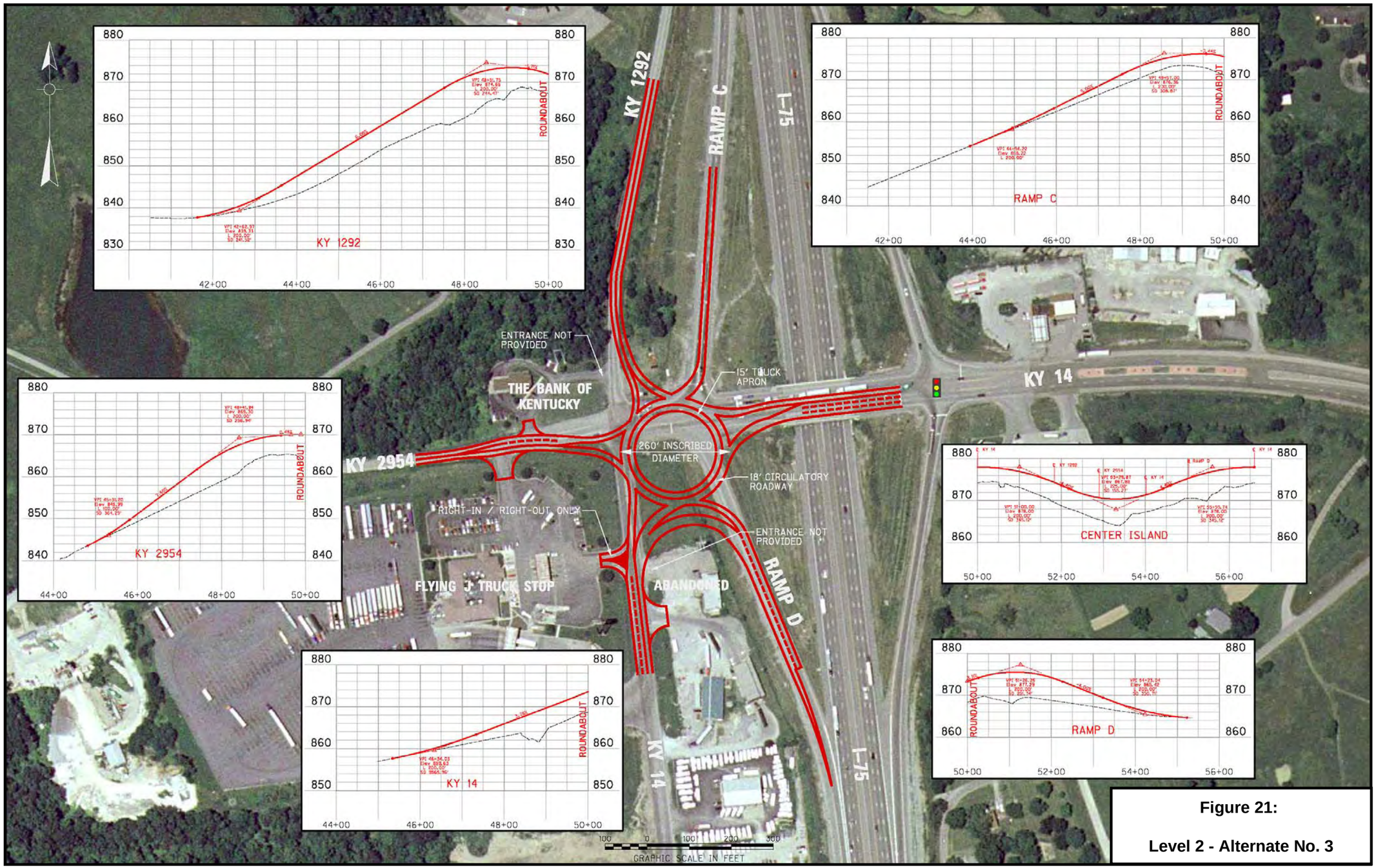



**Figure 21:**

**Level 2 - Alternate No. 3**

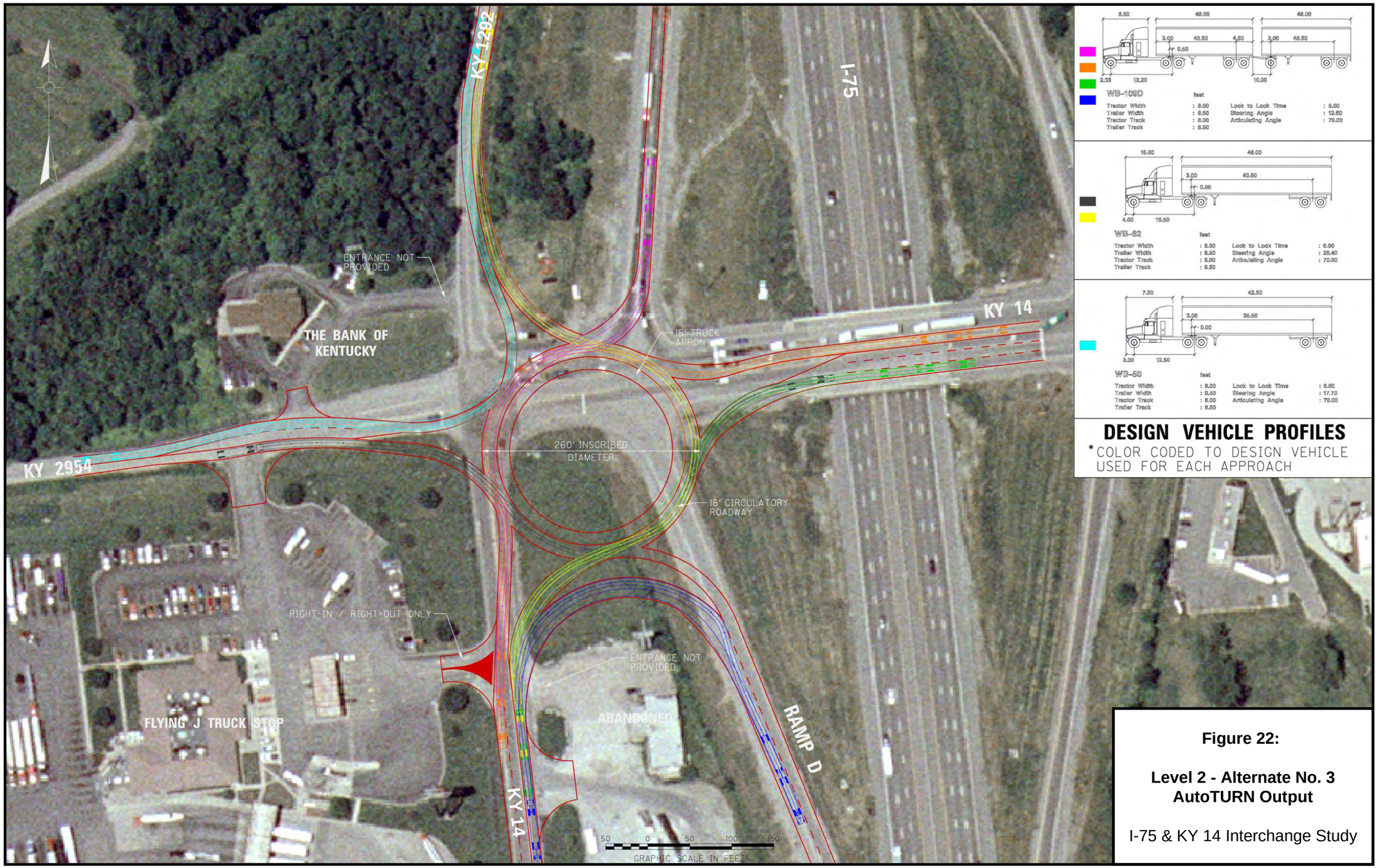



**Figure 22:**

**Level 2 - Alternate No. 3 AutoTURN Output**

I-75 & KY 14 Interchange Study

With regard to roundabout construction, a Feasibility / Constructability Report was developed by PB. This entire report is presented in **Appendix D**. This report indicated there are potential issues with the roundabout from a design and safety standpoint during both construction and maintenance of traffic. While the roundabout is still a feasible alternate from a design perspective, special consideration should be given to these concerns during the next phase of design, if it is carried forward.

The VISSIM model indicated a shut-down of the roundabout nearly halfway through the analysis periods. This was a result of the high volume of trucks entering the roundabout. The result was an impact on nearly all approaches. Also, the additional queuing has a negative effect on the KY 14 intersection with the northbound ramps.

*Level 2 – Alternate 6* – This alternate aligns KY 14 that runs east and west with the KY 14 that runs to the south and then realigns KY 1292 to intersect with KY 14 as shown in **Figure 23**. KY 2954 would intersect with KY 1292. The Southbound On and Off-Ramps would be reconstructed and shifted to the east. It is not anticipated that additional right-of-way would be needed for the shift of the ramps. In addition, the automobile entrance into the Flying J would be reconstructed as a right-in / right-out configuration.

With respect to the VISSIM model, Level 2 – Alternate 6 tested very well. Queues on all approaches were significantly reduced as a result of fewer signal phases as well as coordinated traffic signals. During a Project Team Meeting, the Project Team indicated that the reconfiguration may cause problems for the few vehicles wishing to make a left turn into the Flying J off of KY 2954. Additional study of variations or sub-alternatives for Level 2 – Alternate 6 will be necessary.

Level 2 Alternate Results

Results of the VISSIM traffic analysis are presented in **Figures 24 – 26**. Level 2 – Alternate 6 provided the best overall improvement for the study area for Year 2030. This included a maximum of a level of service (LOS) LOS D for all intersections as well as reduced queues. Level 2 – Alternate 1 and Level 2 – Alternate 3 produced failing LOS in Year 2030. The failure of the roundabout in Level 2 – Alternate 3 also caused the northbound off-ramp to experience LOS F in Year 2030 for both AM and PM.

