Fort Knox Highway Access Study

Submitted to:
Radcliff-Elizabethtown Metropolitan Planning Organization

Submitted by:
ENTRAN
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July 31, 2007

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Executive Summary

The Fort Knox Highway Access Study was conducted to identify and address anticipated traffic problems relating to the U.S. Department of Defense 2005 Base Realignment and Closure (BRAC) Report. The BRAC Report included a number of changes that will take place on the Fort Knox Military Reservation that will affect the post and the surrounding region. The study is needed because the Radcliff-Fort Knox area has experienced significant growth in recent years. With existing roadways already experiencing capacity issues, particularly US 31W ("Dixie Highway"), the BRAC changes will only compound the issue. The study was conducted to determine projected traffic impacts that the BRAC will have on the community and to recommend improvements that will mitigate these impacts.

The study area was centered around US 31W from just south of Lincoln Trail Boulevard (KY 1815) to north of Brandenburg Station Road. Other key roads included in the analysis were North Wilson Road, Bullion Boulevard, and Logsdon Parkway (KY 1646). The study also included the three existing access gates to the post at North Wilson Road, Chaffee Gate at Bullion Boulevard, and Brandenburg Station Road.

US 31W is the primary arterial through Fort Knox and Radcliff and average daily traffic volumes range from 15,700 to 21,100 vehicles per day (vpd) at the north end to 27,400 to 36,300 vpd at the south end, in Radcliff. Average daily traffic volumes on Lincoln Trail Boulevard and North Wilson Road are 15,100 and 14,200 respectively. Sections of US 31W at the south end are already near or over capacity during peak traffic hours.

Crash data for study area roadways were collected for approximately six years, from 2001 through 2006. Of 1,488 reported crashes, 1,009 occurred along US 31W. Of those on US 31W, 217 (22 percent) resulted in an injury. The types of crashes most prevalent were rear-end crashes (40 percent) and angle crashes (30 percent), which are characteristic of congestion and access management problems.

Four key transportation improvements are currently planned for the study area. Of those, the North Wilson Road Design-Build project will have the most impact to Fort Knox. The current two-lane roadway will be widened to a three-lane section with a continuous center left turn lane. This project is currently under construction and completion date is scheduled for 2008. Other planned transportation projects include:

- KY 313 Extension: new roadway to connect existing KY 313 to Brandenburg in Meade County.
- Elizabethtown-to-Radcliff Connector ("E2RC"): new roadway to connect existing KY 313 in Radcliff to the US 31W Bypass in Elizabethtown.
- KY 144 Realignment: includes safety improvements just west of KY 1500 in Vine Grove.

Ultimately the BRAC changes will result in an overall increase in Fort Knox employees. It is anticipated that net increases will be:

- 4,566 new employees (military and civilian)
- 9,212 new residents in the region

Initially these changes were anticipated to take place by 2009, but full implementation could be delayed until 2011 or later.

Traffic simulation models were used to analyze projected future traffic conditions (with BRAC-induced changes) and evaluate the effectiveness of proposed improvements. Key deficiencies noted in the transportation system were:

- **Gate Capacity**. Currently about 2,900 vehicles enter the Fort Knox Military Reservation during the A.M. peak hour on a typical weekday. Noticeable queues are present at all gates; at the Brandenburg Station Road gate, where all trucks are directed to enter the post, these queues frequently extend all the way to US 31W. With full implementation of the BRAC plan, this demand will increase to about 4,800 vehicles at all three gates, a total increase of about 66 percent.
- **Interchange Operations**. Because of queue spillback, operational problems will be exacerbated at US 31W interchanges with Brandenburg Station Road, Bullion Boulevard and North Wilson Road.
- **Traffic Flow on US 31W.** Increased travel demand on US 31W, North Wilson Road and Lincoln Trail Boulevard, as a result of BRAC changes and growth in background traffic, will worsen congestion and delay

along US 31W. Correspondingly, increased crashes related to congestion and access management would be anticipated as well.

Recommended improvements were grouped into four categories:

I. Key Capital Projects
II. Operational/Transportation Systems Management Strategies
III. Safety Recommendations
IV. US 31W Access Management Recommendations

Key Capital Projects consisted of alternatives developed to improve system capacity, particularly those roadways leading to the gates. Specific projects, in their order of priority, include:

1. Improve North Wilson Road by widening to a three-lane section and constructing a new south extension to provide a better intersection with West Lincoln Trail Boulevard west of the existing intersection. This recommendation also includes modifications to connections between North Wilson Road and US 31W between the overpass and West Lincoln Trail Boulevard

2. Expand capacity of the ramp merge from northbound US 31W to Bullion Boulevard by adding an additional inbound lane

3. Reconstruction of the US 31W/Brandenburg Station Road interchange and widening Brandenburg Station Road to four lanes between US 31W and the gate

The total estimated costs for the Key Capital Projects is $9 million.

Operational/Transportation Systems Management recommendations were developed to provide solutions with a measurable impact at a lower cost. These solutions could be implemented easily and over a shorter time frame. They include:

- Optimization of traffic signal timing plans along US 31W
- Converting the existing Brandenburg Station Road to one-way inbound during the A.M. peak period (This is considered a short-term alternative to widening Brandenburg Station Road.)
- Relocate Fort Knox Truck Access
- Providing park-and-ride lots and shuttle service for Fort Knox employee in Radcliff/Elizabethtown and Louisville

Recommendations for area-wide safety improvements were developed with the intent of decreasing crash frequencies and rates at signalized intersections. These include:

- Providing a signal head for each approach lane (including turn lanes) at signalized intersections
- Installing traffic signal backplates for increased visibility and conspicuity of signal heads

Implementation of recommendations from the US 31W Access Management Study was included in this study to more effectively manage access along the corridor and correspondingly improve safety and efficiency. These include:

- Driveway consolidation and provision of cross-site access on the east side of US 31W just south of Lincoln Trail Boulevard
- Construction of a raised, channelized, non-traversable median along US 31W from Spring Street to Knox Boulevard
- Driveway consolidation and provision of cross-site access on the east side of US 31W between Knox Boulevard and Redmar Boulevard

Funding sources for the recommended improvements should be pursued from several different options. Safety improvement projects could be implemented through the Highway Safety Improvement Program (HSIP). Operational/TSM projects possibly could be implemented through regular district-wide maintenance programs. As the Brandenburg Station Road improvements are largely within the boundaries of Fort Knox, Military Construction (MILCON) funding is a potential source.

Other Key Capital Projects using Federal and State funds would have to go through the metropolitan planning process, so it is important for these to be considered in the next cycle of the State Six Year Highway Plan process.

The focus of this study was to improve the access to Fort Knox from the adjoining highway system, particularly US 31W. The projects recommended as a result of this study will not solve traffic problems along US 31W and adjoining roads. Traffic congestion will become a significant issue once the BRAC implementation begins and will remain a problem until new travel alternatives to US 31W are available. The recommended projects will have a measurable impact and definitely are needed to improve both capacity and safety. However, even with these projects, average peak hour delays will be at least double what they are today, if not higher.

With that in mind, additional measures to reduce travel demand along US 31W and/or provide increased capacity must be explored. The upcoming expanded study of the Fort Knox area should focus on regional solutions to relieve travel demand, including consideration of a new inspection gate providing ingress/egress from a facility other than US 31W, improvements (either procedural or infrastructure-related) to reduce delays associated with the inspection process, and capacity enhancements for US 31W and other key roads.

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I. Introduction

The Radcliff-Elizabethtown Metropolitan Planning Organization (MPO) and the Lincoln Trail Area Development District (LTADD) sponsored the Fort Knox Highway Access Study to identify and address likely traffic problems relating to the 2005 Base Realignment and Closure (BRAC) Report. The BRAC Report included a number of considerable changes to take place on the Fort Knox military post that will affect the surrounding region.

Study Purpose and Need

The surrounding region, including the Radcliff-Fort Knox area, has witnessed significant residential growth in recent years. This increase has had an effect on the current roadway system. Multiple transportation planning studies have been conducted in the area in an effort to address this growth. With existing roadways already showing signs of approaching capacity, the BRAC changes will only compound this issue. The purpose of this study was to determine the projected traffic impacts that the BRAC will have on the community and to recommend improvements that would minimize theses impacts to the area.

Objectives

The primary objectives for this study were to first identify the key roadways that function as travel routes leading into and out of the Fort Knox post. Once the existing characteristics of these roadways were determined, the BRAC changes were quantified and assigned to the roadway network accordingly to determine locations with probable deficiencies. Finally, transportation improvements were developed to overcome those deficiencies.

Study Area

The Fort Knox United States military post is located just south of Louisville in portions of Hardin and Meade County, Kentucky. The Fort Knox post is currently home to the U.S. Army Armor Center and the Army Recruiting Command.

Just to the southwest of the military post's boundaries in Hardin County is the City of Radcliff. Due to the close proximity of these two locations, the area is commonly referred to as the Radcliff-Fort Knox area. Fort Knox and the surrounding community have been working together in preparation for the BRAC implementation. An advisory committee referred to as "One Knox" has been developed to better coordinate these planning efforts.

For traffic analysis purposes, the study area limits are Lincoln Trail Boulevard (KY 1815) to the south, Brandenburg Station Road to the north, Lodgson Parkway (KY 1646) to the west, and the Fort Knox boundary to the east. A study area map is displayed in **Figure I-1**.

US 31W

As depicted on the study area map, US 31W functions as the "spine" through this area. This four- to six-lane divided highway serves as a critical infrastructure link in the Radcliff-Fort Knox area's transportation system. Interchange ramps exist along US 31W that provide access onto the military post.

Other Key Roads

In addition to US 31W, other key roads are highlighted on the study area map. The nine existing signalized intersections are also labeled. Multiple roadways within the study area provide access for Fort Knox. Brandenburg Station Road is a rural, two-lane road that terminates to the east at the Fort Knox military post. To the west, the roadway provides access to military training grounds restricted to the public. South of Brandenburg Station, Chaffee Avenue also provides Fort Knox access, but it is limited to exiting traffic only from the post onto US 31W. Bullion Boulevard provides full access to the post at the road's eastern termini. To the west, Bullion Boulevard serves traffic for southern rural Meade County.

Farther south in Radcliff, there are multiple key roads that serve the traffic demand for this part of the study area. Lincoln Trail Boulevard (KY 1815) is one of the main east-west routes inside the city limits. This roadway connects to Joe Prather Highway (KY 313). Two key north-south roads are also located in this area, Logsdon Parkway (KY 1646) and North Wilson Road. Logsdon Parkway travels through the city and terminates to the north at Bullion Boulevard. North Wilson Road is a two-lane road located to the east of KY 1646. For a section of the road, its alignment follows US 31W very closely, with less than 100 feet between the two routes in certain locations. North Wilson Road terminates to the south at West Lincoln Trail Boulevard and extends north of the

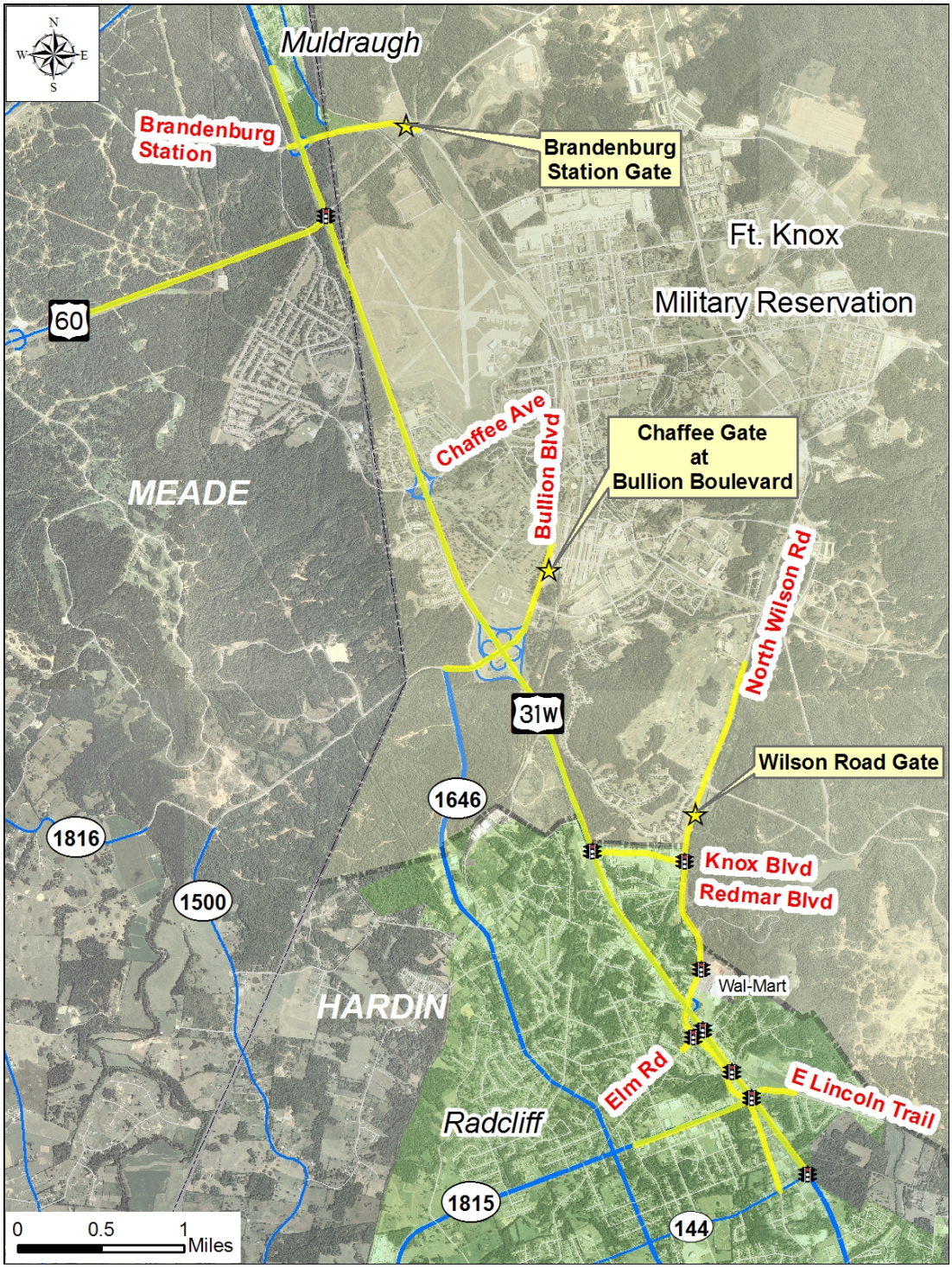

Figure I-1. Study Area Map

Fort Knox boundary. Knox Boulevard and Redmar Boulevard are east-west parallel roads located on the northern edge of Radcliff and connect US 31W to North Wilson Road. Knox Boulevard is primarily zoned for commercial development, while Redmar Boulevard is a residential street.

Gates

Three Fort Knox gates currently serve the ingress and egress movements for the post. They are referred to as Brandenburg Station Road Gate, Chaffee Gate at Bullion Boulevard, and Wilson Road Gate. A fourth gate, the Chaffee Avenue Gate, once provided full access for the post before the gate at Bullion Boulevard was constructed. It now only provides an exit from the post.

Checkpoints are established at each gate for security purposes. These checkpoints cause delays as identification is required before entry onto the post is permitted. Peak hour traffic volumes at the gates vary significantly, as daily activities and events on the Fort Knox post fluctuate. The following discussion describes the existing characteristics for each gate approach.

The northern-most gate, at Brandenburg Station Road, is accessed from US 31W at the Brandenburg Station Road interchange. The roadway leading to this gate is a two-lane road that crosses over a railroad bridge. At the gate, the roadway widens to four lanes, allowing for two commercial vehicle check points and two regular vehicle check point lanes. All commercial traffic must enter the Fort Knox post through this gate.

The second gate, Chaffee Gate at Bullion Boulevard, has been recently reconstructed and is accessed from the US 31W interchange at Bullion Boulevard. This gate facility has the largest capacity of all the gates, with two inbound and two outbound lanes from US 31W to its entrance. At approximately 600 feet from the gate, the two inbound lanes widen to four checkpoint lanes.

Wilson Road Gate is the southern-most gate into Fort Knox, located the closest to Radcliff. Traffic entering and exiting this gate utilizes North Wilson Road. The approach to this gate has one inbound and one outbound lane. Four checkpoint lanes exist at this gate.

It is important to note that not all checkpoint lanes are open at all times of the day. From field observation, it was observed that only during times of peak congestion at the gates are all the checkpoint lanes open. For peak period analysis throughout this study, however, it was assumed that all checkpoint lanes for all gates would be open.

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II. Existing Conditions

This section describes current conditions and performance of the roadways within the study area as well as the gates providing access to the Fort Knox post. Traffic characteristics including traffic volumes, areas of congestion, and crash history are summarized. Planned and programmed transportation projects in the area are also identified. The accurate depictions of the community's current traffic conditions provided the foundation necessary to identify the deficiencies that would likely be exacerbated by the BRAC changes.

Traffic Characteristics

Existing traffic characteristics for the study area were obtained through field investigations and data provided by local and state agencies. Additionally, traffic simulation models were developed for the study area to better examine current traffic conditions.

Traffic Volumes

Recent average daily traffic volumes (ADT) for the study area roadways were obtained from the Kentucky Transportation Cabinet. A summary of the ADT data as well as each roadway's functional classification is provided in **Figure II-1**. As illustrated, US 31W carries a range of traffic volumes within the study area. At the north, the ADT is between 18,300 and 21,100; at the south, the ADT ranges from 27,400 to 36,300. KY 1815 and North Wilson Road also carry relatively high daily traffic volumes with 15,100 and 14,200, respectively.

As mentioned in the previous section, traffic volumes at the Fort Knox gates are generally not consistent on a daily basis. To determine an estimate of typical peak hour volumes, traffic counts were collected for the AM peak hour period for each gate. The peak hour volumes were compared to previous counts obtained by Fort Knox. The Fort Knox counts also demonstrated the daily fluctuation in weekday hourly volumes. The most probable reason for this variance was the occurrence of special events on post. It was decided to utilize the more recent traffic counts as a base year condition for the AM peak hour. High averages from the Fort Knox traffic counts were utilized for the PM peak hour. **Table II-1** displays the traffic counts utilized for the existing peak hour conditions at each gate.

Table II-1. AM & PM Peak Hour Gate Traffic Counts

Ft. Knox Gate	Existing			
	AM Peak		PM Peak	
	Enter	Exit	Enter	Exit
Brandenburg Station Rd.	811	110	412	905
Chaffee at Bullion Blvd.	1,432	163	601	1,129
N. Wilson Rd.	640	226	288	831
Total	**2,883**	**499**	**1,301**	**2,865**

Levels-of-Service (LOS) and Volume-to-Service Flow (VSF) Ratios

Peak hour traffic counts were conducted at key intersections within the study area to obtain existing Levels-of-Service (LOS). LOS provides an indication of the quality of traffic conditions in the form of a letter grade. LOS ranges from A to F, with A representing free-flow, uncongested conditions and F representing severe congestion and over-capacity conditions. LOS D is considered acceptable in an urban setting. A summary of the existing LOS at signalized study area intersections is provided in **Table II-2**.

Table II-2. Existing Intersection LOS

Intersection	AM Peak		PM Peak	
	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
US 31W & KY 1815	153.3	F	168.7	F
US 31W & Spring St.	33.0	C	26.1	C
US 31W & Elm Rd.	189.9	F	200.4	F
US 31W & Knox Blvd.	24.8	C	27.8	C
US 31W & US 60	32.7	C	34.5	C
N. Wilson Rd. & Elm Rd.	22.3	C	20.4	C
N. Wilson Rd. & Wal-Mart Ent.	55.2	E	20.7	C
N. Wilson Rd. & Knox Blvd.	7.5	A	9.6	A

As indicated, intersections along US 31W are currently performing at unacceptable levels of service. The intersection at N. Wilson Road and the Wal-Mart Entrance during the AM peak hour currently operates at LOS E.

Volume-to-service flow (VSF) ratios for the roadways are shown in **Figure II-2**. The VSF ratio is calculated as the actual daily volume of traffic along a roadway segment divided by the roadway's theoretical capacity. A VSF ratio over 1.0 indicates the roadway operates over capacity, and higher VSF ratios indicate more congested conditions. The roadways in the vicinity of Radcliff have high VSF ratios, indicating high levels of congestion in this area.

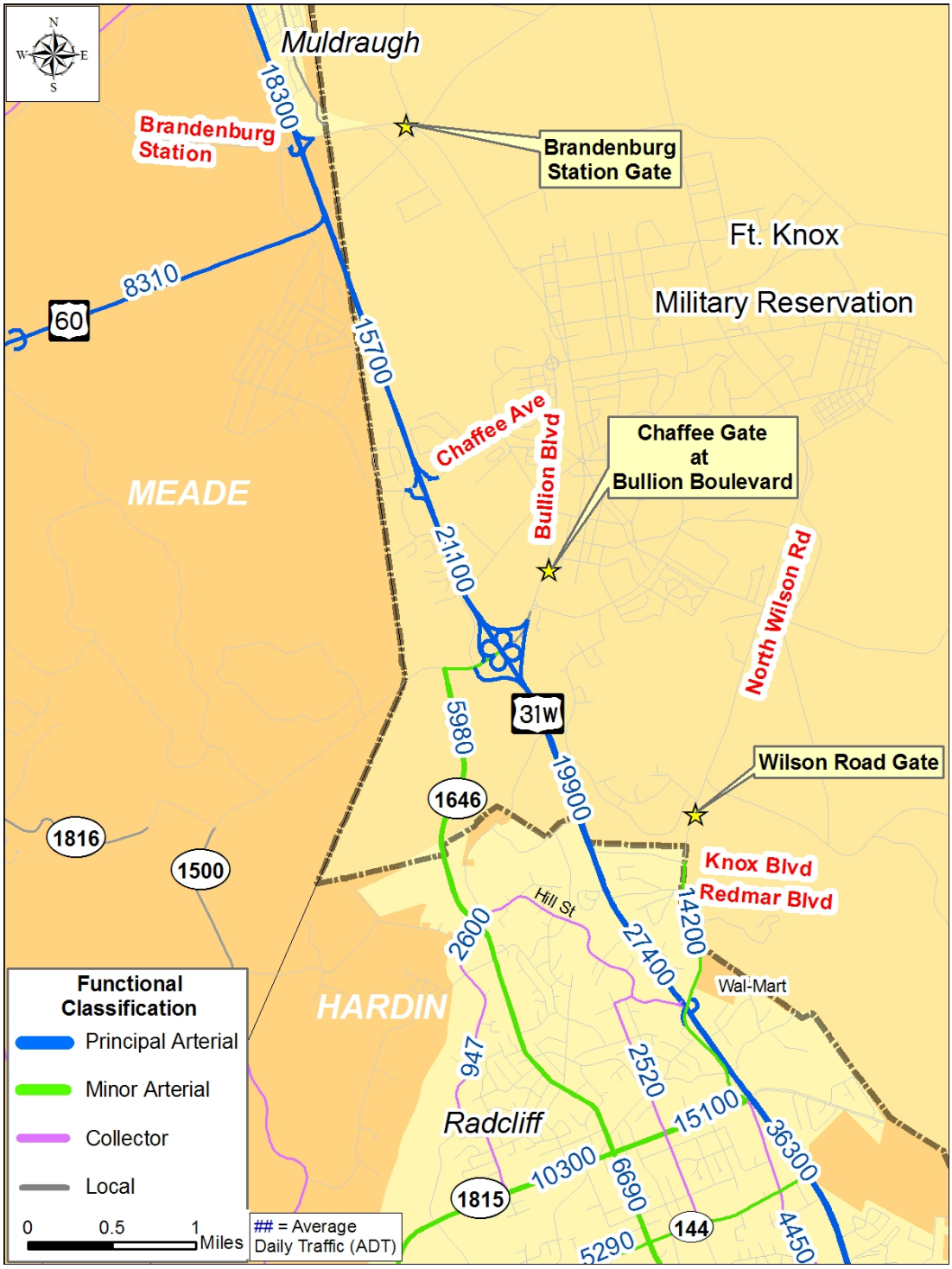

Figure II-1. Average Daily Traffic (ADT) and Functional Classification for the Radcliff-Fort Knox Area