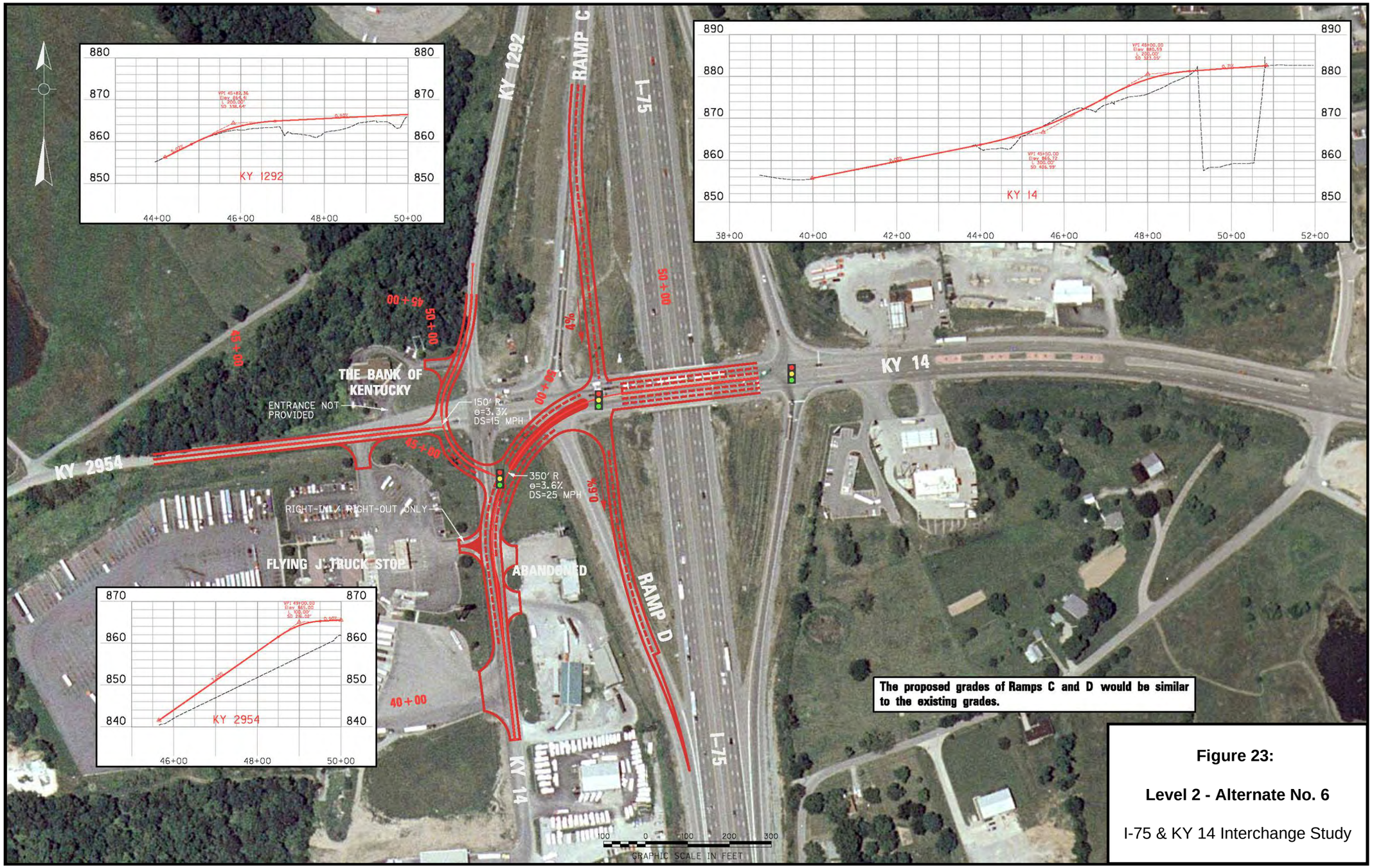
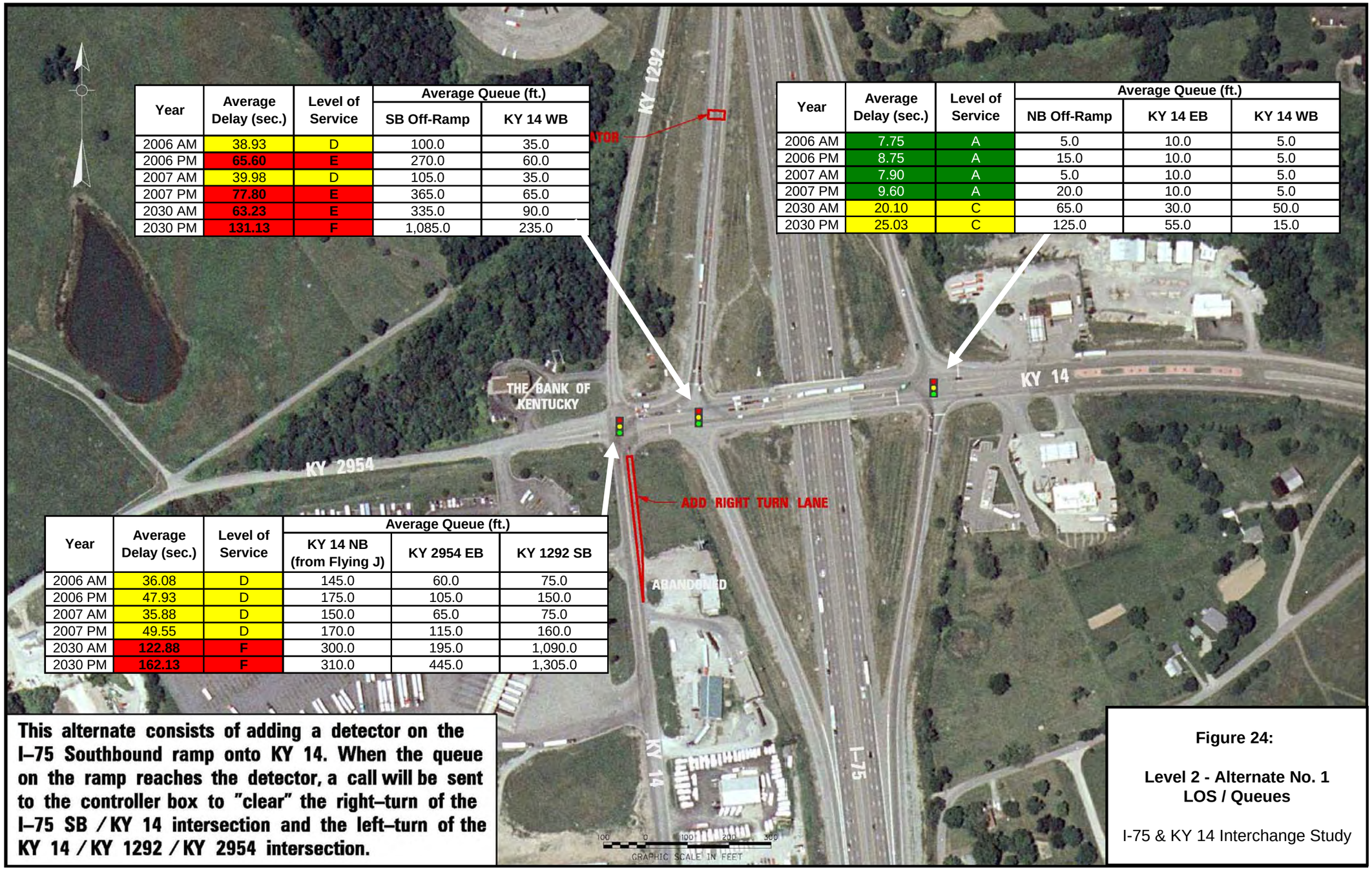



**Figure 23:**

**Level 2 - Alternate No. 6**

I-75 & KY 14 Interchange Study




| Year | Average Delay (sec.) | Level of Service | Average Queue (ft.) | |
|---|---|---|---|---|
| | | | SB Off-Ramp | KY 14 WB |
| 2006 AM | 38.93 | D | 100.0 | 35.0 |
| 2006 PM | **65.60** | **E** | 270.0 | 60.0 |
| 2007 AM | 39.98 | D | 105.0 | 35.0 |
| 2007 PM | **77.80** | **E** | 365.0 | 65.0 |
| 2030 AM | **63.23** | **E** | 335.0 | 90.0 |
| 2030 PM | **131.13** | **F** | 1,085.0 | 235.0 |

| Year | Average Delay (sec.) | Level of Service | Average Queue (ft.) | | |
|---|---|---|---|---|---|
| | | | NB Off-Ramp | KY 14 EB | KY 14 WB |
| 2006 AM | 7.75 | A | 5.0 | 10.0 | 5.0 |
| 2006 PM | 8.75 | A | 15.0 | 10.0 | 5.0 |
| 2007 AM | 7.90 | A | 5.0 | 10.0 | 5.0 |
| 2007 PM | 9.60 | A | 20.0 | 10.0 | 5.0 |
| 2030 AM | 20.10 | C | 65.0 | 30.0 | 50.0 |
| 2030 PM | 25.03 | C | 125.0 | 55.0 | 15.0 |

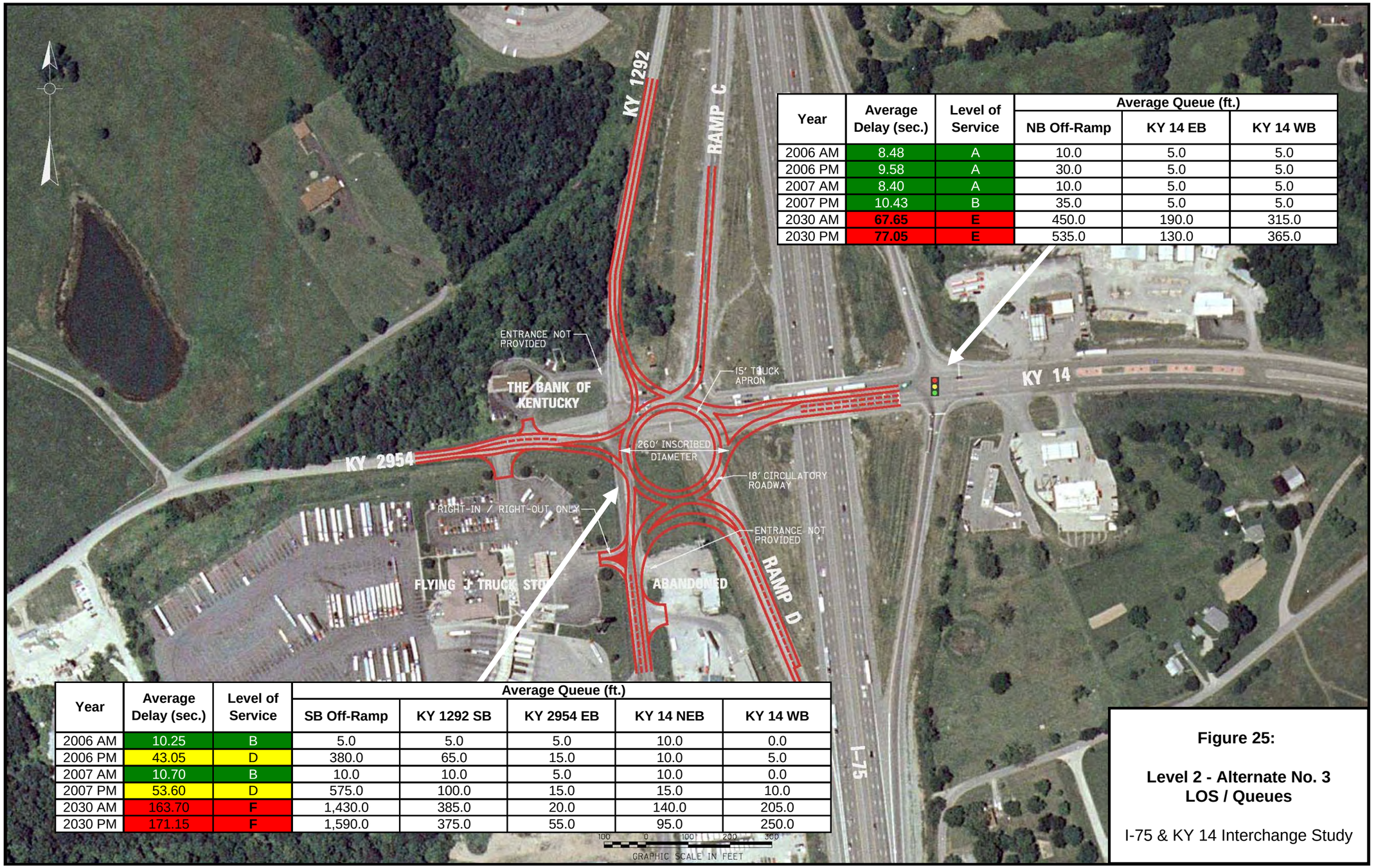
| Year | Average Delay (sec.) | Level of Service | Average Queue (ft.) | | |
|---|---|---|---|---|---|
| | | | KY 14 NB (from Flying J) | KY 2954 EB | KY 1292 SB |
| 2006 AM | 36.08 | D | 145.0 | 60.0 | 75.0 |
| 2006 PM | 47.93 | D | 175.0 | 105.0 | 150.0 |
| 2007 AM | 35.88 | D | 150.0 | 65.0 | 75.0 |
| 2007 PM | 49.55 | D | 170.0 | 115.0 | 160.0 |
| 2030 AM | **122.88** | **F** | 300.0 | 195.0 | 1,090.0 |
| 2030 PM | **162.13** | **F** | 310.0 | 445.0 | 1,305.0 |

**This alternate consists of adding a detector on the I–75 Southbound ramp onto KY 14. When the queue on the ramp reaches the detector, a call will be sent to the controller box to "clear" the right–turn of the I–75 SB / KY 14 intersection and the left–turn of the KY 14 / KY 1292 / KY 2954 intersection.**