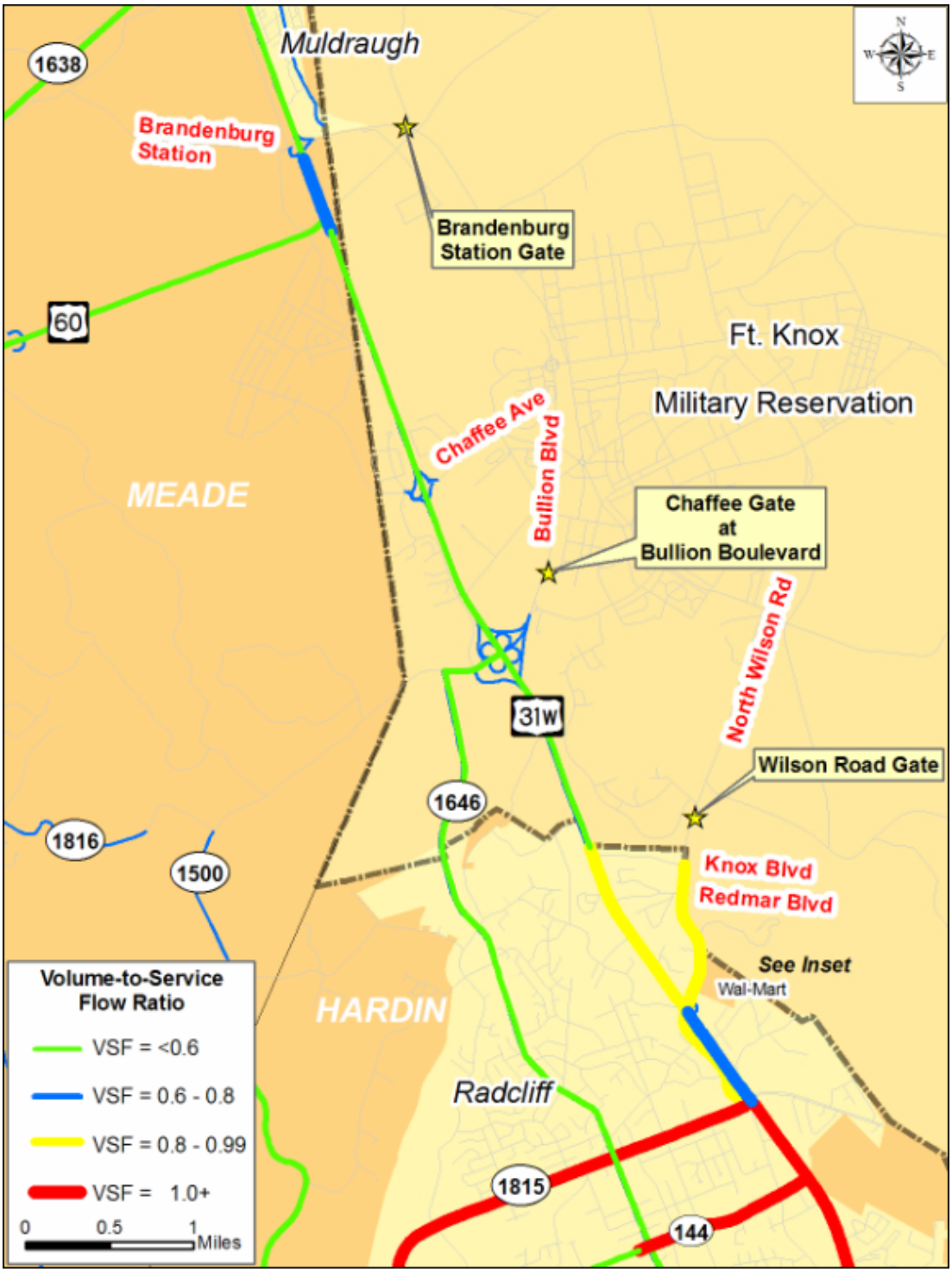

Figure II-2. Volume-to-Service (VSF) Flow Ratio for the Radcliff-Fort Knox Area

Fort Knox Gate Delays

Table II-3 presents a summary of average queue delays collected at each gate during the AM peak period. The queue delay was recorded as the time from when a vehicle arrived at the beginning of the checkpoint lane queue to the time the vehicle departed from the guard post after being cleared. This queue delay did not account for the delays approaching the gate entrances due to congestion. Delays were not collected for the North Wilson Road Gate as the traffic counts for this gate were collected at the Knox Boulevard/N. Wilson Road intersection; therefore, the gate entrance was not within distance to obtain vehicle delays.

Table II-3. Fort Knox Gate Queue Delays

Ft. Knox Gate	Avg. Queue Delay per vehicle (sec.)	Standard Deviation (sec.)
Brandenburg Station Rd. - Regular Vehicle Lanes	31.8	21.8
Brandenburg Station Rd. - Commercial Vehicle Lanes	481.3	244.1
Chaffee Gate at Bullion Blvd.	19.2	19.0
N. Wilson Rd.	---	---

During field reconnaissance, the most significant delays observed at the Fort Knox gates occurred during the morning peak period when heavy commuter traffic was entering the post. The following queue lengths were noted during the morning peak period from field observation:

- Brandenburg Station Road Gate: Queue from the gate to the off-ramp at US31W
- Chaffee Gate at Bullion Boulevard: Queue of approximately fifteen cars per checkpoint lane; also, queue at US 31W NB off-ramp at Bullion Boulevard merge
- North Wilson Road Gate: Queue along North Wilson Road northbound between US 31W bridge and the signalized entrance to Wal-Mart

During the PM peak period, the following queue lengths were noted due to heavy traffic exiting the Fort Knox gates:

- Brandenburg Station Road Gate: No queues observed
- Chaffee Gate at Bullion Boulevard: No queues observed
- North Wilson Road Gate: Queue along North Wilson Road southbound between Redmar Boulevard and Elm Road

Traffic Simulation Model

A microscopic traffic simulation model for the study area was created using Caliper © Corporation's TransModeler simulation software. The software provides an animated display of traffic moving throughout the network. An image of the simulation model network is displayed in **Figure II-3**.

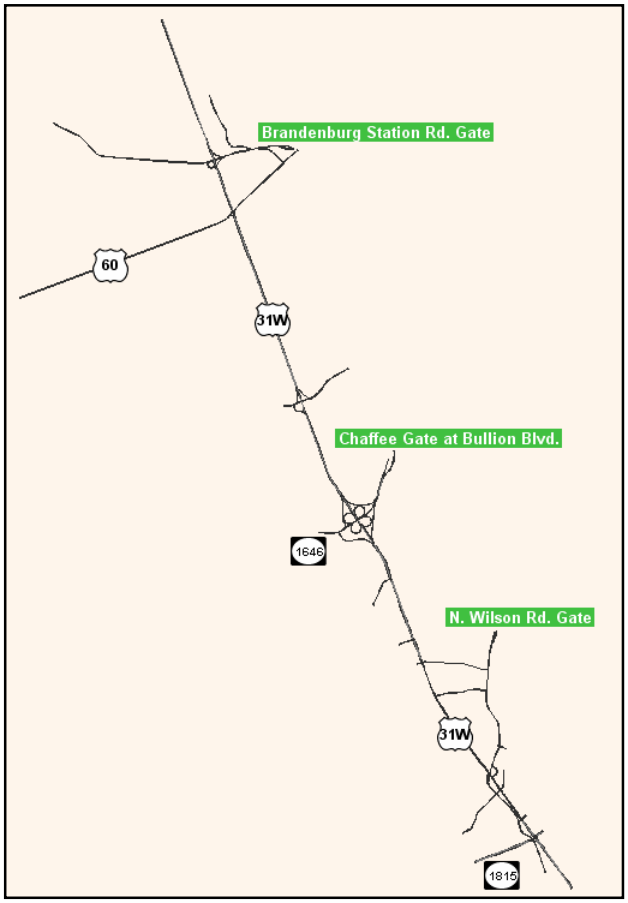

Figure II-3. Existing Traffic Simulation Model

Simulation models provide detailed performance measures of system operation. Typical performance measures include travel time, average travel speed, delay and queue lengths. Individual simulation models were created for

typical weekday AM (7:00 – 8:00) and PM (4:30 – 5:30) peak traffic hours. For this study, the simulation models and performance measures were used to provide a quantitative comparison of traffic operations associated with recommended improvements when compared to the existing and future "no-build" condition.

A key, unique component of creating the simulation models for this study was the accurate depiction of the Fort Knox gates' operations. Fortunately, TransModeler software had the ability to replicate the gate checkpoints and provide user-defined gate delays. **Figure II-4** shows a screen capture image of the animation at the Chaffee Gate at Bullion Boulevard during the AM peak hour.

Figure II-4. Existing Traffic Simulation Model Image of Chaffee Gate AM Traffic Operations

The individual model runs were made for the AM and PM peak hours. The simulation models were calibrated for accuracy by using the model run output. Queue lengths at the gates, roadway segment volumes, and intersection turning movement volumes from the models were compared with the existing data collected.

The Root Mean Square Error (RMSE) was also computed for the AM and PM peak traffic simulation models. RMSE is a measure of deviation between the estimated traffic volume in the simulation model and the actual traffic volume. For both the AM and PM simulation models, the RMSE (Root Mean Square Error) of less than 1 percent was obtained. A RMSE value of less than 10 percent is considered extremely accurate to the actual value.

Crash Analysis

Crash data were obtained from the Kentucky Transportation Cabinet's Division of Highway Safety from January 1, 2001 through November 1, 2006 for the following city- and state-maintained study area routes:

- Dixie Highway (US 31W)
- US 60
- Logsdon Parkway/Bullion Boulevard (KY 1646)
- West Lincoln Trail Boulevard (KY 1815)
- South Wilson Road (CS 2440)
- North. Wilson Road (CS 2255)
- Knox Boulevard (CS 2405)
- Redmar Boulevard (CS 2137)

In summary, a total of 1,488 crashes were reported on the listed routes, with 1,009 crashes (68 percent) of those occurring along US 31W.

Of the US 31W crashes, 217 (22 percent) resulted in an injury. The types of crashes most prevalent were rear-end crashes (40 percent) and angle crashes (30 percent). These statistics indicate congestion and access management issues present along this roadway.

Rear-end and angle crashes also occurred most frequently along North Wilson Road. These crashes accounted for 151 of the 209 total crashes reported.

Another tool to analyze the crash data involves computing critical crash rate factors (CCRF). These values are displayed in **Figure II-5**. The CCRF is a comparison of the calculated crash rate to a critical crash rate, where the critical crash rate is a statistically-determined value for

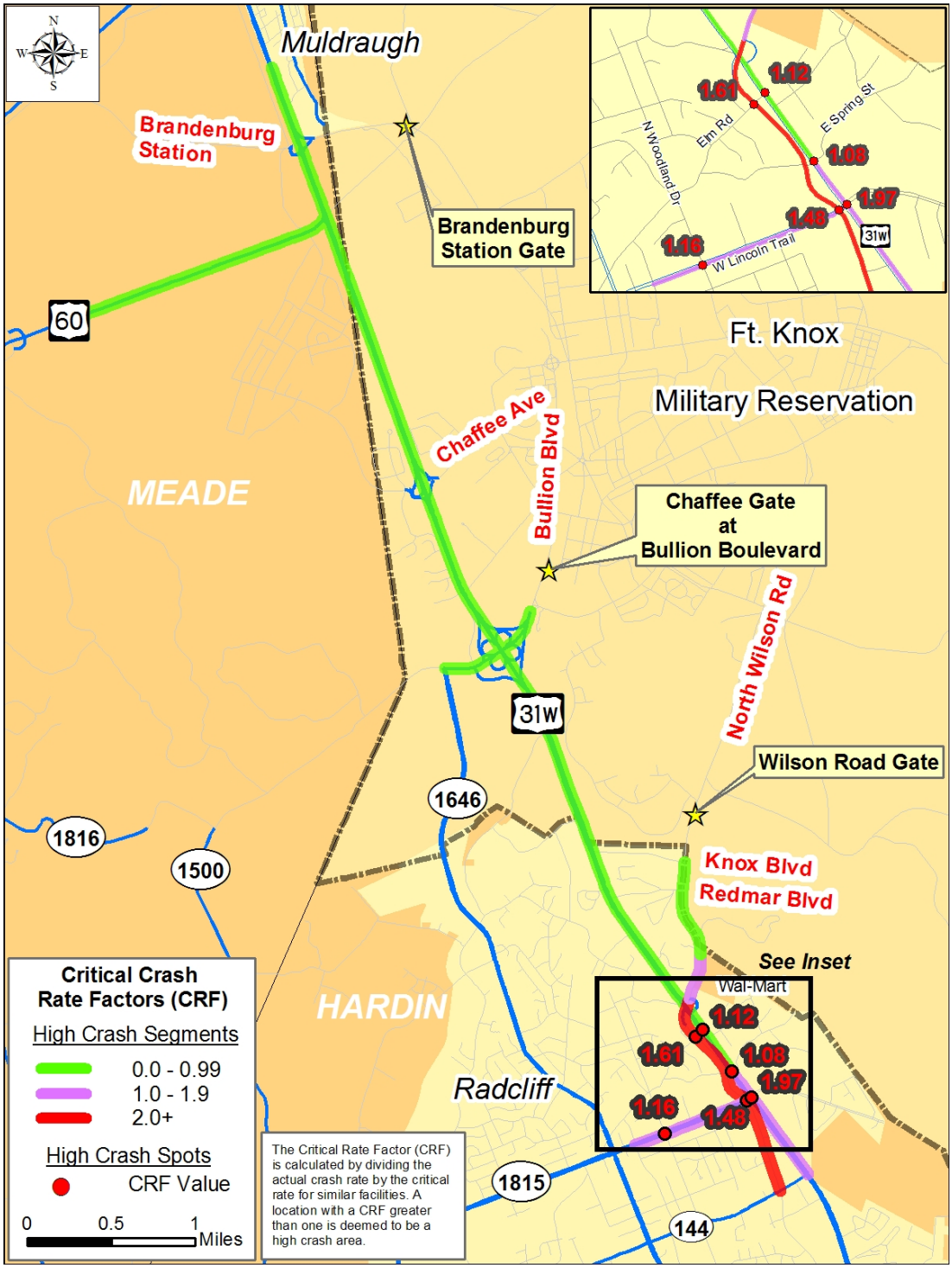

Figure II-5. Critical Crash Rate Factors (CCRF) for the Radcliff-Fort Knox Area

similar-type facilities across Kentucky. These rates allow for a comparison of crash experiences along roadways or at intersections for different facility types and entering traffic volumes. A CCRF value greater than 1.0 is considered to be very problematic; that is, compared to similar roadways or intersections, their crash experience in relation to their traffic volumes is uncharacteristically high.

Those roadway sections and intersections determined to have unusually high crash experience are located primarily in the Radcliff area. In particular, significantly high crash experiences are located along the following roadway sections:

- US 31W from KY 144/Vine Grove Road to Hill Street
- KY 1815/West Lincoln Trail from Deepwood Drive to US 31W
- North/South Wilson Road from KY 144 to Stinson Place

Additionally, the following roadway spots (a roadway length of less than 0.1 miles) have been identified as high crash locations:

- US 31W at KY 1815
- US 31W at Spring Street
- US 31W at Elm Road
- KY 1815 at Woodland Drive
- *KY 1815 at Wilson Road**
- North Wilson Road at Elm Road

**A non-traversable median was constructed along KY 1815 at this location during the crash analysis period. Since the installation of this barrier, annual crashes at this location decreased by approximately 75 percent.*

Planned Projects for the Study Area

Four key transportation improvements are currently planned for the study area, as shown in **Figure II-6**. Of those, the North Wilson Road Design-Build project will have the most impact to Fort Knox. The current two-lane roadway will be widened to a three-lane section with a continuous center left turn lane. The widening will begin just north of the US 31W bridge and continue north to Knox Boulevard. This project is currently under construction and completion date is scheduled for 2008.

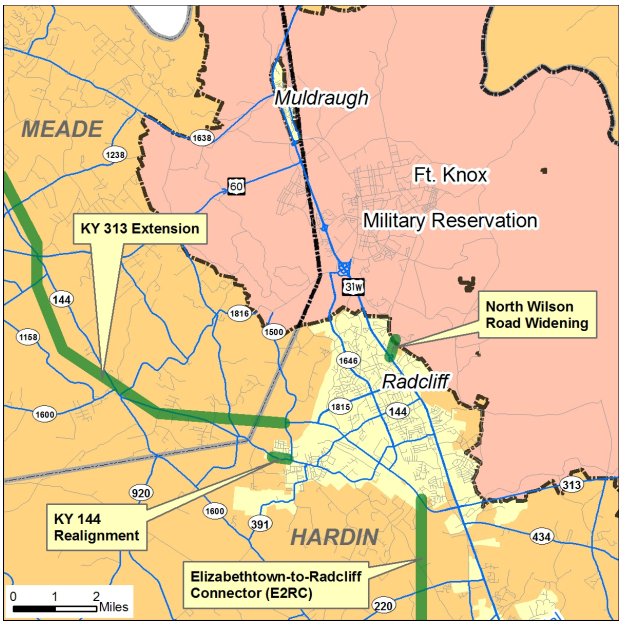

Figure II-6: Planned Improvements

Other planned transportation projects include the following:

- KY 313 Extension: new roadway to connect existing KY 313 to Brandenburg in Meade County.
- Elizabethtown-to-Radcliff Connector ("E2RC"): new roadway to connect existing KY 313 in Radcliff to the US 31W Bypass in Elizabethtown.
- KY 144 Realignment: includes safety improvements just west of KY 1500 in Vine Grove.

III. BRAC Changes

This section explains the Base Realignment and Closure (BRAC) changes that are planned for the Fort Knox military post. Although details and timelines are still being finalized, the following discussion describes the most recent information provided for the study.

General Information

BRAC is a means by which the U.S. Department of Defense (DoD) evaluates and makes recommendations concerning its base assets in order to maximize efficiency and decrease costs associated with operations and maintenance. The process allows the DoD the opportunity to recommend closure or "realignment" of its military installations by consolidating facilities between the various services in a manner that is open and transparent to the public. The key criterion used in the evaluation of a facility is its "military value", or the facility's significance in assisting the military branches in preparing for and winning wars.

The most recent BRAC recommendations were announced in May 2005 and made law that Fall. The following recommendations from the 2005 BRAC are expected to have an impact on traffic conditions in the area:

- Relocate the US Army Accessions Command and US Army Cadet Command to Fort Knox, KY.
- Realign Army Human Resources Command leased facilities in Alexandria, VA, Indianapolis, IN, and St. Louis, MO. Relocate and consolidate all functions at Fort Knox, KY.
- Close Louisville United States Army Reserve Center and relocate the 100th DIV(IT) headquarters to Fort Knox, KY.
- Realign Crystal Square 2, a leased installation in Arlington, VA, by relocating the Army HR XXI office to Fort Knox, KY.
- Realign the Park Center IV Building, a leased installation in Falls Church, VA, by relocating the Army Center for Substance Abuse to Fort Knox, KY.

Time Frame

The time frame for implementation of the BRAC recommendations is estimated to be between 2006 and 2011 or possibility later. The breakdown of the changes and estimated timeframe of arrival is summarized below in **Table III-1**.

Table III-1. BRAC Timeline

Organization	Estimated Arrival Timeframe
19th Engineer Battalion	Arrived Jan-Jun 2006
3rd Expeditionary Sustainment Command	Summer 2007
Human Resource Command	2008-2011
3rd Brigade, 1st Infantry Division	Late 2009
84th Army Reserve Region Training Center	2009-2011
U.S. Army Accessions Command & U.S. Army Cadet Command	2009-2010

Source: www.oneknox.com

Quantified Changes

Extensive efforts were made to obtain accurate quantifications of the BRAC changes. This was essential because those numbers were used to analyze the future traffic conditions and to base improvements on such conditions. The numbers below are the changes that were used for the BRAC traffic forecasting analysis in Chapter IV.

Change in Employment

The BRAC changes will result in an overall increase in Fort Knox employees, both military and civilian workers. **Table III-2** summarizes this increase once the BRAC changes are fully implemented. The percentages of those employees living in on-post housing and those residing off-post were not available.

Table III-2. Fort Knox Employment Increase

BRAC Moves	Ft. Knox Employees		
	Military	Civilian	Total
Gains	7,855	2,575	**10,430**
Losses	4,754	1,110	**5,864**
Net Increase	**3,101**	**1,465**	**4,566**

Source: Fort Knox

Change in Population

The BRAC changes will also have an impact on the regional population growth. A number of Fort Knox employees will bring families with them when relocating to the area, either on- or off-post. Because of the BRAC growth in the area, other new jobs may become available and promote other people to move into the area as well. The total increase in population associated with the BRAC changes that have been provided for this study is summarized in **Table III-3**. The population difference is the amount of people that can be expected to move into the area by 2009. Initially these changes were anticipated to take place by 2009, but full implementation could be delayed until 2011 or later.

Table III-3. Regional Population Increase

Year	Regional Population Increase from BRAC Changes
2006	6,253
2009	15,465
Difference	**+9212**

Source: Fort Knox

IV. Future Projected Conditions

This section focuses on the methodology and process to estimate the traffic impacts from the implementation of the BRAC recommendations. Roadway deficiencies within the study area were identified. With this information, transportation improvements at these problem locations are recommended.

Methodology

The following steps represent the basic methodology to project the increase in traffic flow to the study area once the BRAC changes have been fully implemented.

1. The future year for traffic forecasting purposes was determined to be 2009. This selected year was chosen to demonstrate the major impacts occurring at the earliest-reported timeframe. However, the BRAC changes may not be fully implemented until 2011 or later.

2. An annual growth rate was applied to the existing traffic volumes to obtain Future Base Year traffic volumes.

3. A traffic forecasting process was then performed for the Fort Knox households living on-post and for those living off-post.

4. Once the new trips had been quantified and distributed, these were added to the Future Base Year traffic volumes to obtain the BRAC Future Year traffic volumes.

5. AM and PM future year simulation models were created and the BRAC Future Year traffic volumes were applied.

6. The simulation models were evaluated and the deficiencies were identified within the network.

Study Area Growth Forecasts

Two separate traffic projections were estimated for this study: (1) increases due to the general growth occurring in the area and (2) increases due to the BRAC changes. A key resource to estimate growth forecasts and regional distribution patterns for this study was the Radcliff-Elizabethtown MPO Travel Demand Model (TDM). The TDM was developed in 2003 using TransCAD software as part of the Radcliff-Elizabethtown Urbanized Transportation Plan. The TDM encompasses the entire roadway network for Meade and Hardin counties as shown in **Figure IV-1**. As the TDM is a 24-hour traffic model, hourly volumes are not available. However, growth and distribution percentages still apply for planning level applications such as this study.

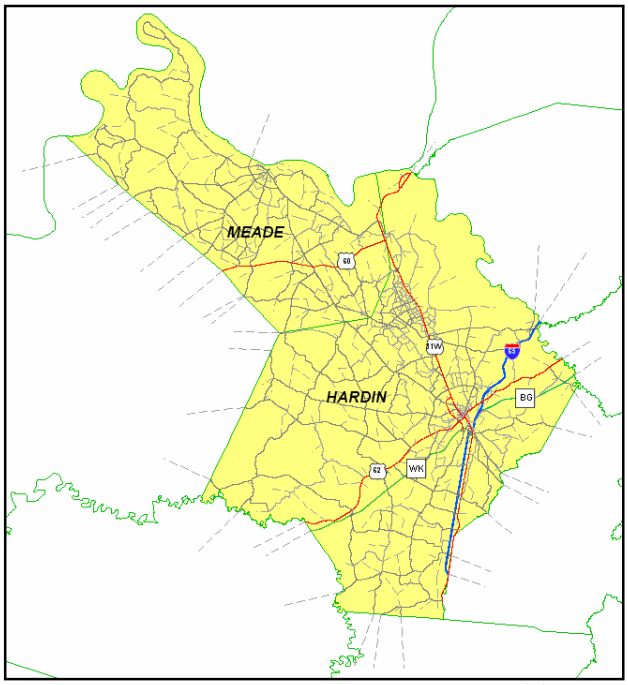

Figure IV-1. Radcliff-Elizabethtown MPO Travel Demand Model (TDM) Network

To estimate overall growth or "background traffic" for the future year, annual growth rates from the TDM along the study area roadways were applied to the existing (2006) traffic volumes. This resulted in the traffic volumes for the 2009 Future Base Year.

BRAC Growth Forecasts

From the quantified numbers listed in Chapter III, it was assumed that 4,566 households would be created as a result of the BRAC. From each of these households, several types of vehicle trips will take place. To estimate these vehicle trips, a basic categorization of the types of

vehicle trips was assumed. The chart in **Figure IV-2** illustrates the breakdown of trip types.

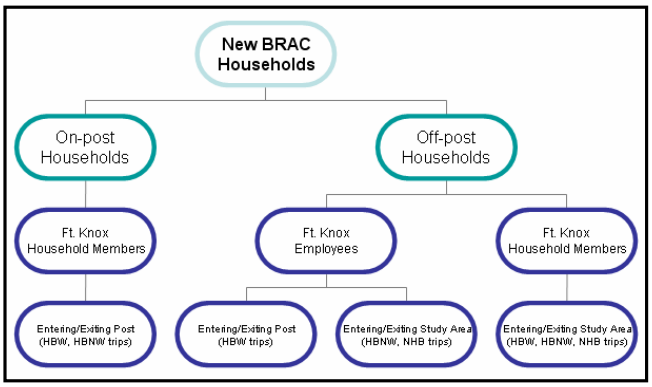

Figure IV-2. Trip Categories for BRAC Changes

From the chart above, the first level of categorization is the location of the BRAC households: located either on or off the Fort Knox military post. An assumption was made based on received information from multiple resources that all civilian worker households and approximately one-third of the military worker households would be located off-post.

The categorization for the second level was split into Fort Knox employees and Fort Knox household members. Of the on-post households, it was assumed that the Fort Knox employees would not be leaving from or returning to the post during the peak hours, and therefore, would not be contributing to BRAC peak traffic increases. However, it was necessary to account for a percentage of on-post household members producing vehicle trips during the peak hours. The types of vehicle trips assumed were a combination of Home-Based Work (HBW) trips and Home-Based Non-Work (HBNW) trips.

An example of a HBW trip would be a trip orginating at a residence on the Fort Knox post and terminating at a place of employment outside the post either within the study area or outside the study area. An example of a HBNW trip would be a trip originating at a residence on the Fort Knox post and terminating at a place other than the workplace, possibly a restaurant or a shopping center. There is a third type of trip, Non-Home Based (NHB), which originates from a place other than a home. This trip type was disregarded for on-post households, as the number would be relatively insignificant during the peak hours.

BRAC On-Post Trip Generation

To quantify the peak vehicle trips generated by the on-post household members, the existing Fort Knox on-post population and the number of vehicles exiting the gates during the peak periods were examined. It was then assumed that 15 percent of the BRAC on-post households would have a vehicle trip exiting the post for a work destination during the AM peak hour, while 10 percent would produce a vehicle trip entering the post during the PM peak hour for the return trip from work. For HBNW trips, it was assumed that five percent of on-post household would produce a vehicle trip leaving the post for a non-work destination during the AM peak hour, while 10 percent was assumed for the PM peak hour.

BRAC On-Post Trip Allocation

Conveniently, the TDM quantifies daily vehicle trips separated by HBW, HBNW, and NHB trip types. For the HBW and HBNW trip types, a subarea analysis was performed to obtain the distribution of those trips produced by on-post household members. It was determined from the TDM that most of the vehicle trips that originate inside the Fort Knox post terminate at locations external of the study area. The same applies to vehicle trips with destinations inside the Fort Knox post. Only 16 percent of HBW daily trips in the TDM that originate from the post terminated at destinations inside the study area. These daily distribution percentages were utilized for this study's peak hour analysis as well.

To estimate the trip distribution for which Fort Knox gates would be utilized for the on-post household members, the existing traffic distribution at the gates and the anticipated locations of new Fort Knox housing were examined. The majority of trips were distributed to the North Wilson Road and Chaffee at Bullion Boulevard Gates for the peak hours.

BRAC Off-Post Trip Generation

For off-post households, both Fort Knox employees and Fort Knox household members were assumed to generate daily trips as displayed in Figure IV-2.

Of those daily trips, several assumptions were made to quantify the peak hour vehicle trips generated by the off-post households. The following trip generation rate assumptions came from the TDM. The peak trip

percentages from the daily trips were assumed based on local travel patterns.

- For ALL trips:
  - 1.1 vehicle occupancy factor was assumed
- For HBW trips:
  - 1.9 daily trips per household, including 1 trip with a Fort Knox post destination; the reverse of these trips was assumed for the PM peak hour
  - 80 percent of the daily trips were generated during the peak hours
- For HBNW trips:
  - 5.0 daily trips per household
  - 20 percent and 30 percent of the daily trips were generated during the AM and PM peak hour, respectively
- For NHB trips:
  - 2.1 daily trips per household
  - 10 percent and 70 percent of the daily trips were generated during the AM and PM peak hour, respectively

BRAC Off-Post Trip Allocation

Determining where existing off-post Fort Knox employees reside and where planned residential growth will likely occur was key in distributing the BRAC off-post peak trips.