**Figure 24:**

**Level 2 - Alternate No. 1 LOS / Queues**

I-75 & KY 14 Interchange Study




| Year | Average Delay (sec.) | Level of Service | Average Queue (ft.) | | |
|---|---|---|---|---|---|
| | | | NB Off-Ramp | KY 14 EB | KY 14 WB |
| 2006 AM | 8.48 | A | 10.0 | 5.0 | 5.0 |
| 2006 PM | 9.58 | A | 30.0 | 5.0 | 5.0 |
| 2007 AM | 8.40 | A | 10.0 | 5.0 | 5.0 |
| 2007 PM | 10.43 | B | 35.0 | 5.0 | 5.0 |
| 2030 AM | 67.65 | E | 450.0 | 190.0 | 315.0 |
| 2030 PM | 77.05 | E | 535.0 | 130.0 | 365.0 |

| Year | Average Delay (sec.) | Level of Service | Average Queue (ft.) | | | | |
|---|---|---|---|---|---|---|---|
| | | | SB Off-Ramp | KY 1292 SB | KY 2954 EB | KY 14 NEB | KY 14 WB |
| 2006 AM | 10.25 | B | 5.0 | 5.0 | 5.0 | 10.0 | 0.0 |
| 2006 PM | 43.05 | D | 380.0 | 65.0 | 15.0 | 10.0 | 5.0 |
| 2007 AM | 10.70 | B | 10.0 | 10.0 | 5.0 | 10.0 | 0.0 |
| 2007 PM | 53.60 | D | 575.0 | 100.0 | 15.0 | 15.0 | 10.0 |
| 2030 AM | 163.70 | F | 1,430.0 | 385.0 | 20.0 | 140.0 | 205.0 |
| 2030 PM | 171.15 | F | 1,590.0 | 375.0 | 55.0 | 95.0 | 250.0 |

**Figure 25:**

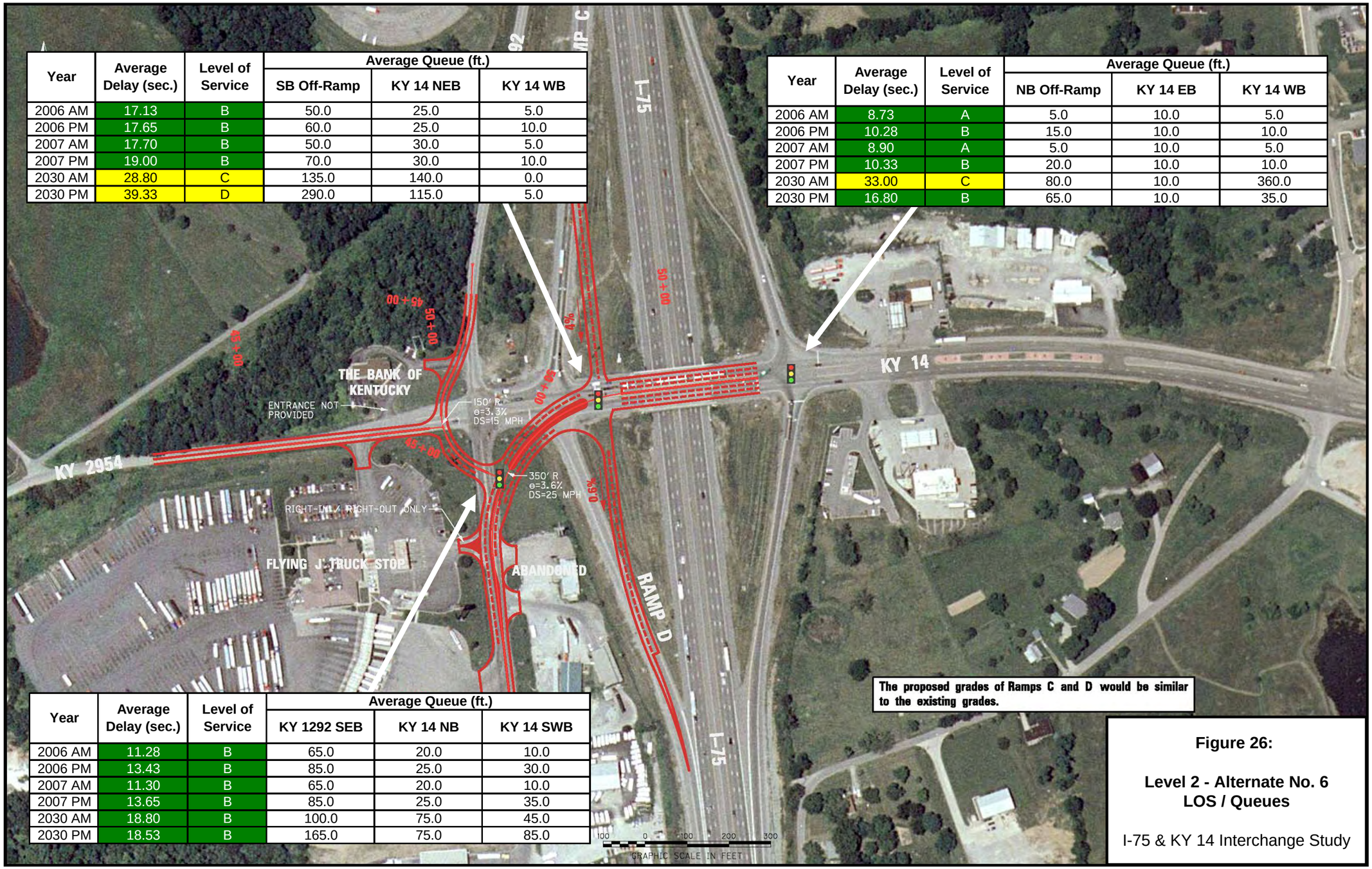
**Level 2 - Alternate No. 3 LOS / Queues**

I-75 & KY 14 Interchange Study

| Year | Average Delay (sec.) | Level of Service | Average Queue (ft.) | | |
|---|---|---|---|---|---|
| | | | SB Off-Ramp | KY 14 NEB | KY 14 WB |
| 2006 AM | 17.13 | B | 50.0 | 25.0 | 5.0 |
| 2006 PM | 17.65 | B | 60.0 | 25.0 | 10.0 |
| 2007 AM | 17.70 | B | 50.0 | 30.0 | 5.0 |
| 2007 PM | 19.00 | B | 70.0 | 30.0 | 10.0 |
| 2030 AM | 28.80 | C | 135.0 | 140.0 | 0.0 |
| 2030 PM | 39.33 | D | 290.0 | 115.0 | 5.0 |

| Year | Average Delay (sec.) | Level of Service | Average Queue (ft.) | | |
|---|---|---|---|---|---|
| | | | NB Off-Ramp | KY 14 EB | KY 14 WB |
| 2006 AM | 8.73 | A | 5.0 | 10.0 | 5.0 |
| 2006 PM | 10.28 | B | 15.0 | 10.0 | 10.0 |
| 2007 AM | 8.90 | A | 5.0 | 10.0 | 5.0 |
| 2007 PM | 10.33 | B | 20.0 | 10.0 | 10.0 |
| 2030 AM | 33.00 | C | 80.0 | 10.0 | 360.0 |
| 2030 PM | 16.80 | B | 65.0 | 10.0 | 35.0 |

| Year | Average Delay (sec.) | Level of Service | Average Queue (ft.) | | |
|---|---|---|---|---|---|
| | | | KY 1292 SEB | KY 14 NB | KY 14 SWB |
| 2006 AM | 11.28 | B | 65.0 | 20.0 | 10.0 |
| 2006 PM | 13.43 | B | 85.0 | 25.0 | 30.0 |
| 2007 AM | 11.30 | B | 65.0 | 20.0 | 10.0 |
| 2007 PM | 13.65 | B | 85.0 | 25.0 | 35.0 |
| 2030 AM | 18.80 | B | 100.0 | 75.0 | 45.0 |
| 2030 PM | 18.53 | B | 165.0 | 75.0 | 85.0 |




The proposed grades of Ramps C and D would be similar to the existing grades.

**Figure 26:**

**Level 2 - Alternate No. 6 LOS / Queues**

I-75 & KY 14 Interchange Study

To compare ramp operations between the alternates, a level of service and delay matrix was compiled for each alternate and compared to the No-Build baseline. Model output for both the southbound and northbound ramps are shown in **Tables 4** and **5**.

**Table 4: VISSIM Model Summary – Southbound Ramps**

| Year | No Build | | Alternate 1 | | Alternate 3 | | Alternate 6 | |
|---|---|---|---|---|---|---|---|---|
| | Average Delay | Level of Service | Average Delay | Level of Service | Average Delay | Level of Service | Average Delay | Level of Service |
| 2006 AM | 27.88 | C | 38.93 | D | 10.25 | B | 17.13 | B |
| 2006 PM | 101.88 | **F** | 65.60 | E | 43.05 | D | 17.65 | B |
| 2007 AM | 29.93 | C | 39.98 | D | 10.70 | B | 17.70 | B |
| 2007 PM | 107.35 | **F** | 77.80 | E | 53.60 | D | 19.00 | B |
| 2030 AM | 122.33 | **F** | 63.23 | E | 163.70 | **F** | 28.80 | C |
| 2030 PM | 138.33 | **F** | 131.13 | **F** | 171.15 | **F** | 39.33 | D |

**Table 5: VISSIM Model Summary – Northbound Ramps**

| Year | No Build | | Alternate 1 | | Alternate 3 | | Alternate 6 | |
|---|---|---|---|---|---|---|---|---|
| | Average Delay | Level of Service | Average Delay | Level of Service | Average Delay | Level of Service | Average Delay | Level of Service |
| 2006 AM | 7.50 | A | **7.75** | A | 8.48 | A | 8.73 | A |
| 2006 PM | 8.75 | A | **8.75** | A | 9.58 | A | 10.28 | B |
| 2007 AM | 7.73 | A | **7.90** | A | 8.40 | A | 8.90 | A |
| 2007 PM | 9.35 | A | **9.60** | A | 10.43 | B | 10.33 | B |
| 2030 AM | 22.35 | C | **20.10** | C | 67.65 | E | 33.00 | C |
| 2030 PM | 16.75 | B | **25.03** | C | 77.05 | E | 16.80 | B |

As shown, Level 2 – Alternate 6 has the best overall operations on both ramps with LOS D as the worst LOS condition. Level 2 – Alternate 1 has the next best overall performance while Level 2 – Alternate 3 has the worst operating performance.

The construction costs (shown below) are planning level estimates in 2006 dollars and include a 25% contingency. The costs do not include right of way or utility relocation costs.

Level 2 – Alternate 1 – $150,000
Level 2 – Alternate 3 – $2,600,000
Level 2 – Alternate 6 – $3,200,000

An evaluation matrix was developed in order to compare the three alternates. A value ranging from 1 to 5 was assigned to alternates based on five criteria consistent with the Purpose and Need for this project. The value was assigned based on a relative ranking among each alternate for each criteria. **Table 6** provides the evaluation matrix results.

## Table 6: Evaluation Matrix

| Alternate No. | Description of Alternate | Ranking[1] | | | | | Estimated Construction Cost[2] |
|---|---|---|---|---|---|---|---|
| | | Reduce Vehicle Emissions | Improve Safety | Improve LOS | Reduce Queue Lengths | Provide for High Truck Volume | |
| 1 | Add right turn lane to NB KY 14 and add actuator on SB Off-Ramp | 1 | 3 | 1 | 3 | 3 | $150,000 |
| 3 | Construct Roundabout at KY 14 / KY 1292 / KY 2954 Intersection | 2 | 2 | 1 | 1 | 3 | $2,600,000 |
| 6 | Re-align KY 14 / KY 1292 / KY 2954 Intersection | 4 | 4 | 5 | 4 | 3 | $3,200,000 |

NOTES:
1. Ranking based on qualitative comparison to other alternates in which "1"=no improvements and "5"=best.
2. Construction costs are 2006 planning level estimates and include a 25% contingency.

The overall rankings indicate that Level 2 – Alternate 6 provides the best improvements with respect to the Purpose and Need for this project. It should also be noted that Level 2 – Alternate 6 also has the highest costs of each of the three alternates.

### 6.4 Additional Alternates

During the second Project Team meeting, additional alternates and variations of alternates were discussed. The following text describes this discussion.

Sweger Alternates

Two additional alternates were proposed by Brent Sweger of KYTC's Division of Planning. These alternates were provided after PB had conducted its traffic analysis for this project. These included:

- Sweger Alternate 1: This included the realignment of the Southbound Off-Ramp onto KY 1292. A new T-intersection or roundabout would be constructed as this new intersection. The KY 14 / KY 1292 / KY 2954 intersection would be constructed with a new signal system or a roundabout.

- Sweger Alternate 2: This includes the realignment of KY 1292 along the old roadbed so that it intersects with KY 2954 at the bottom on the hill. In addition, the Southbound Off-Ramps would be shifted to old KY 1292 to allow for a through movement to the Flying J.