Fort Knox provided the places of residence for existing off-post employees, both civilian and military workers. **Table IV-1** summarizes this data. As shown, most existing Fort Knox employees live in Hardin County. Jefferson and Meade counties contain a smaller percentage of residents employed by Fort Knox.

Table IV-1. Fort Knox Off-post Employee Housing

County	Civilian Workers	Military
Hardin	61%	82%
Jefferson	10%	9%
Meade	12%	6%
Breckinridge	3%	---
Indiana	3%	---
Remaining (Each less than 2% of total)	11%	3%
Total	100%	100%

As Hardin County contained the largest population of Fort Knox commuters, more detailed information for this county was needed. Local planning agencies provided the locations of planned residential developments within Hardin County. These data were grouped by TAZ (Traffic Analysis Zone) to better visualize the concentrated areas of planned development. **Figure IV-3** shows the total housing units planned for development by TAZ within Hardin County. As illustrated, the majority of planned residential development is located south of Radcliff and west of the US 31W corridor.

Based on these two sources, it was assumed that all the BRAC off-post Fort Knox households would be located outside the study area. The distribution for the generated trips is displayed in **Figure IV-4**.

As the households would be located outside the study area, the TDM was utilized to determine the percentage of generated trips that would have origins and/or destinations within the study area. Similar to the method used for the on-post trip distribution outcome, most of the generated trips for the region do not use the study area roadways. Therefore, only a small percentage of trips generated by off-post Fort Knox household members were contributed to the BRAC traffic increases during the peak hours.

To estimate the trip distribution for which Fort Knox gates would be utilized for the off-post household members, the existing traffic distribution at the gates and the existing capacity for additional traffic into the gates were considered. The majority of trips were distributed to the North Wilson Road and Chaffee at Bullion Boulevard Gates for the peak hours since most Fort Knox employees living off-post would be located south of the study area and since Brandenburg Station Road Gate currently has the least capacity.

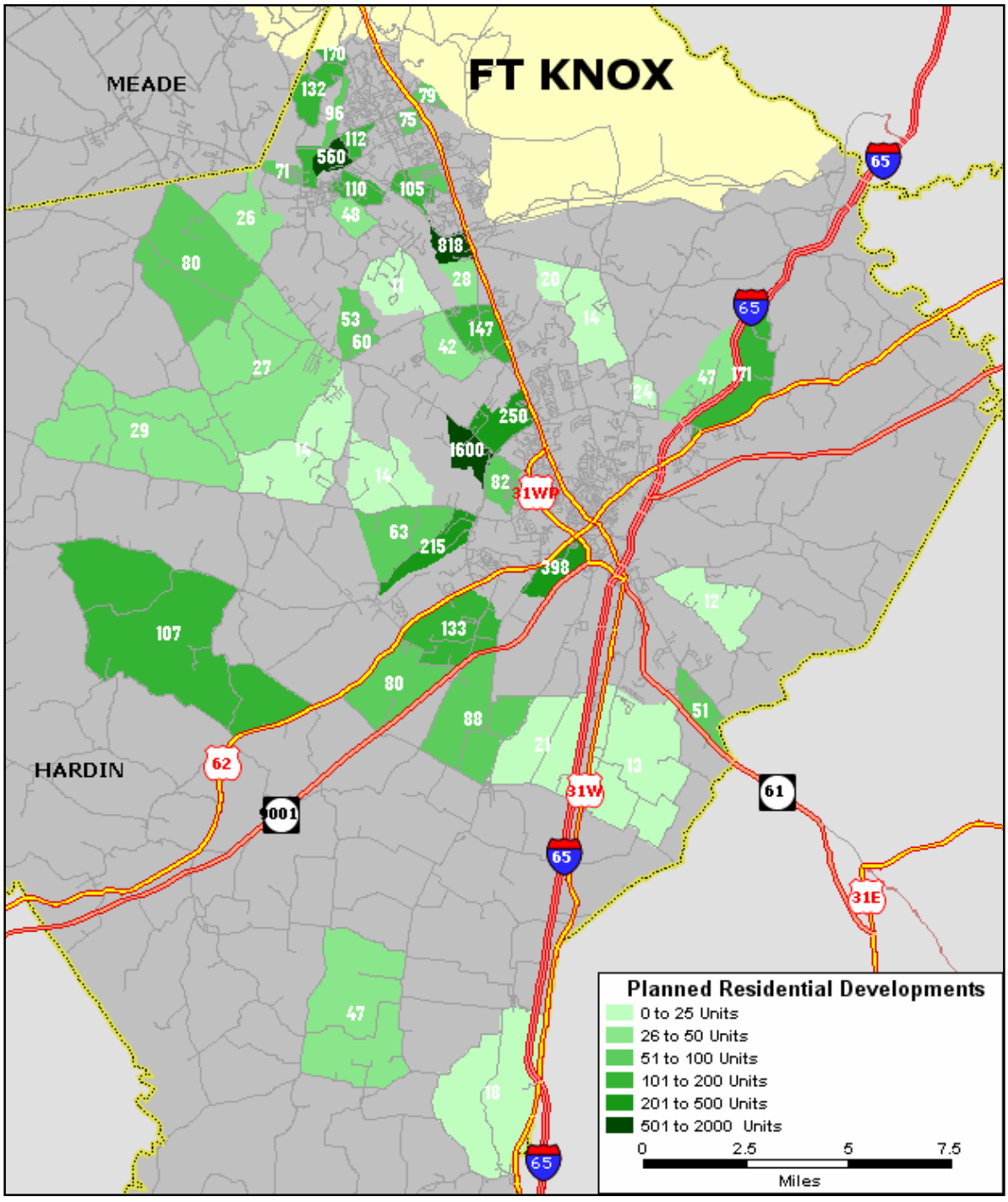

Figure IV-3. Planned Residential Development Areas by TAZ for the Radcliff-Fort Knox Area

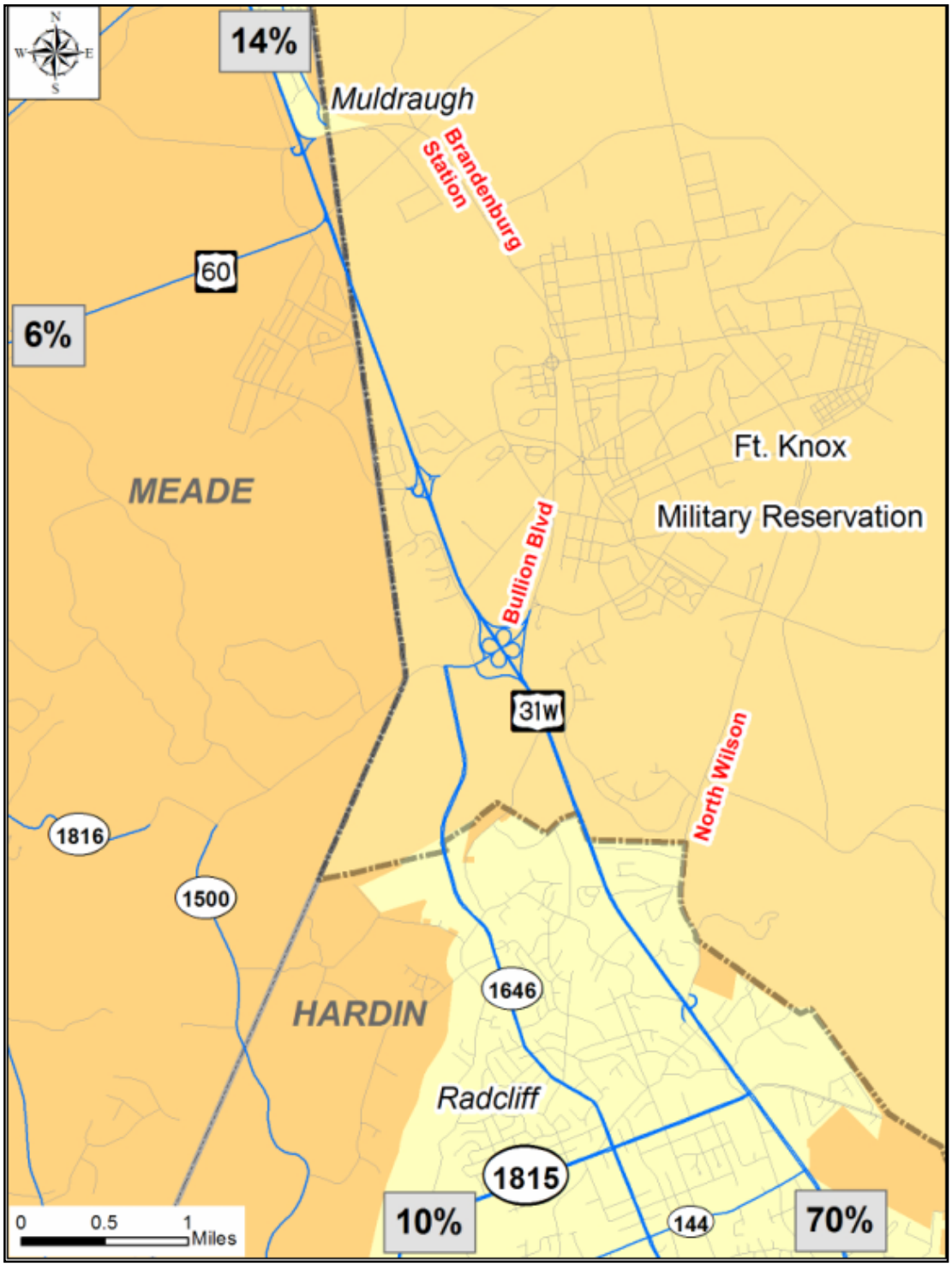

Figure IV-4. Allocation of BRAC Off-Post Traffic Increases for the Radcliff-Fort Knox Area

Gate Volumes

Table IV-2 presents a summary of the existing and projected future year traffic volumes for each of the gates.

Table IV-2. Existing (2006) vs. Future BRAC (2009) Projected Gate Volumes

Ft. Knox Gate	Existing			
	AM Peak		PM Peak	
	Enter	Exit	Enter	Exit
Brandenburg Station Rd.	811	110	412	905
Chaffee at Bullion Blvd.	1,432	163	601	1,129
N. Wilson Rd.	640	226	288	831
Total	**2,883**	**499**	**1,301**	**2,865**

Ft. Knox Gate	Future			
	AM Peak		PM Peak	
	Enter	Exit	Enter	Exit
Brandenburg Station Rd.	1,101	189	514	1,147
Chaffee at Bullion Blvd.	2,415	242	587	2,216
N. Wilson Rd.	1,274	371	397	1,418
Total	**4,790**	**802**	**1,498**	**4,781**

Ft. Knox Gate	Percent Increase			
	AM Peak		PM Peak	
	Enter	Exit	Enter	Exit
Brandenburg Station Rd.	36%	72%	25%	27%
Chaffee at Bullion Blvd.	69%	48%	-2%	96%
N. Wilson Rd.	99%	64%	38%	71%
Total	**66%**	**61%**	**15%**	**67%**

Traffic entering the post during the AM peak hour is expected to increase by approximately 66 percent with the BRAC implementation, from 2,883 vehicles per hour currently to 4,790 vehicles in the future. The North Wilson Road gate is anticipated to encounter the largest increase in entering traffic during the AM peak hour, nearly doubling from approximately 640 vehicles per hour to 1,274 vehicles per hour. Substantial increases are also expected to occur at Brandenburg Station Road (36 percent) and Bullion Boulevard (69 percent) during the AM peak.

In the PM peak hour, traffic exiting the post is anticipated to increase by approximately 67 percent, from 2,866 vehicles per hour to 4,781 in the future. Bullion Boulevard is expected to see the largest increase in PM exiting volumes, nearly doubling from 1,129 vehicles per hour to 2,216 vehicles. The North Wilson Road gate is also anticipated to see a significant increase in PM exiting traffic, increasing by approximately 71 percent from 831 vehicles currently to 1,418 vehicles in the future.

BRAC Future Year Deficiencies

The increased demand for AM ingress and PM egress to the Fort Knox post will place a tremendous burden on the existing transportation system. In order to better understand the potential deficiencies associated with the existing Fort Knox gates, it is important to consider the "theoretical" vehicular capacity at each ingress location. That is, how many vehicles can be served at each gate during the AM peak when vehicles are inspected as they enter Fort Knox. **Table IV-3** presents a summary of the theoretical capacities for ingress at each gate in their current configuration for three example assumed delays with the range that would be required to service the future demand.

Table IV-3. Theoretical Gate Capacities

Assumed average delay:		**6** seconds	
		Capacity	
Brandenburg Station	2 auto gates	1,200	
Bullion Boulevard	4 auto gates	2,400	
N Wilson Road	4 auto gates	2,400	
		6,000	**TOTAL CAPACITY**

Assumed average delay:		**8** seconds	
		Capacity	
Brandenburg Station	2 auto gates	900	
Bullion Boulevard	4 auto gates	1,800	
N Wilson Road	4 auto gates	1,800	
		4,500	**TOTAL CAPACITY**

Assumed average delay:		**10** seconds	
		Capacity	
Brandenburg Station	2 auto gates	720	
Bullion Boulevard	4 auto gates	1,440	
N Wilson Road	4 auto gates	1,440	
		3,600	**TOTAL CAPACITY**

The estimates presented in Table IV-3 depict the number of vehicles that can theoretically enter the post during the AM peak, assuming average delays of six, eight, and ten seconds. Note these figures include the stopped delay for each vehicle to be inspected and do not attempt to account for lost time associated with waiting in the queue, decelerating to a stop, and accelerating after being cleared for entry. Based on these estimates, stopping each vehicle for six seconds would allow for a total of 6,000 vehicles to enter post in a single hour. Increasing that delay by two seconds decreases the total ingress capacity by 1,500 vehicles.