**Figures 27** and **28** on the following pages depict the alternates conceptually.

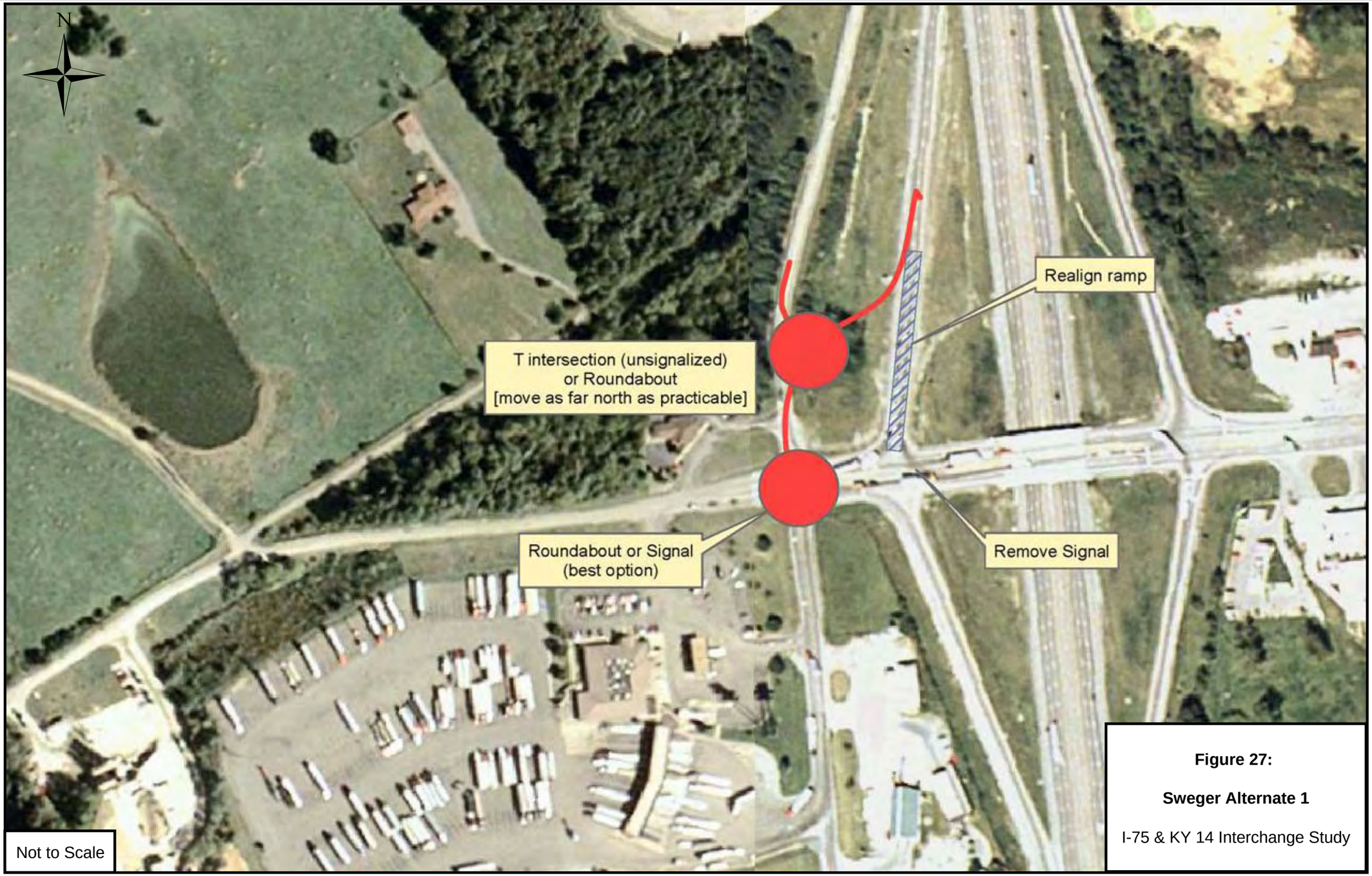



**Figure 27:**

**Sweger Alternate 1**

I-75 & KY 14 Interchange Study

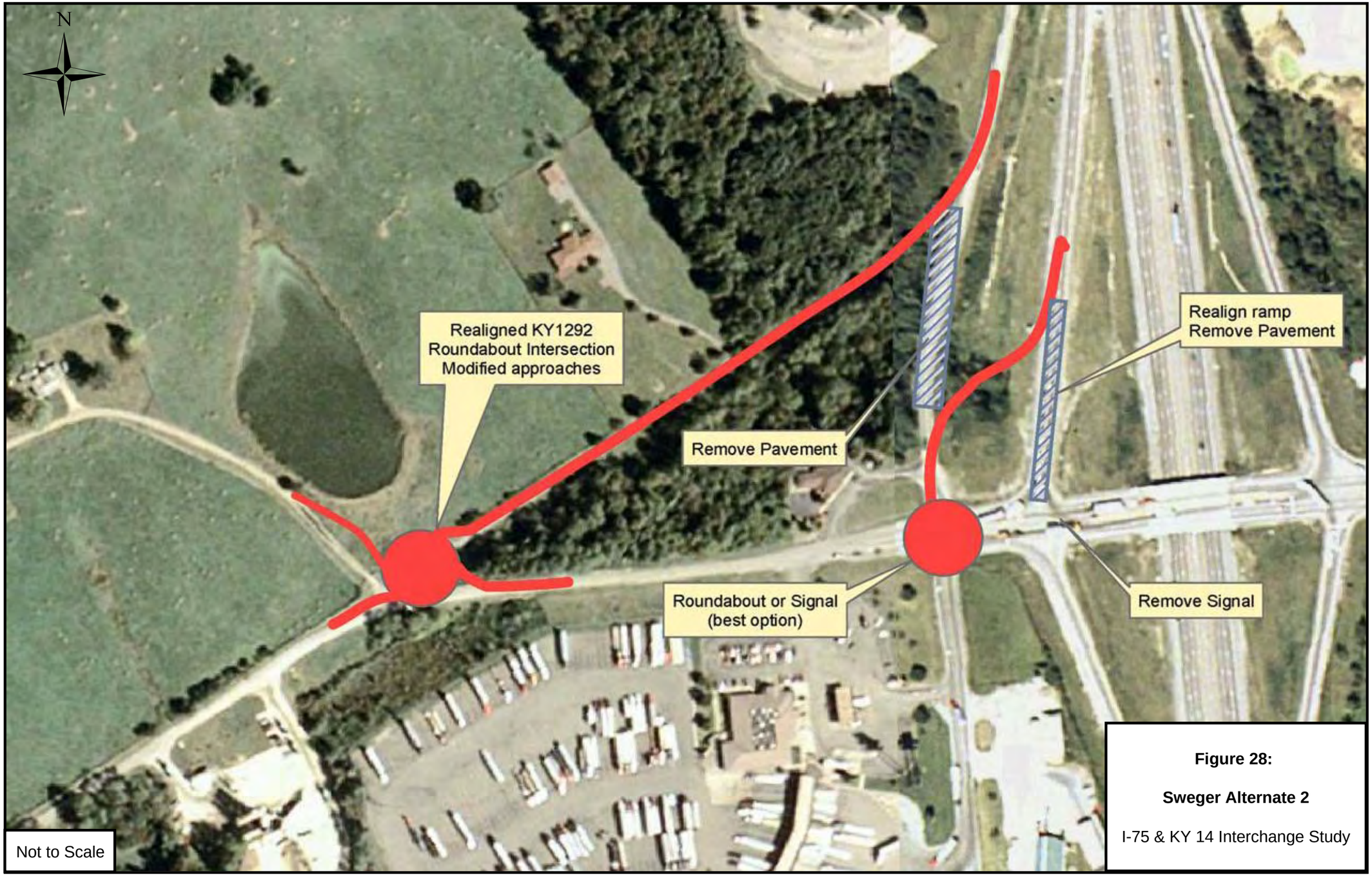



**Figure 28:**

**Sweger Alternate 2**

I-75 & KY 14 Interchange Study

Near-Term Alternate

It was noted that the addition of the northbound right turn lane in Level 2 – Alternate 1 and retiming of the traffic signals could provide some reduction in delays at the intersections. Given the $150,000 cost estimate of this alternate, current CMAQ funds could be used for this short term improvement.

Also, there was discussion regarding the proposed right-in / right-out entrance at the Flying J off of KY 14 as part of the short term improvement. It was noted that any change to the entrance would require right-of-way acquisition, which would require additional funding. However, a concrete median along KY 14 may eliminate this issue, and could be considered with the short term improvement.

KY 1292 / KY 2954 Realignments

It was noted that additional investigation into KY 1292 and KY 2954 realignments should be conducted during the next design phase of this project. As a follow-up to the second Project Team Meeting, three additional alternates were developed which were variations of Level 2 – Alternate 6. These include:

- Alternate 6B – This alternate is similar to Level 2 – Alternate 6 in that it aligns KY 14 that runs east and west with the KY 14 that runs to the south. KY 2954 is realigned to intersect with KY 14 as shown in **Figure 29**. KY 1292 would be realigned along the old roadbed to its intersection with KY 2954 approximately 800 feet from the existing KY 14 / KY 1292 / KY 2954 intersection. The pavement of Old KY 1292 would be removed.

- Alternate 6C – This alternate is similar to Alternate 6B in that KY 1292 is relocated to intersect with KY 2954 west of the existing KY 14 / KY 1292 / KY 2954 intersection as shown in **Figure 30**. However, in this alternate, KY 1292 would be located through the existing wooded area near The Bank of Kentucky at a 6% grade. The new intersection of KY 1292 / KY 2954 would be approximately 400 feet from the existing KY 14 / KY 1292 / KY 2954 intersection. The pavement of Old KY 1292 would be removed.

- Alternate 6D – This alternate is similar to Level 2 – Alternate 6 with the exception that KY 2954 is relocated to intersect with KY 1292 north of the existing KY 14 / KY 1292 / KY 2954 intersection as shown in **Figure 31**. The relocated portion of KY 2954 follows the old KY 1292 roadbed to its intersection with KY 1292, which is approximately 400 feet from the existing KY 14 / KY 1292 / KY 2954 intersection. The pavement of Old KY 2954 would be removed except for access to the Flying J Travel Plaza along KY 2954. In addition, there would be no changes to the access to the Bank of Kentucky.

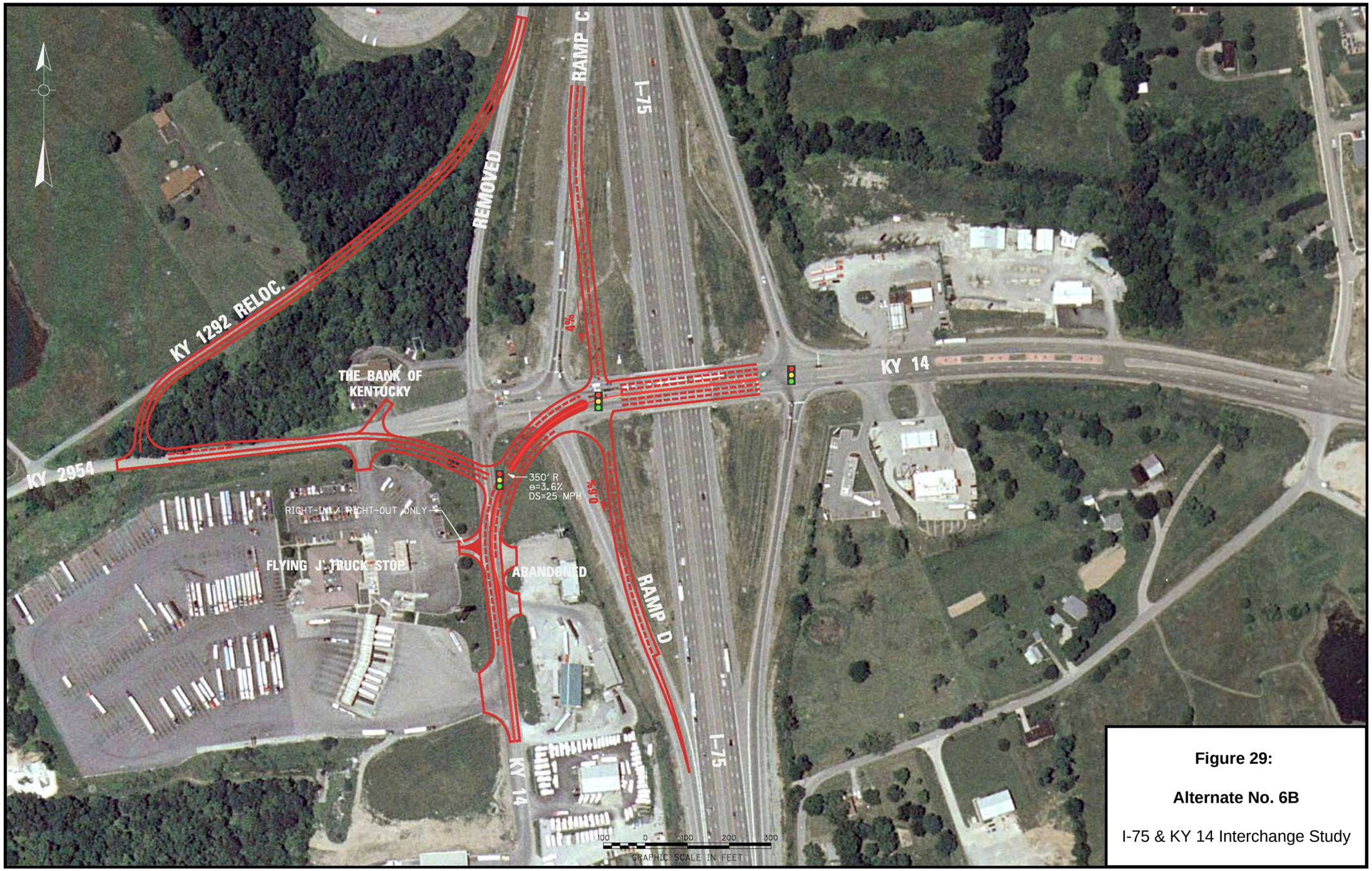



**Figure 29:**

**Alternate No. 6B**

I-75 & KY 14 Interchange Study

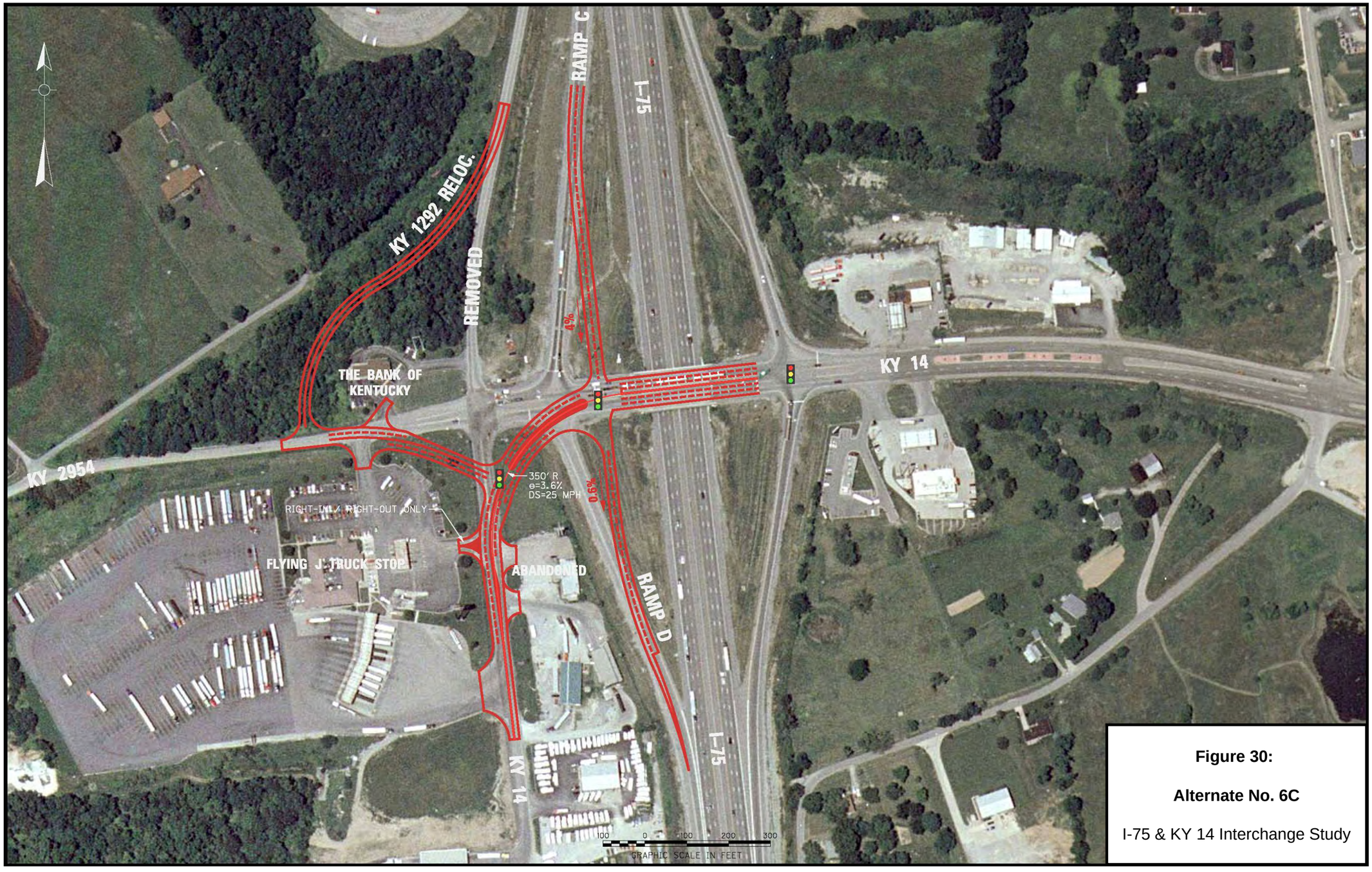



**Figure 30:**

**Alternate No. 6C**

I-75 & KY 14 Interchange Study

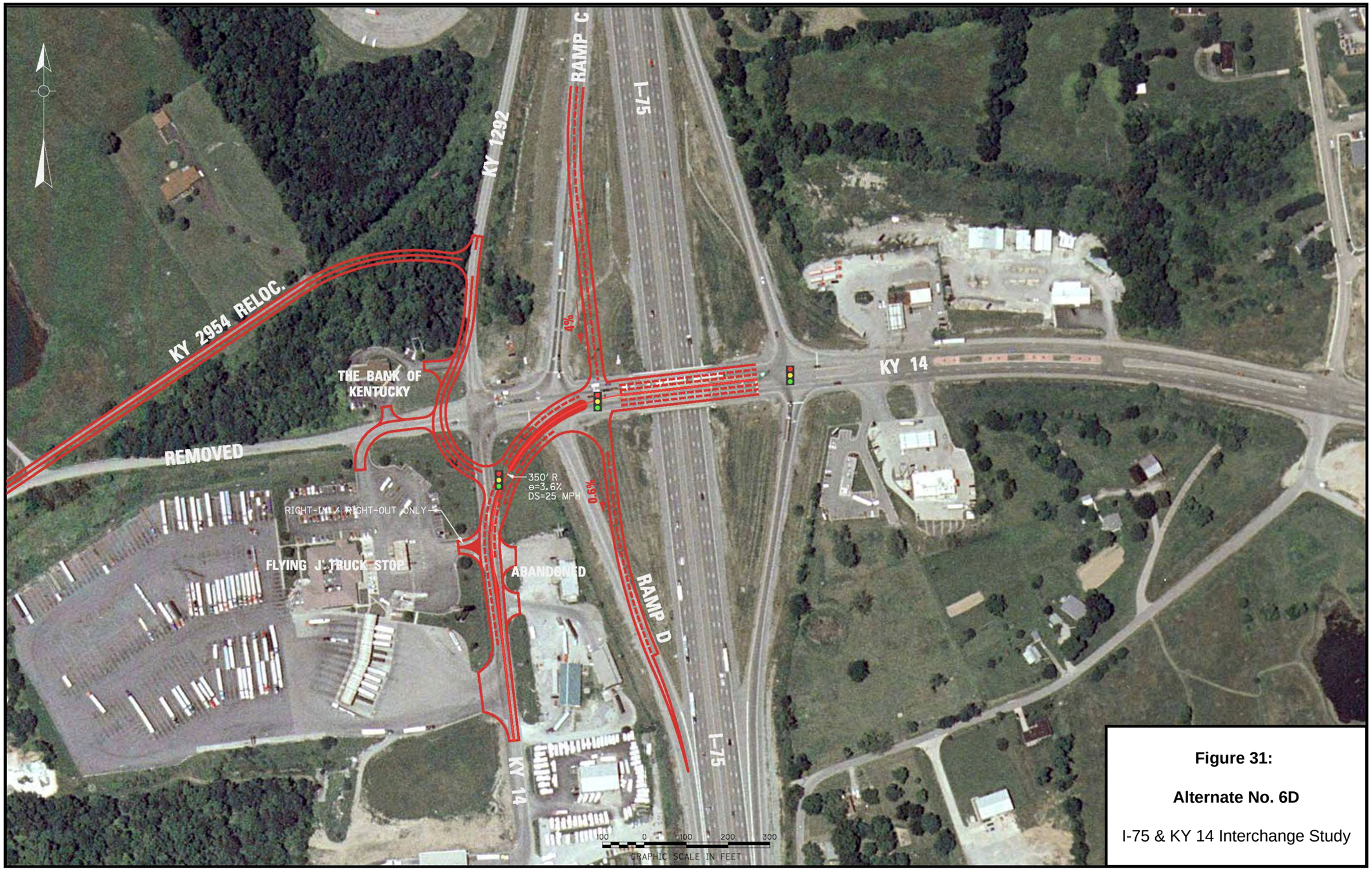



**Figure 31:**

**Alternate No. 6D**

I-75 & KY 14 Interchange Study

The construction costs (shown below) for the new alternates are planning level estimates in 2006 dollars and include a 25% contingency. The costs do not include right of way or utility relocation costs.

Alternate 6B - $3,600,000
Alternate 6C - $3,500,000
Alternate 6D - $3,800,000

As shown, the estimated construction costs for the three alternates are between 9.4% and 18.8% higher than Level 2 – Alternate 6.

Other Alternate Discussion

With respect to alternates, a two-lane roundabout was suggested during the Project Team meeting as a possible solution to the congestion shown in the one-lane roundabout modeled in Level 2 – Alternate 3. One of the legs could also possibly be eliminated. Concern, however, was expressed over the high volume of trucks that will utilize the roundabout, which would possibly use the extra lane as part of its turn maneuver. It was also noted that a two-lane roundabout alternate may not result in any better operation of traffic than Level 2 – Alternate 6 and would still be left with the constructability and maintenance of traffic issues.

# 7.0 RECOMMENDATION / DESIGN ISSUES / NEXT STEPS

## 7.1 Recommendation

The Project Team agreed that (Level 2, Alternate 1) the addition of the northbound turn lane on KY 14 at the KY 14 / KY 1292 / KY 2954 intersection, and possible addition of the signal actuator on the I-75 SB ramp, would serve as an appropriate short-term improvement to the congestion at the I-75 / KY 14 interchange. This recommendation would also involve the re-phasing and re-timing of the traffic signals at this intersection. The construction of a concrete divided median along KY 14 in front of the passenger car entrance to the Flying J should also be considered. CMAQ funding was identified as a possible funding source for this project.

With respect to a long-term solution, the Project Team agreed (as a whole) that Level 2 – Alternate 6 or sub-alternate would provide the optimal long-term solution to the study area. With this alternate there are less constructability concerns and traffic can more easily be maintained during construction without road closures and significant detours. The planning level cost estimate in 2006 dollars is $3,200,000 which includes a 25% contingency factor but does not include right-of-way or utility relocation costs.

## 7.2 Design Issues

During the next phase of design, specific consideration should be given to the grades within the study area. In addition, consideration should be given to the high volume of trucks to ensure the design is accessible to these vehicles.

## 7.3 Next Steps / Implementation

In the near term, funding should be secured and allocated for the construction of the northbound turn lane and signal re-timing. Funding should also be secured for the design and construction of Level 2 – Alternate 6. During the actual design phase, any design issues resulting from this initial study should be evaluated and discussed prior to plan finalization.