In order to accommodate the demand for inbound travel during the future AM peak hour, gate staff would be required to stop and inspect each vehicle in less than eight seconds. The demand for ingress at the Bullion Boulevard gate (approximately 2,415 vehicles during the peak hour) would require that vehicles be stopped for no more than six seconds in order to accommodate the demand.

These estimates suggest the need to provide an additional gate for access to the post during the morning peak hours. Currently, the average delay for each vehicle entering the post is over eight seconds. However, observation of the Brandenburg Station inspection process indicates that vehicles are currently cleared faster at that location, as evidenced by it accommodating just over 800 vehicles during the AM peak hour. This suggests an average delay per vehicle of approximately nine seconds.

With the anticipated growth in travel to and from Fort Knox, the roadways serving the gates will experience increased levels of congestion in the future. Accommodating the increased travel demand at the existing ingress and egress points may be infeasible in the future as these locations are currently congested during the peak hours. This stresses the importance of considering a new gate providing access to the post from a facility other than US 31W.

The primary purpose of this study is to determine locations where future deficiencies are anticipated and to identify and prioritize improvements to improve traffic flow and provide a better connection to US 31W. With that purpose in mind, Future Year traffic simulation models for the AM and PM peak hours were developed using the additional traffic generated by the BRAC changes. A "No-Build" scenario was developed that does not include any transportation improvements for comparison to the existing models. **Table IV-4** presents a summary of the simulation model output for the existing year simulation models and the Future Year.

Performance measures were developed for the simulation networks as a whole. Performance measures include the following:

- Vehicle-miles of travel (VMT)
- Vehicle-hours of travel (VHT)
- Average speed through the network
- Total vehicular delay (in hours)

Table IV-4. Simulation Model Output

Time Period		Vehicle-miles of Travel (VMT)	Vehicle-hours of Travel (VHT)	Average Speed (mph)	Delay (hours)
AM Peak	Existing	19,116.5	938.8	25.7	340.6
	No-Build	21,516.4	2,496.6	15.7	1,170.4
	Percent change	*13%*	*166%*	*-39%*	*244%*
PM Peak	Existing	21,389.1	882.8	28.8	294.4
	No-Build	20,671.8	2,577.2	17.6	785.2
	Percent change	*-3%*	*192%*	*-39%*	*167%*

Vehicle-miles of travel (VMT) is the sum of the total distance traveled by all vehicles in the model network during each 60-minute analysis period (A.M. peak and P.M. peak). Vehicle-hours of travel (VHT) is the sum of total travel time by all vehicles traveling through the network during the simulation period. Average speed is defined as the travel speed averaged over all vehicles completing their trips through the network during the simulation period. Average speed includes time stopped at traffic signals; it is equivalent to traveling at a lower constant speed without stopping. Delay (in hours) represents the difference in actual travel time compared with an unimpeded, free-flowing travel time through the network during the simulation period.

The Future Year no-build simulation models show significant congestion on most roadway facilities due to the traffic increases associated with the BRAC recommendations. Overall VMT does not differ significantly between the existing and no-build scenarios, but VHT increases by approximately 166 percent in the AM peak hour and by approximately 192 percent in the PM peak. Average travel speeds decrease by approximately 39 percent in both the AM and PM peaks, and overall delay increases by 244 percent in the AM and 167 percent in the PM.

These performance measures suggest that without significant transportation improvements, the existing system will be incapable of providing the capacity required to serve the anticipated future demand. Each of the three gates relies on US 31W for ingress in the morning and egress in the afternoon. US 31W currently operates at or near capacity during the peak hours, and the additional

traffic anticipated with BRAC will cause travel conditions to deteriorate exponentially.

The following locations are anticipated to suffer from severe congestion as a result of BRAC:

AM Peak Hour

- Northbound North Wilson Road between US 31W bridge and the North Wilson Road gate
- Southbound and northbound US 31W off-ramps at Brandenburg Station Road
- Northbound US 31W off-ramp at Bullion Boulevard

PM Peak Hour

- US 31W between KY 144 and Knox Boulevard
- Southbound North Wilson Road between Elm Road and the North Wilson Road gate

The most severely congested locations include US 31W between Lincoln Trail and Knox Boulevard during the PM peak hour and North Wilson Road between Lincoln Trail and Knox Boulevard in both the AM and PM. As discussed previously, the access gates for Fort Knox will experience long delays and queues during the AM peak hour if they are not expanded and continue to operate in their current manner. Northbound US 31W entering the study area will also see increased levels of congestion as more commuters travel to work on post from the south.

In the afternoon, the gates provide free-flowing egress from post. Therefore, future congestion will occur at locations downstream from the gates. With each gate relying on access to US 31W, the increased traffic will result in traffic volumes well over the roadway's capacity resulting in near gridlock conditions.

The cost of congestion can be estimated by equating the total hours of delay to a cost of time. Ordinarily, this calculation is performed on a daily basis. However, the analyses for this study focus on the AM and PM peak hours, and the anticipated level of daily delay is unknown. Therefore, **Table IV-5** presents an annualized cost for delays experienced in the AM and PM peak hour for the existing and no-build scenarios. These costs assume an average salary of $15 per hour and 250 working days per year.

Table IV-5. Existing and No-Build Peak Hour User Costs

Time Period		Delay (hours)	Annual Cost
AM Peak	Existing	340.6	$ 1,277,250
	No-Build	1,170.4	$ 4,389,000
	Difference		*$ 3,111,750*
PM Peak	Existing	294.4	$ 1,104,000
	No-Build	785.2	$ 2,944,500
	Difference		*$ 1,840,500*

The results indicate that the existing 340.6 hours of delay during the AM peak hour costs approximately $1.28 million annually. In the no-build scenario, that cost will increase to approximately $4.39 million, a difference of over $3.1 million. In the PM peak, existing delays cost motorists approximately $1.1 million annually. That is expected to increase to approximately $2.94 million in the no-build scenario, an increase of over $1.8 million.

These values represent the cost of doing nothing. In other words, if the transportation system remains unchanged and the BRAC recommendations are implemented, accrued delays within the AM and PM peak hours alone will result in nearly $5 million in additional travel costs.

V. Public Involvement

A key component to any project is to provide the stakeholders and citizens in the community with pertinent information and to obtain their feedback on such issues. This section summarizes the involvement between the Study Team, stakeholders and citizens throughout the study.

Technical Advisory Committee (TAC) Meetings

A Technical Advisory Committee (TAC) was developed for this study and was comprised of members of the MPO's Technical Advisory Committee and other representatives from various local interests. The TAC served as the technical review liaison for the local interests it represented.

Three TAC meetings were held throughout the study. Additional discussion through email correspondence was also made on a regular basis. Key information gathered for the study and general comments from each meeting are summarized below.

October 26, 2006 TAC Meeting

- With respect to the BRAC, Army post population demographics will be shifting. There will be more employees living off-post, owning personal autos, and driving to work.
- There will be a lot of construction activities on the post. This will be generating a lot of contractor traffic. Also there will be new residential construction in the area.
- The possibility of access to the post from KY 313 has been previously discussed, but at the time of the meeting it was only an idea.
- A KY 313/Radcliff West Bypass also was discussed as an idea for improving mobility. Currently there is no bypass around either side of Radcliff. The bypass project has not gone through the MPO planning process, however.
- Inside the post, Wilson Road will be widened to four lanes from the Wilson Road Gate to Eisenhower Avenue.
- Fort Knox is considering public transportation for workers. This is an ongoing study; the consultant will be provided information. The transit service would involve bus transportation between the post and park-and-ride lots.

December 13, 2006 TAC Meeting

- A Fort Knox representative (Mr. Paul Frye) pointed out that congestion at the Brandenburg Station gate frequently is a result of trucks backing up to the point where the additional lanes through the gate begin, blocking those vehicles that would use these added lanes. Lengthening these lanes is restricted by the bridge located between US 31W and the gate; the bridge would need widening in order to extend the lanes significantly. Mr. Frye also noted that widening opportunities for Brandenburg Station Road are limited due to the terrain.
- A TAC member asked if consideration had been given to scheduling commercial vehicles so that they do not enter the base during peak traffic times. Mr. Frye said that some consideration had been given, but that no changes have been made to date.
- Mr. Frye stated that BRAC-related construction activities and associated traffic will ramp up considerably in the summer of 2007. Significant construction traffic increase is expected. Also, there will be an interim period where the Armor School is still active at Fort Knox and BRAC-related activities will be underway. Traffic congestion could be at its worst during this time.

March 27, 2007 TAC Meeting

- Fort Knox military trainees will live on post so they will have no impact on peak hour traffic.
- The Rose Terrace housing located in Traffic Analysis Zone (TAZ) 77 will be rebuilt.
- The Human Resources Building will be constructed in TAZ 148.
- A Fort Knox representative (Mr. Paul Frye) stated that many new Fort Knox employees will be working in TAZ 147.

Fort Knox Gate Operations Meeting

The consultant team met with several of the Fort Knox military officials on November 14, 2006 to gather input regarding gate operations. The following points summarize findings from the meeting.

- Traffic volumes at the gates are highest during the AM Peak from 6:30am – 9:00am. Military employees usually arrive on the post earlier than Civilian workers, resulting in morning peaks that are earlier in the day and spread over a longer period as compared to typical peaks.
- Mid-day traffic volumes are also high for the Chaffee Avenue at Bullion Boulevard and N. Wilson Road Gates.
- The existing roadway geometrics at the Bullion Boulevard merge near the Chaffee Avenue Gate is a major traffic issue. It is not signed appropriately.
- Currently, visitors are allowed to enter the post at all gates. Fort Knox is considering designating the Chaffee Avenue at Bullion Boulevard Gate as the only gate for visitors to enter the post.
- The Brandenburg Station Road Gate is the designated gate for commercial vehicle access onto the post.
- The Brandenburg Station Road Gate experiences long queues in the morning periods that extend to US 31W regularly.

Public Meeting

In addition to the Study Team's regular involvement with the TAC, the general community also participated in the study process.

A public meeting was held on Wednesday, July 11, 2007 at the Radcliff City Hall Building. The public was invited to comment on the study's draft list of potential transportation improvements for the area. Two handouts were distributed: a study area map labeled with potential improvements and a survey form. A presentation was given with an overview of the study and details of the potential improvements.

Received Comments

Approximately twenty individuals were present for the meeting. However, a limited number of surveys were returned. The following list summarizes the written comments from the survey forms and the verbal comments expressed during the meeting.

- A suggestion was made to restrict commercial vehicle traffic access to the Fort Knox base during the heavy morning peak hours.
- An additional improvement was recommended to extend Logsdon Parkway to Elizabethtown.
- One individual expressed hesitation regarding the possible elimination of the Spring Street signal.
- A suggestion was made to construct a clover-leaf ramp for N. Wilson Road southbound traffic at the US 31W bridge.
- Comments were expressed to better coordinate the traffic signals along US 31W in Radcliff.
- Concern was voiced about the potential improvements along N. Wilson Road being short-term solutions to the traffic problems.
- A comment was made regarding the planned projects for the area not being funded, especially the KY 313 project because this roadway could relieve existing traffic from US 31W.
- A recommendation was made to involve Fort Knox in the development of the transportation improvements.
- A comment was made that drivers should be encouraged to utilize Knox Boulevard to access the N. Wilson Road Gate in order to relieve congestion on N. Wilson Road.

VI. Recommendations and Cost Estimates

The objective of this study was to determine where future traffic congestion and bottlenecks may occur based on the level of traffic that will be entering and exiting the Fort Knox Military Reservation. A particular focus of this study was access to Fort Knox from US 31W via the Wilson Road gate. Ultimately, the study was to identify and prioritize improvements to improve traffic flow and provide a better connection to US 31W.

With that in mind, project recommendations have been developed to help alleviate the transportation deficiencies associated with existing safety issues and anticipated traffic growth surrounding Fort Knox. These recommendations have been grouped into four categories based on the type of improvement involved. This section includes detailed discussion of each alternative.

Key Capital Projects

Key Capital Projects include alternatives developed to improve capacity on roadways leading to the gates.

Improve North Wilson Road

North Wilson Road north of West Lincoln Trail, shown in **Figure VI-1**, tends to be congested during peak travel periods. In addition, this two-lane corridor has a high crash rate. Turn lanes are not provided at the intersections along North Wilson Road.

The proposed Human Resources Command building is located off North Wilson Road inside the post. A design-build project is underway to improve North Wilson Road between the US 31W overpass and Knox Boulevard to a three-lane section with a continuous center turn lane. This section is currently under construction. However, there are no planned improvements for the section between US 31W and West Lincoln Trail.

Figure VI-1. North Wilson Road Southwest of US 31W

In 2004, the KYTC closed access from North Wilson Road to South Wilson Road at West Lincoln Trail (see **Figure VI-2**) due to the proximity of that intersection to the existing signal at US 31W and West Lincoln Trail. Both approaches to Wilson Road were converted to right-in/right-out only with a median in the center of West Lincoln Trail, and U-turns are not allowed on West Lincoln Trail. However, U-turns have been witnessed at the US 31W intersection during site reconnaissance.