# APPENDIX A:

# SUMMARY OF MEETING WITH FLYING J MANAGEMENT

**Project Memo**

***To:*** Project File

***From:*** Scott Walker

***Date:*** December 12, 2005

***Subject:*** Conversation with Flying J Store Manager

This purpose of this file is to document a conversation between a store manager of the Flying J Travel Center in Walton, Kentucky on December 7, 2005 by Lindsay Walker and Scott Walker, both of Parsons Brinckerhoff.

Lindsay informed the manager that traffic counts were being conducted in the vicinity of the travel center and it was important to determine when the Flying J experienced its peak traffic. The manager, appearing certain of his response, indicated that between 10:00 AM on Tuesday through 10:00 PM on Thursday were the peak times for the travel center. He also indicated that this particular Flying J was the 3rd busiest Flying J in the United States.

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# APPENDIX B:

# PROJECT TEAM MEETING #1 MEETING MINUTES

**Parsons Brinckerhoff Quade & Douglas, Inc.**

**Memorandum**

TO: Scott Thomson, PE
Project Manager
Kentucky Transportation Cabinet – Central Office, Division of Planning

FROM: Frank S. (Steve) Slade, PE, PLS
Project Manager
Parsons Brinckerhoff, Inc.

DATE: August 9, 2006

SUBJECT: I-75 / KY 14 Interchange Study
Statewide Modeling MDL-1
Summary of Project Team Meeting on August 7, 2006

A Project Team Meeting for the subject project was held August 7, 2006 at the District 6 Office in Covington, Kentucky. The following people were in attendance:

| NAME | REPRESENTING | E-MAIL ADDRESS |
|---|---|---|
| Tom Schomaker | KYTC – District 6 – Chief District Engineer | tom.schomaker@ky.gov |
| Jim Brannon | KYTC – District 6 – Pre-Construction | jim.brannon@ky.gov |
| Rob Hans | KYTC – District 6 – Planning | robert.hans@ky.gov |
| Mike Bezold | KYTC – District 6 – Planning | mike.bezold@ky.gov |
| Jimmy Wilson | KYTC – Central Office – Planning | jimmy.wilson@ky.gov |
| Scott Walker | Parsons Brinckerhoff | walkersc@pbworld.com |
| Steve Slade | Parsons Brinckerhoff | slade@pbworld.com |

The purpose of the meeting was to provide an update on progress that has been made on the study and to review the current baseline data and preliminary alternates that have been developed.

The following is a summary of what was discussed at the meeting:

1. The draft purpose and need statement was discussed. It was noted that air quality improvements should be included with the statement.

2. The scope of work and the current progress for the study was discussed.

3. PB provided attendees a handout that included the draft purpose and need statement, draft of current ADT, draft of base year AM and PM turning movements, and crash data. It was noted that collection of data has not yet been completed.

4. It was discussed that the Flying J may be at or near capacity and therefore judgment should be used with respect to the traffic forecast of vehicles to and from this truck stop. It was also noted that the future development east of the interchange should be accounted for with the traffic forecast.

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5. PB presented preliminary alternates that have been developed and provided attendees a copy of the layouts. The alternates included:

   - Alternate 1 – Add an actuator on the SB off-ramp that would help clear the right turn of the intersection when the queue reaches the detector.

     This alternate was deemed to be worth further development and evaluation.

   - Alternate 2 – Re-phase the signals into a 4-phase cycle and each phase would have an extended red clearance to clear vehicles from both intersections. The two intersections would operate as one.

     Concern was expressed regarding potential conflicts of simultaneous left turns that would have to be made by KY 1292 and SB off-ramp vehicles. This alternate was deemed to be unfavorable for further evaluation. This will be discussed further with the District 6 traffic staff to see if they agree.

   - Alternate 2A – This is similar to Alternate 2 with the exception that the two existing signal controllers would be replaced with one controller and the two intersections would operate as one with one set of signal heads.

     This alternate was deemed to be unfavorable with respect to having only one set of signal heads and therefore will not be retained for further evaluation.

   - Alternate 3 – This is construction of a roundabout for vehicles on all 6 legs.

     This alternate was deemed to be desirable for further development and evaluation.

   - Alternate 4 – This is for construction of a spur ramp off of the SB off-ramp that would intersect KY 1292 and be primarily for trucks heading toward the Flying J and for trucks heading back north to the landfill. The SB off and on ramps would be reconstructed and shifted to the east to provide more room between the intersections. A slip ramp to the SB on-ramp would also be constructed for trucks and other vehicles leaving the Flying J.

     Concern was expressed regarding the tie-in of the spur ramp to KY 1292 and that this may just push the queue problem to this area. The potential need for a signal at this intersection was also considered undesirable. Therefore, this alternate will not be retained for further development and evaluation.

   - Alternate 5 – This is for construction of aligning KY 14 that runs east and west with the KY 14 that runs to the south and then realigning KY 2954 to intersect with KY 14. KY 1292 would be realigned to intersect with KY 2954 further to the west. The SB on and off ramps would be reconstructed and shifted to the east.

     It was discussed that it is more desirable to have KY 1292 intersect KY 14 as in Alternate 6 and therefore this alternate will not be retained for further evaluation in favor of keeping Alternate 6.

- Alternate 5A – This is the same as Alternate 5 except that the SB on and off ramps would not be reconstructed toward the east.

  This alternate will not be retained for further evaluation in favor of keeping Alternate 6.

- Alternate 6 – This is for construction of aligning KY 14 that runs east and west with the KY 14 that runs to the south and then realigning KY 1292 to intersect with KY 14. KY 2954 would intersect with KY 1292. The SB on and off ramps would be reconstructed and shifted to the east.

  This alternate was deemed to be desirable for further development and evaluation.

- Alternate 6A – This is the same as Alternate 6 except that the SB on and off ramps would not be reconstructed toward the east.

  This alternate will not be retained for further evaluation in favor of keeping Alternate 6.

6. The next Project Team Meeting is scheduled for September 26, 2006. The baseline VISSIM model will be presented along with further development of the selected alternates and the respective VISSIM modeling and analysis of improvements derived.

7. It was agreed that the current schedule can be revised such that the final report will be submitted by the end of the year.

cc: All Attendees

# APPENDIX C:

# PROJECT TEAM MEETING #2 MEETING MINUTES

**Parsons Brinckerhoff Quade & Douglas, Inc.**

**Memorandum**

TO: Scott Thomson, PE
Project Manager
Kentucky Transportation Cabinet – Central Office, Division of Planning

Rob Hans, PE
Branch Manager for Planning
Kentucky Transportation Cabinet – District 6

FROM: Steve Slade, PE, PLS
Project Manager
Parsons Brinckerhoff, Inc.

DATE: October 16, 2006

SUBJECT: I-75 / KY 14 Interchange Study
Project ID: 06-206.00
Statewide Modeling MDL-1
Summary of Project Team Meeting on September 26, 2006

A Project Team Meeting for the subject project was held September 26, 2006 at the KYTC District 6 Office in Covington, Kentucky. The following people were in attendance:

| NAME | REPRESENTING | E-MAIL ADDRESS |
|---|---|---|
| Tom Schomaker | KYTC – District 6 – Chief District Engineer | tom.schomaker@ky.gov |
| Jim Brannon | KYTC – District 6 – Pre-Construction | jim.brannon@ky.gov |
| Rob Hans | KYTC – District 6 – Planning | robert.hans@ky.gov |
| Mike Bezold | KYTC – District 6 – Planning | mike.bezold@ky.gov |
| Bill Madden | KYTC – District 6 – Traffic | billf.madden@ky.gov |
| Mike Yeager | KYTC – District 6 – Traffic | mike.yeager@ky.gov |
| Stacee Hans | KYTC – District 6 – Environmental | stacee.hans@ky.gov |
| Brad Eldridge | KYTC – Central Office - Design | brad.eldridge@ky.gov |
| Jimmy Wilson | KYTC – Central Office – Planning | jimmy.wilson@ky.gov |
| Scott Thomson | KYTC – Central Office – Planning | scott.thomson@ky.gov |
| Brent Sweger | KYTC – Central Office – Planning | brent.sweger@ky.gov |
| Bob Koehler | OKI | rkoehler@oki.org |
| Adam Kirk | Kentucky Transportation Center | akirk@engr.uky.edu |
| Steve Slade | Parsons Brinckerhoff | slade@pbworld.com |
| Don MacLean | Parsons Brinckerhoff | maclean@pbworld.com |
| Arlen Sandlin | Parsons Brinckerhoff | sandlin@pbworld.com |
| Scott Walker | Parsons Brinckerhoff | walkersc@pbworld.com |

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*FAX: (859) 272-6556*

The purpose of the meeting was to present the Level 2 alternates that had been developed by PB along with the results of the respective traffic analyses.

Each Project Team member was provided a copy of the presentation prepared by PB. The following is a summary of what was discussed at the meeting:

1. The key points of the purpose and need statement were discussed. Improving air quality was noted as one of the more important aspects of this project along with improving congestion.

2. The schedule for the study was discussed. As a result of the preliminary work of Level 1 alternates at the beginning of the project, the schedule has been adjusted so that the Final Report would be submitted before the end of 2006, two months earlier than the original completion date of February, 2007.

3. Current traffic volumes within the study area were discussed. This included both ADT and turning movement counts.

4. Traffic forecasts were developed as part of this project. During the forecasting process, emphasis was placed on the forecasts of both cars and trucks. The forecasts included the assumption that the Flying J may be at or near capacity. In order to reflect the current and future development east of the interchange, growth rates were increased and turning movement percentages were adjusted in the east. It was noted that the focus of growth near Walton is east of the study area with less emphasis on the west.

5. Crash information was presented to the Project Team. KY 14 and old KY 2954 currently have crash rates higher than similar roads in Kentucky. Angle crashes and rear end collisions were the two most common types of crashes.

6. Since some attendees were unable to attend the August 7, 2006 Project Team Meeting, a summary of Level 1 alternates was presented. The summary included a brief explanation of each of the six alternates as well as the reasoning for keeping or removing alternates from the Level 2 Analysis.

7. VISSIM was the traffic simulation software package used for the traffic analysis. The software allows a common methodology for comparing various types of alternates. The model for this project was calibrated using existing traffic volumes and field observations of current traffic conditions. The VISSIM simulation for Year 2030 No Build was shown to the Project Team. In this scenario, traffic volumes were shown queuing onto the interstate, despite optimized signal timings.

8. Three of the Level 1 alternates were carried forward to the Level 2 analysis and presented to the Project Team. In addition, the VISSIM model was shown for each alternate. For consistency, the VISSIM simulation was for the afternoon peak in the year 2030, which presented the worst case scenario for this design year.

   Each of the Level 2 alternates is discussed in more detail below:

- Alternate 1 (also Level 1 Alternate 1) – An actuator on the SB off-ramp would be added in order to help clear the right turn of the intersection when the queue reaches the detector. While not affecting traffic operations on the ramp, the actuator would serve as a safety measure to prevent queuing onto mainline I-75. In addition, a northbound right turn lane was added along KY 14 just south of the KY 14 / KY 1292 / Old KY 2954 intersection. The signal phasing was adjusted to allow for a simultaneous right turn onto KY 14 toward I-75 while vehicles were making the westbound left turn on KY 14.

  The VISSIM model shown to the Project Team presented a similar scenario as the No Build scenario. While a bit reduced, the queuing remained on the SB off-ramp. In addition, queues on the other approaches were slightly longer than in the No Build scenario.

- Alternate 2 (Level 1 Alternate 6) – This alternate aligns KY 14 that runs east and west with the KY 14 that runs to the south and then realigning KY 1292 to intersect with KY 14. KY 2954 would intersect with KY 1292. The SB on and off ramps would be reconstructed and shifted to the east. It is not anticipated that additional R/W would be needed for the shift of the ramps. In addition, the automobile entrance into the Flying J would be reconstructed as a right-in / right-out configuration.

  With respect to the VISSIM model, Alternate 2 tested very well. Queues on all approaches were significantly reduced as a result of fewer signal phases as well as coordinated traffic signals. The Project Team indicated that the reconfiguration may cause problems for the few vehicles wishing to make a left turn into the Flying J off of KY 2954. Additional study of variations or sub-alternatives for Alternate 2 will be necessary as noted below in Section 12.

- Alternate 3 (also Level 1 Alternate 3) – This is construction of a roundabout for vehicles on all 6 legs. Special consideration was given to the diameter of the roundabout as well as the approach radii in order to accommodate six legs as well as the large volume of trucks entering / exiting the roundabout. The software package AutoTURN was used to verify the requirements for trucks.

  The Feasibility / Constructability Report prepared by PB and presented to Project Team members on August 18, 2006 was noted. This report indicated there are potential issues with the roundabout from a design and safety standpoint during both construction and maintenance of traffic. While the roundabout is still a feasible alternate from a design perspective, special consideration should be given to these concerns during the next phase of design, if it should be carried forward.

  The VISSIM model indicated a shut-down of the roundabout nearly halfway through the analysis periods. This was a result of the high volume of trucks entering the roundabout. The result was an impact on nearly all approaches. Also, the additional queuing has a negative effect on the KY 14 intersection with the NB ramps.

9. Results of the traffic analysis were presented. Alternate 2 provided the best overall improvement for the study area for Year 2030. This included a maximum of a level of service (LOS) LOS D for all intersections as well as reduced queues. Alternate 1 and

Alternate 3 produced failing LOS in Year 2030. The failure of the roundabout in Alternate 3 also caused the NB off-ramp to experience LOS F in Year 2030 for both AM and PM.

10. The ranking of the alternates as well as the construction costs were presented in an evaluation matrix. The construction costs (shown below) are planning level estimates in 2006 dollars and include a 25% contingency. The costs do not include right of way or utility relocation costs. The overall rankings indicate that Alternate 2 provides the best improvements with respect to the Purpose and Need for this project.

    - Alternate 1 – $150,000
    - Alternate 2 – $3,200,000
    - Alternate 3 – $2,600,000

11. Two additional alternates proposed by Brent Sweger were presented to the Project Team. These alternates were provided after PB had conducted its traffic analysis for this project. These included:

    - Sweger Alternate 1: This included the realignment of the SB off-ramp onto KY 1292. A new T-intersection or roundabout would be constructed as this new intersection. The KY 14 / KY 1292 / old KY 2954 intersection would be constructed with a new signal system or a roundabout.

    - Sweger Alternate 2: This includes the realignment of KY 1292 along the old roadbed so that it intersections with old KY 2954 at the bottom on the hill. In addition, the SB off-ramps would be shifted to old KY 1292 to allow for a through movement to the Flying J.

12. Upon completion of the presentation, the Project Team discussed the alternates. Key points included:

    - The addition of the NB right turn lane in Alternate 1 and retiming of the traffic signals could provide some reduction in delays at the intersections. Given the $150,000 cost estimate of this alternate, current CMAQ funds could be used for this short term improvement.

    - There was discussion regarding the proposed right-in / right-out entrance at the Flying J off of KY 14 as part of the short term improvement. It was noted that any change to the entrance would require right-of-way acquisition, which would require additional funding. However, a concrete median along KY 14 may eliminate this issue, and could be considered with the short term improvement.

    - With respect to a long-term solution, the Project Team agreed (as a whole) that Alternate 2 would provide the optimal long-term solution to the study area. With this alternate there are less constructability concerns and traffic can more easily be maintained during construction without road closures and significant detours. It was noted that additional investigation into KY 1292 and KY 2954 realignments should be conducted during the next design phase of this project. Variations of this alternate could include:

- Realignment of KY 1292 along the old roadbed with an intersection of KY 2954 at the bottom of the hill and west of the truck stop. KY 2954 would then be realigned to intersect with the realignment of KY 14.

- Realignment of KY 1292 with it being relocated just west of The Bank of Kentucky to intersect KY 2954. This intersection, however, would be in an area of KY 2954 that has a grade of ~6%, which may be undesirable.

- The segment of KY 2954 could be removed and relocated along the old KY 1292 roadbed and then intersect with KY 1292 just north of the project area.

13. A two-lane roundabout was suggested as a possible solution to the congestion shown in the one-lane roundabout modeled in Alternate 3. One of the legs could also possibly be eliminated. Concern, however, was expressed over the high volume of trucks that will utilize the roundabout, which would possibly use the extra lane as part of its turn maneuver. It was also noted that a two-lane roundabout alternate may not result in any better operation of traffic than Alternate 2 and would still be left with the constructability and maintenance of traffic issues.

14. The Project Team requested that all alternates should be included in the final report. In addition, the alternates should be not be renumbered in the report (i.e., Level 2 Alternate 2 should be remain as the original Alternate 6). The report should also include the reasons why the Level 1 alternates were removed from consideration.

15. PB will proceed with development of the final report with a draft to be submitted by the middle of November.

cc: All Attendees
Michael Loyselle – FHWA
Bernadette Dupont - FHWA

# APPENDIX D:

# FEASIBILITY / CONSTRUCTABILITY REPORT

# I-75 / KY 14 INTERCHANGE STUDY
## Alternate 3
## Issues Regarding Constructability of a Roundabout

Alternate No. 3 provides for the construction of a single-lane roundabout at the I-75 Southbound Ramps / KY 14 / KY 1292 / KY 2954 intersection. There are several issues that may be a concern with construction of a roundabout at this location. The following is a discussion of the issues affecting the constructability of this alternate.

**ROUNDABOUT DIAMETER AND VERTICAL ALIGNMENT**

"Roundabouts: An Informational Guide" published by the Federal Highway Administration provides in-depth detail and information regarding the design and construction of modern roundabouts. The diameter of a modern roundabout is a critical design feature. The guide recommends a roundabout diameter of 115-130' for a rural single-lane roundabout for a WB-67 design vehicle (double-trailer truck). This size would be typical of a roundabout in a location with relatively flat grades, 90 degree intersection angles, and no more than four legs.

Due to the requirement to geometrically accommodate six legs within a roundabout on this alternate, the diameter must be increased significantly. The diameter of the roundabout required as a result of the existing geometrics of the six legs is approximately 275-300'. This results in a very large roundabout in an area where the existing approaches are already steep. As a result, the required large roundabout diameter could result in significant reconstruction of the approach roads on this project.

Most modern roundabouts are constructed with approaches that have relatively flat existing grades. In areas with a fair amount of grade through the existing intersection, the roundabout must be "tilted" about its center to accommodate the approaching grades on the main route. In this case, the KY 14 approach from the east will enter the roundabout on its high side, progress downgrade to the low point of the roundabout near the KY 2954 approach, and travel upgrade back to the KY 14 approach on the east end. The high volume of trucks at this location traveling downgrade and turning could possibly present a risk of overturning compared to a roundabout constructed on a flatter grade.

**ROUNDABOUT AND APPROACH ROAD GRADES**

According to the guide on roundabouts, "It is generally not desirable to locate roundabouts in locations where grades through the intersection are greater than four percent." The grades within the study area along KY 14 are currently at this limit while grades on two of the approach roads exceed four percent. Figure 1 on the following page shows the approximate existing grades of the roadways within the study area.

In a case of an intersection with steep approach grades of this nature, the guide suggests that the intersection should be relocated or the vertical alignment modified. In this case, the intersections cannot be relocated without major reconstruction and the ability to modify the existing grades is limited due to the close proximity of the bridge over I-75 and the desire to maintain traffic during construction. The need to provide a solution to the traffic issues within the study area while maintaining traffic and limiting the amount of reconstruction that takes place limits the ability to modify the existing geometrics. Therefore, a roundabout alternate needs to fit the existing geometrics of the area as best as possible.

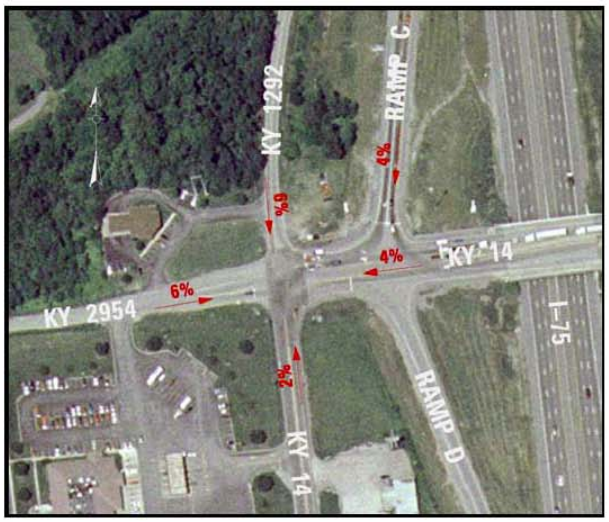


Figure 1 – Existing Grades in Project Study Area

## CONCEPTUAL DESIGN OF ROUNDABOUT ALTERNATES

Before analyzing and modeling the traffic improvements that a roundabout may provide it was prudent to evaluate geometrics of a roundabout to ensure that one could physically fit at the intersection. Three conceptual designs have been developed – Alternates 3, 3A, and 3B. The layouts and approximate limits of construction of these alternates are shown on Figures 2, 3, and 4. It should be noted that limited mapping and terrain data was available for development of approximate existing and proposed roadway profiles. The following is a description of each alternate and the respective issues and concerns.

### Alternate 3

- Large roundabout diameter of 292'.
- Proposed grade of the roundabout is approximately 4 feet above existing ground at the KY 2954 approach.
- Roundabout vertical alignment may be undesirable with large volume of truck traffic.
- KY 1292 and KY 2954 must be raised approximately 8 feet, possibly requiring temporary closure during construction.
- Ramp C must be raised approximately 9 feet, possibly requiring retaining walls and temporary closure during construction.
- Ramp D must be raised approximately 6 feet, possibly requiring temporary closure during construction.

### Alternate 3A

As a result of the issues associated with Alternate 3, Alternate 3A was developed to determine if a southward shift of the roundabout could reduce the adverse impacts of Alternate 3.

- Large roundabout diameter of 260' (less than Alternate 3).
- Proposed grade of the roundabout is approximately 4 feet above existing ground at the KY 2954 approach.
- Roundabout vertical alignment may be undesirable with large volume of truck traffic.
- KY 1292 and KY 2954 must be raised approximately 8 feet, possibly requiring temporary closure during construction.

- KY 14 must be raised approximately 5 feet, possibly requiring temporary closure during construction.
- Ramp C must be raised approximately 2 feet, an improvement over Alternate 3.
- Ramp D must be raised approximately 6 feet, possibly requiring temporary closure during construction.

Shifting the entire roundabout southward minimizes construction required along Ramp C. However, only minimal improvements to the required grade changes on the remainder of the approaches are realized with this configuration.

**Alternate 3B**

A significant factor affecting the grades required along the approach roads is the short length around the roundabout and the inability to provide significant grade changes across the roundabout in order to minimize the amount of construction that needs to take place on the approach roads. A roundabout or similar type facility of greater length would allow a greater amount of grade change to take place across its length. This led to study of an elongated roundabout situated with its long axis running east to west along KY 2954 and KY 14.

- Outside radius of 75' may need to be enlarged to accommodate truck traffic without requiring significant lane width (this would have a negative impact on approach road vertical alignments).
- Proposed grade of the roundabout is approximately 2 feet above existing ground at the KY 2954 approach.
- Roundabout vertical alignment may be undesirable with large volume of truck traffic.
- KY 1292, KY 2954, and Ramp C must be raised approximately 2 feet, an improvement over the previous alternates.
- Ramp D must be raised approximately 6 feet, likely requiring temporary closure during construction.
- Construction of such a facility could enhance driver confusion associated with these types of intersections.

**CONCLUSIONS AND RECOMMENDATION**

Due to the significant grades and number of approaches at this location, the design and construction of a roundabout may be difficult to accomplish in a manner that provides a safe intersection and has the ability to maintain traffic during construction. Particular care will need to be paid to safety. Given the nature of the existing geometrics a downgrade turning movement along the roundabout could be a concern with trucks being susceptible to overturning.

In addition, on Ramp C in particular, trucks approaching the intersection may be required to yield to allow circulatory traffic to clear the roundabout. Ramp C will likely require a short increase in grade before tying to the proposed roundabout. This could create an issue with trucks having difficulty getting restarted on the steep grade.

While not infeasible, there appears to be significant obstacles associated with the design and construction of a roundabout alternative. Particular attention will need to be paid during preliminary design in maximizing safety through the intersection due to the high volume of trucks. Preliminary design will need to be an involved and iterative process using more detailed field survey data to try to develop a roundabout alternative that minimizes the amount of construction required along the approach roads and maintain traffic on all approaches during construction. In addition, preliminary design will need to evaluate or research actual

susceptibility of overturning possibilities of large trucks traversing along the roundabout as well as the area of the path that is needed for a large truck wheel base.