Figure VI-2. Southbound North Wilson Road at West Lincoln Trail

An existing slip ramp, shown in **Figure VI-3**, provides access to and from southbound US 31W to North Wilson Road, just west of the US 31W overpass. However, sight distance is limited from the slip ramp to northbound North Wilson Road, making left turns difficult. Access to and from northbound US 31W is provided by a ramp east of the overpass with a right-in/right-out onto US 31W.

Figure VI-3. Slip Ramp from US 31W to North Wilson Road

An improvement alternative for North Wilson Road consisting of four individual components has been developed. These four components are summarized below.

1. Eliminate existing slip ramp from southbound US 31W to North Wilson Road; construct new access road from North Wilson Road with right-in/right-out access on US 31W north of Elm Road.
2. Widen North Wilson Road to three lanes to provide a center turn lane from south of the US 31W bridge to West Lincoln Trail.
3. Widen Elm Road between North Wilson Road and US 31W to provide a center left turn lane; add a left turn lane on eastbound Elm Road west of North Wilson Road to provide a left turn lane.
4. Construct North Wilson Road connector from south of West Spring Street to West Lincoln Trail west of the existing alignment.
    - Evaluate new intersection with West Lincoln Trail for installation of new traffic signal
    - Evaluate Spring Street intersection with US 31W for removal of existing traffic signal. Convert Spring Street to right-in/right-out only access to US 31W.

The overall North Wilson Road improvement alternative is shown in **Figure VI-4**. Red indicates roadways to be eliminated, green indicates improving the existing alignment, and yellow indicates new construction. This alternative ties into the widening of North Wilson Road east of US 31W which is currently underway.

West of the US 31W overpass, North Wilson Road should be widened to a three lane section with a center turn lane. Currently, a single left-turning vehicle can significantly block traffic if opposing through traffic is present.

Elm Road is currently a two-lane facility, and its signalized intersections at North Wilson Road and US 31W are approximately 250 feet apart. This distance, combined with a single lane on each approach, does not provide adequate storage for vehicles approaching US 31W and traffic routinely backs up to North Wilson Road. Elm Road should be widened between North Wilson and US 31W to provide an additional eastbound lane to serve as a left-turn lane onto northbound US 31W. As right-of-way is not currently available, the widening should focus on encroaching into the parking lot north of the roadway. Additionally, a right-turn lane on southbound North Wilson Road should be added at Elm Road to accommodate the heavy right turn volume.

The BP Station to the south currently has six driveways, with two on US 31W, two on Elm Road (shown in **Figure VI-5**), and two on North Wilson Road. Consideration should be given to eliminating the access points on Elm Road or, at minimum, providing a single right-in/right-out access point to minimize interference with the signalized intersections.

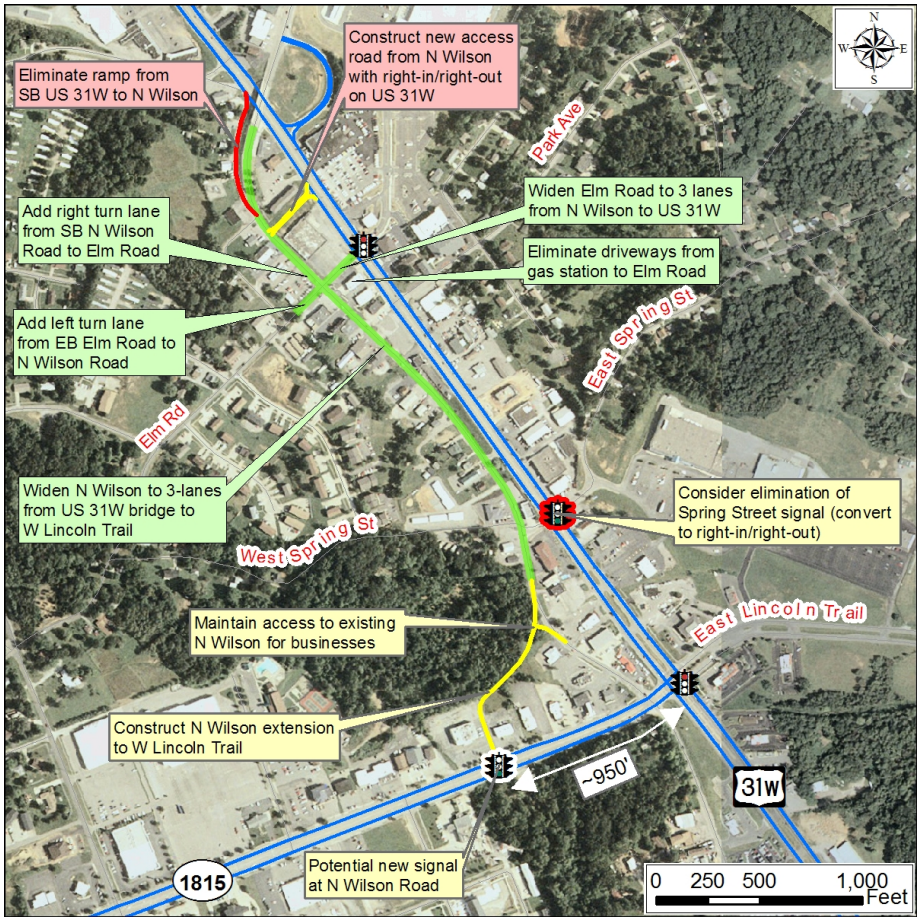

Figure VI-4. North Wilson Road Improvement Alternative

Figure VI-5. Elm Road Approaching US 31W

The existing slip ramp is not to be removed completely as it provides access to businesses located on its west side. However, it should be severed west of North Wilson Road. The proposed access road will provide access from southbound US 31W to northbound North Wilson Road and from southbound North Wilson Road to southbound US 31W; its intersection with US 31W will be a right-in/right-out only. The proposed three-lane section on North Wilson Road will provide storage for left-turning vehicles onto the ramp. Access from northbound North Wilson Road is not anticipated as it is provided at Elm Road and points south.

To the south, a new connector is proposed to provide an enhanced connection to West Lincoln Trail west of the existing intersection, with the existing North Wilson Road served by a tee intersection to maintain access to businesses. As shown, the new extension connects to West Lincoln Trail approximately 950 feet west of the US 31W/West Lincoln Trail intersection. While this distance is less than desirable to provide a new traffic signal on West Lincoln Trail, the demand for travel from West Lincoln Trail to northbound North Wilson Road will likely require a signal be installed. Locating the intersection farther west is likely not feasible due to the topography and existing land use north of West Lincoln Trail. A future connection from the connector intersection with West Lincoln Trail to South Wilson Road could be considered at a later date.

The existing traffic signal on US 31W at West Spring Street is approximately 900-feet north of the signalized intersection at West Lincoln Trail (KY 1815.) West Spring Street between North Wilson Road and US 31W is less than 100-feet long, providing storage for no more than four or five vehicles and causing backups on southbound North Wilson Road in the PM peak. The approach to US 31W, shown in Figure VI-6, is at a steep angle and is prone to vehicles bottoming out. With the construction of the proposed connector, the demand for left turns from northbound US 31W to West Spring Street will likely be diminished. This makes the traffic signal at that location a candidate for removal. If the signal is to be removed, the intersection could be converted to right-in/right-out only.

Figure VI-6. West Spring Street west of US 31W

Reconstruct Brandenburg Station Road and Interchange with US 31W

The existing Brandenburg Station Road interchange with US 31W provides minimal deceleration lanes southbound on US 31W and no deceleration lane northbound. The location of Dickerson Lake southeast of the interchange is problematic for the northbound exit ramp, and the ramp is currently located northwest of the lake. The southbound exit ramp is a tight loop with a radius of approximately 140 feet; this ramp has an advisory speed of 15 miles per hour (MPH). These constraints make this interchange less than desirable for truck operations, and the two-lane Brandenburg Station Road does not provide adequate capacity for peak hour traffic operations.

An alternative was developed to bring the interchange up to current design standards and to provide additional capacity on Brandenburg Station Road. Shown in **Figure VI-7**, this alternative increases the radius for the southbound US 31W exit ramp to approximately 200 feet, which is within guidelines for a 25 MPH design speed. The southbound entrance ramp would be relocated outside the exit ramp, and appropriate deceleration/acceleration lanes should be provided for both ramps.

On the northbound side, the US 31W exit ramp would be relocated east of Dickerson Lake, tying in approximately at the same location as the entrance ramp from Brandenburg Station Road to northbound US 31W. From this point east, Brandenburg Station Road is widened to four lanes (two per direction) for approximately 2,500 feet, requiring replacement of the existing railroad bridge west of the gate.

This alternative is recommended if Fort Knox decides not to pursue the AM peak hour one-way operation of Brandenburg Station Road (as discussed in "Operational/ Transportation Systems Management Strategies".) Even if the one-way operation is implemented, the reconstruction of the existing ramps is recommended to increase safety and operational efficiency of the interchange, especially if trucks continue to use the facility.

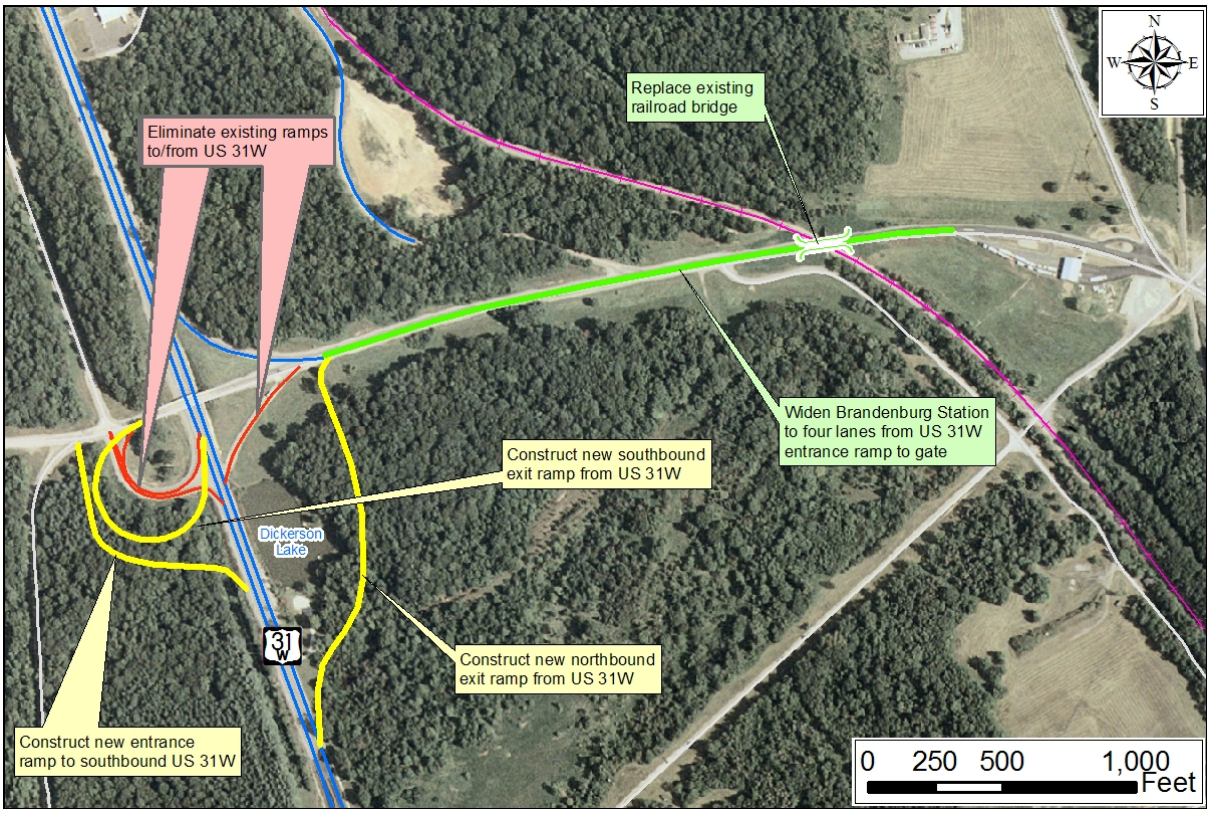

Figure VI-7. Brandenburg Station Road Improvement Alternative

Improve Exit Ramp Merge from Northbound US 31W to Inbound Bullion Boulevard

The existing ramp from the northbound US 31W exit ramp to Bullion Boulevard is two lanes and it ties into a two-lane Bullion Boulevard. The left lane from the ramp merges into the right lane on Bullion Boulevard, and the right ramp lane has a short acceleration lane before it merges into Bullion Boulevard, as shown in **Figure VI-8**. Bullion Boulevard extends to the gate with two inbound lanes. Note that photographs of this area are not available as Fort Knox protocol prohibits photography in the vicinity of the depository building, located west of Bullion Boulevard.