With respect to this scoping study phase of this project, it recommended that traffic modeling and cost estimation for a roundabout alternate be completed and be based upon Alternate 3A. The traffic benefits derived from the modeling are basically independent of the actual configuration of the roundabout. While Alternate 3B appears to minimize the lengths of approach roads that must be reconstructed, it is possible that the radii would need to be increased. It is possible that some variation of Alternate 3B could be developed through a more detailed iterative design process; however, Alternate 3A will result in a more conservative estimate of costs and impacts.

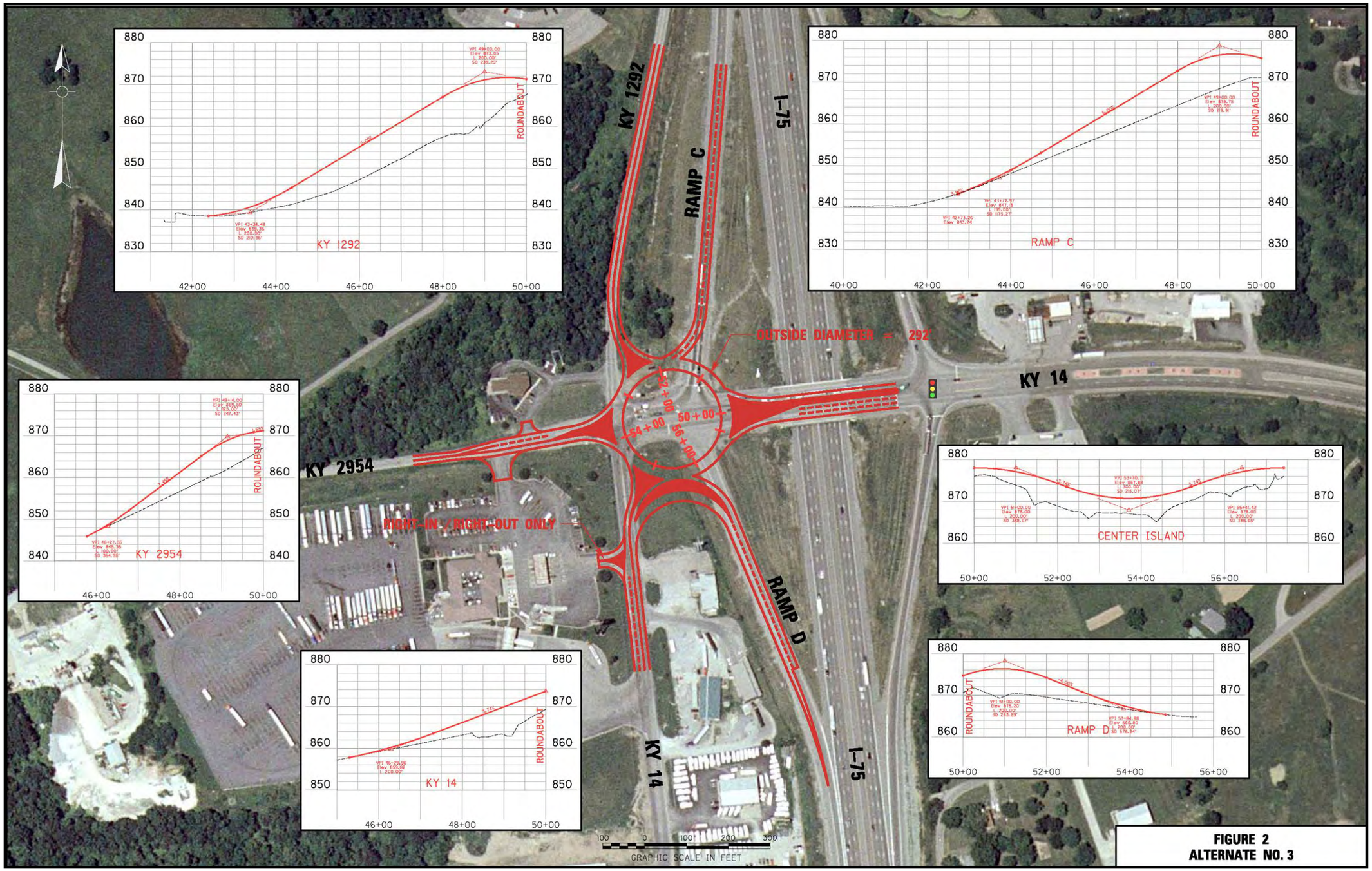


**FIGURE 2**
**ALTERNATE NO. 3**

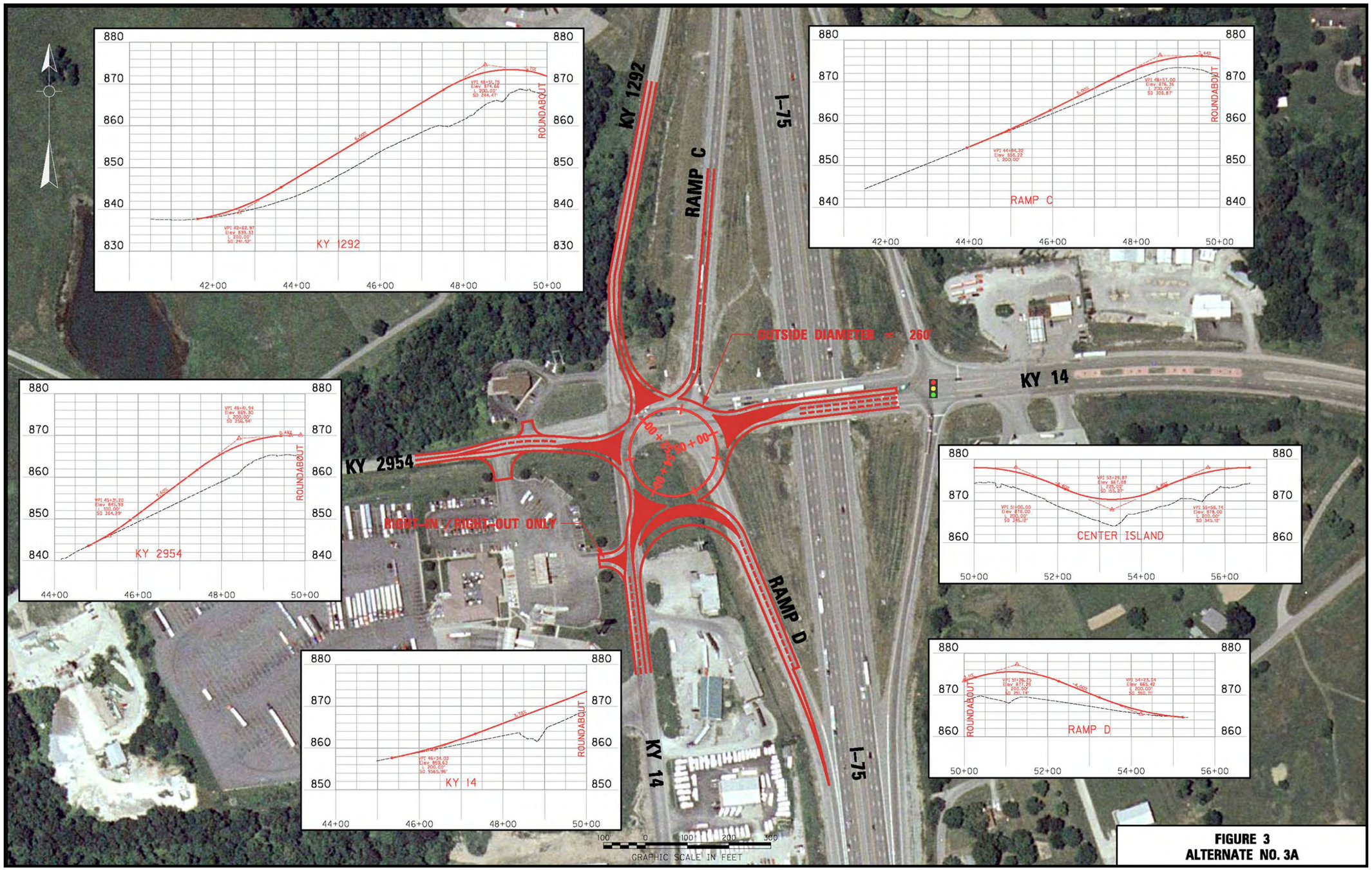


**FIGURE 3**
**ALTERNATE NO. 3A**

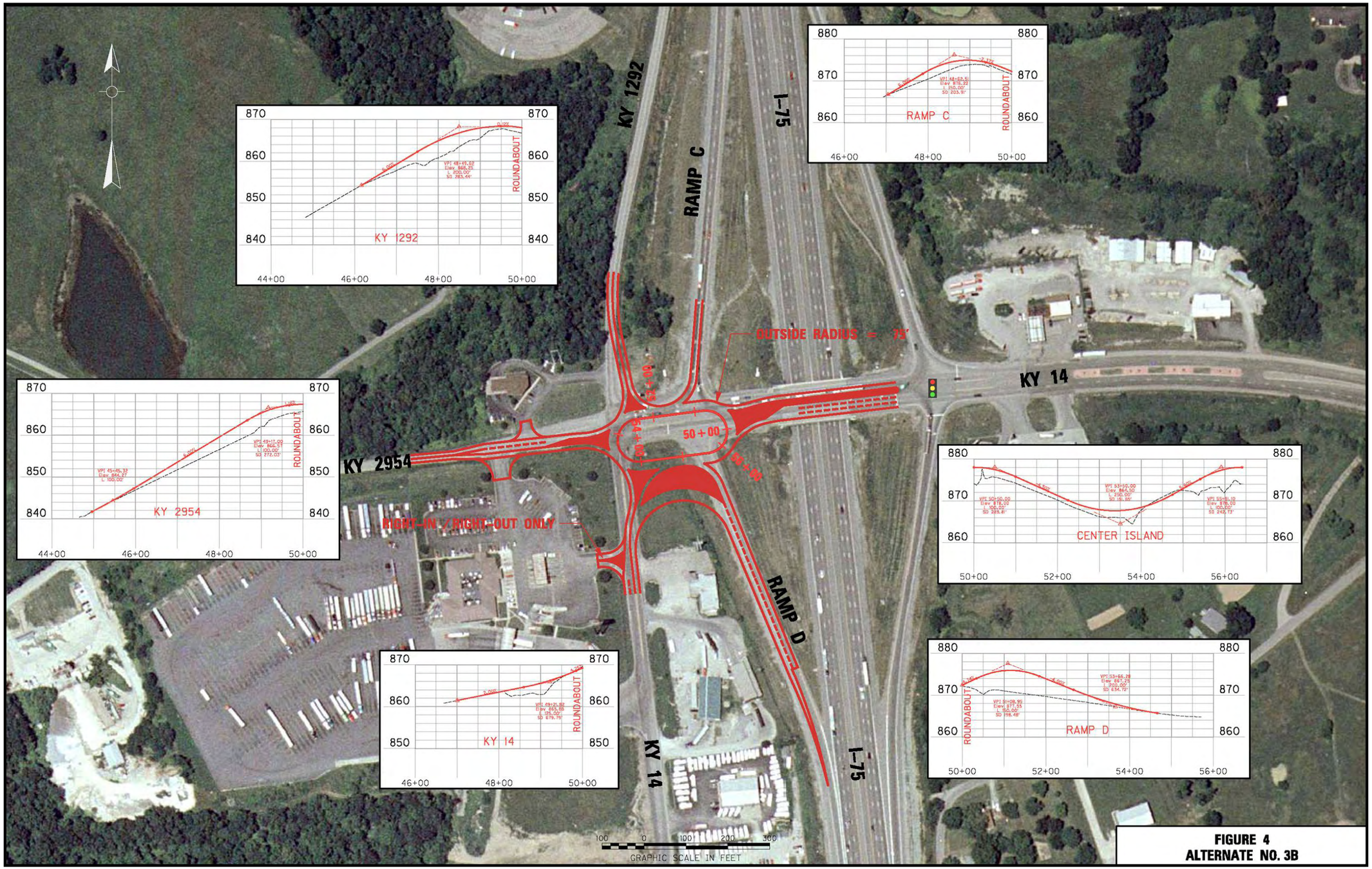


**FIGURE 4**
**ALTERNATE NO. 3B**