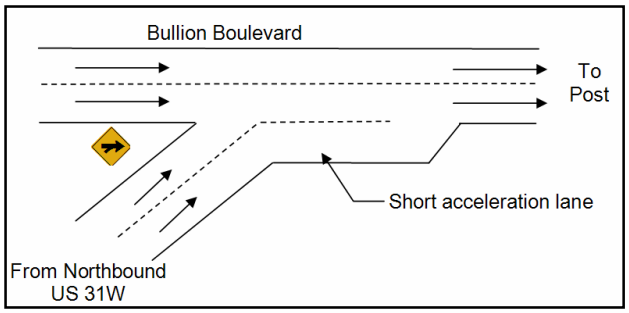

Figure VI-8. Northbound US 31W Exit Ramp Merge at Bullion Boulevard
(Not to Scale)

The right ramp lane should be extended farther northeast, as shown in **Figure VI-9** to provide additional capacity and to eliminate merging issues associated with the short acceleration lane. This provides an opportunity to construct an additional inbound lane from the exit ramp to the existing "Chaffee Gate," thereby providing increased capacity for post ingress.

Figure VI-9. Bullion Boulevard Improvement Alternative

Operational / Transportation Systems Management (TSM) Strategies

Operational/Transportation Systems Management (TSM) strategies have been developed to provide needed benefits with a lower capital cost. These alternatives rely heavily on the existing infrastructure but seek new ways to better use the current transportation system.

Optimize Traffic Signal Timing Plans

Signal timing plans along US 31W should be updated periodically in response to changing traffic conditions. Timing plans should be developed for peak traffic periods – the weekday A.M., mid-day and P.M. peak hours, as well as a weekend peak (particularly in the vicinity of Wal-Mart). Updated timing plans should be developed now and evaluated annually while the BRAC recommendations are being implemented to minimize delay and maximize opportunities for traffic progression along US 31W. Traffic signal timing optimization was recommended in the Radcliff-Elizabethtown Urbanized Area Transportation Plan for the section between Lincoln Trail Boulevard and Elm Road.

Convert existing Brandenburg Station Road to One-way (inbound) During AM Peak Period

As the sole gate for commercial vehicles and with only a two-lane roadway leading into the post, traffic entering via Brandenburg Station Road routinely backs up westward to the US 31W interchange during the AM peak hours. As mentioned during a TAC meeting, the commercial vehicles have been observed to be blocking the automobile entrance lanes. Additionally, the existing traffic exiting this gate during the AM peak hour, representing only 12 percent of the total peak hour volume utilizing the gate, was the lowest exiting volume of the three gates. Reconstructing the roadway will be expensive (see "Key Capital Projects" for more information), so another alternative was developed to provide additional inbound capacity during the morning commute.

During the morning peak hours (approximately 6:00 to 9:00 AM), Brandenburg Station Road could be converted to one-way traffic between US 31W and the post. Both travel lanes could be used to double the inbound capacity and military police personnel at the gates could close the outbound lane with cones. Traffic exiting the post can utilize the existing Chaffee Avenue interchange, approximately 2.2 miles south on US 31W. (Note the exit ramps from US 31W to Chaffee Avenue have been removed, but the entrance ramps remain open to traffic exiting post.) At the conclusion of the peak period, the exit lane could be reopened and Brandenburg Station Road returned to two-way flow. This option is shown graphically in **Figure VI-10**.

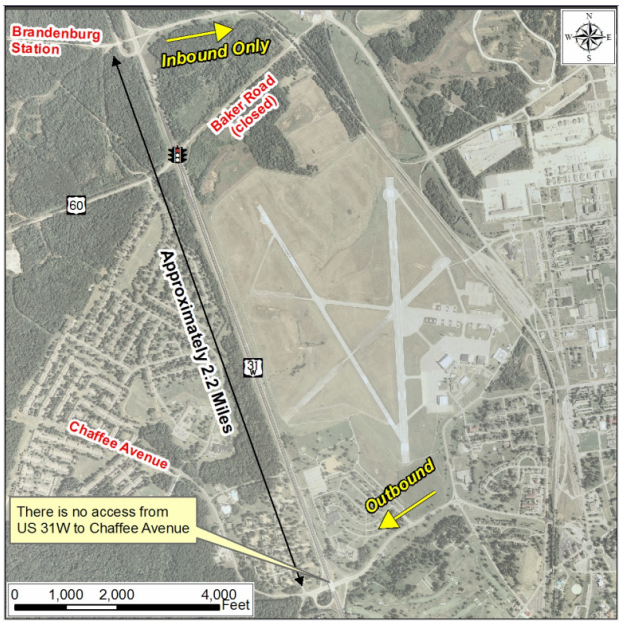

Figure VI-10. Operational Alternative for Brandenburg Station Road

Discussions with Fort Knox staff revealed one issue with this alternative. Currently, tanks destined for training grounds west of US 31W use Brandenburg Station Road to access those facilities. The BRAC recommendations call for the armor school to be relocated to Georgia, which would negate that need in the future. In addition, tank movement on Brandenburg Station Road could be limited to off-peak hours. Baker Road (currently closed to traffic) to US 60 was mentioned as another option for tank movements; however, the at-grade rail crossing at the east end of Baker Road and the signalized intersection with US 60 make that an undesirable option for tank access.

Relocate Fort Knox Truck Access

The existing Brandenburg Station Road gate provides a total of four checkpoints, two for automobile traffic and two for commercial vehicles. The inspection process for personal autos takes significantly less time than for commercial vehicles. With that, the two vehicle checkpoints are often choked with automobiles while the two truck gates are serving only a limited number of trucks.

The Chaffee Avenue gate was closed some time ago and relocated to Bullion Boulevard. However, most of the infrastructure for the former Chaffee Gate remains in place, with the exception of the exit ramps from US 31W. If those ramps were reconstructed, a "new" gate could be opened at Chaffee Avenue to serve truck inspections only, thereby allowing for four checkpoints for private automobiles at Brandenburg Station Road. Outbound access at Chaffee Avenue would remain unchanged.

Traffic from residential areas west of US 31W mixing with commercial vehicles poses one problem for this alternative. It would be imperative to monitor the operations of the US 31W exit ramps to ensure automobiles do not enter Chaffee Avenue. Otherwise, it would be very difficult to discern post traffic from those that have exited US 31W in error. This could be accomplished, however, by placing the checkpoints just prior to the ramp terminals at Chaffee Avenue rather than on Chaffee Avenue entering the post. In the former configuration of the interchange's exit ramps (a loop for southbound US 31W traffic and a directional ramp for northbound traffic), all exiting traffic destined for the post entered Chaffee Avenue on its south side. If only the ramps were replaced in a similar manner, a single inspection lane could be constructed that channels all exiting traffic into the checkpoint before being released for post access.

Fort Knox personnel expressed some concern with existing vertical clearances at railroad overpasses on post, noting that many have less than eleven feet of vertical clearance. Semi-trailer trucks do not have the desired vertical clearance to reach destinations to the east of the railroad tracks. However, discussions with Fort Knox suggested an interest in this option even if it requires improving some of the grade separated rail crossings.

Fort Knox personnel also suggested the possibility of placing time restrictions on truck deliveries so that one or both of the truck gates at Brandenburg Station Road could be utilized for automobile access during the morning commute.

Provide Fort Knox Employee Shuttle from Points in Elizabethtown and Louisville

With the volume of new traffic destined for the post each day, commuters to Fort Knox are likely to be attracted to public transit opportunities. Therefore, an employee shuttle should be established serving park-and-ride lots in Elizabethtown (possibly off the US 31W bypass) and near Louisville (possibly near I-265/Gene Snyder Freeway.) An

employee shuttle would reduce the overall number of vehicles entering the post and requiring inspection. Identification could be verified as employees board the buses.

The Kentucky Transportation Cabinet (KYTC) has agreed to purchase two 35-passenger buses for use at Fort Knox. Each trip made by a bus operating at capacity could eliminate approximately 32 vehicles from the roadway, assuming an average vehicle occupancy rate of 1.1 persons per vehicle.

On a similar note, carpooling should be encouraged by providing designated parking areas within the park-and-ride lots for carpool traffic destined for the Fort Knox post. Observation of gate operations indicates that the current occupancy rate for personal automobiles entering the post is quite low. All efforts to encourage increasing carpool activities should be considered.

Safety (area-wide) Recommendations

Safety recommendations include area wide considerations that are aimed at decreasing crash rates at signalized intersections.

Provide Signal Head per Lane at Each Signalized Intersection

The KYTC and the City of Radcliff should be commended for their efforts in providing a minimum of one traffic signal head per lane of traffic (or two signal heads for a single lane approach). Studies have shown that installing one signal head per lane can reduce crash rates 10 to 22 percent. Should any new traffic signals be installed, it is recommended that a minimum of one signal head per lane be installed as well.

Install Traffic Signal Backplates at Each Signalized Intersection

Traffic signal backplates provide for increased visibility and conspicuity of signal heads. Studies have shown that the installation of backplates can decrease right angle crashes by up to 32 percent and can decrease the occurrence of red light running by 50 percent. Therefore, it is recommended that retro-reflectorized backplates be installed at all signalized intersections within the study area. An existing example of backplates in the study area is shown in **Figure VI-11**.

Figure VI-11. Retro-reflectorized Signal Back plates at US 31W and KY 1638 in Muldraugh

US 31W Access Management Study Recommendations

ENTRAN worked with the Radcliff-Elizabethtown Metropolitan Planning Organization (MPO) to complete the US 31W Access Management Study in 2006. The study was undertaken to seek feasible strategies to more effectively manage access along the corridor and, in doing so, improve the safety and efficiency of the highway. Three recommendations from that study have been carried forward as they affect roadways within the study area.

Driveway Consolidation/Cross Site Access – US 31W South of Lincoln Trail (KY 1815)

The northbound approach of US 31W at Lincoln Trail is four-lane divided with a center left turn lane. Within 375 feet of the intersection, there are a total of seven driveways to five different fast-food restaurants, as shown in **Figure VI-12**. Of 178 reported crashes in the last five years, over half were either rear-end or angle crashes, those types frequently associated with driveway ingress and egress movements. The recommendation was to combine driveways and therefore eliminate some of the access points. The current driveway to Arby's could be modified to serve as internal collector that also could provide access to McDonald's and Subway, for example. Conceptually, the seven driveways could be reduced to three.

Figure VI-12. Closely Spaced Multiple Driveways

Construct Non-Traversable Median from Spring Street to Knox Boulevard (KY 2214) in Radcliff

This 1.6-mile section is four-lane with two continuous left-turn lanes (one left turn lane in each direction), as shown in **Figure VI-13**. It is characterized by dense retail development on both sides of the road and numerous, sometimes closely-spaced access drives. The crash rate for the southern segment – from Spring Street to Hill Street – is 30 percent higher than the critical crash rate, indicating that this segment has an unusually high crash experience. These are crashes that can be mitigated using access management techniques. Though the northern segment (Hill Street to Knox Boulevard) does not show an unusually high crash frequency, the adjacent land use and numerous closely spaced access drives make this a strong candidate for median separation.

Figure VI-13. US 31W in Radcliff

The recommendation was to construct a raised median with designated channelized openings and with allowable U-turns, from Spring Street to Knox Boulevard. Where single left-turn lanes are to be constructed, positive offset should be provided to enhance sight distance.

Driveway Consolidation/Cross Site Access – Between Knox Boulevard and Redmar Boulevard in Radcliff

Between Redmar Boulevard and Knox Boulevard in Radcliff there lie a number of adjacent businesses on the east side of US 31W, collectively with multiple driveways, as shown in **Figure VI-14**. This is another location where the application of a program to combine driveways and provide cross-site access could be used to reduce crashes.

Figure VI-14. US 31W South of Knox Boulevard

The recommendation was to combine driveways and therefore eliminate some of the access points. Conceptually, the nine driveways could be reduced to five.

Cost Estimates for Key Capital Projects

Planning-level cost estimates were developed based on current unit cost figures used for KYTC design projects and generalized right-of-way costs based on area type. These estimates are provided in Table VI-1. All estimates reflect current (2007) dollars. The total cost to implement all the key capital projects is just over $9 million.

Table VI-1. Key Capital Project Cost Estimates

Key Capital Project	Cost
Reconstruct Brandenburg Station Road and Interchange with US 31W	$ 5,550,000
Improve Exit Ramp Merge from Northbound US 31W to Inbound Bullion Boulevard	$ 325,000
Improve North Wilson Road	$ 3,155,000
Construct new ramp to/from southbound US 31W to North Wilson Road	*$ 375,000*
Widen North Wilson Road to three lanes	*$ 1,470,000*
Widen Elm Road between North Wilson Road and US 31W	*$ 285,000*
Construct North Wilson Road connector	*$ 1,025,000*
TOTAL, KEY CAPITAL PROJECTS	**$ 9,030,000**

Project Benefits

Peak hour traffic simulation models depicting the key capital improvements were developed to estimate the benefits associated with those alternatives. **Table VI-2** presents a comparison of the no-build simulation results and the models depicting the key capital projects. Note the existing year simulation results are provided for reference.

Table VI-2. Traffic Simulation Model Output

Time Period		Vehicle-miles of Travel (VMT)	Vehicle-hours of Travel (VHT)	Average Speed (mph)	Delay (hours)
AM Peak	Existing	19,116.5	938.8	25.7	340.6
	No-Build	21,516.4	2,496.6	15.7	1,170.4
	Key Capital Projects	21,904.4	2,080.5	16.4	1,035.8
	Percent change	*2%*	*-17%*	*4%*	*-12%*
PM Peak	Existing	21,389.1	882.8	28.8	294.4
	No-Build	20,671.8	2,577.2	17.6	785.2
	Key Capital Projects	25,547.5	1,986.6	21.0	698.9
	Percent change	*24%*	*-23%*	*19%*	*-11%*

The simulation model results suggest the key capital projects will produce network-wide operational improvements. Overall VMT increases and VHT decreases when comparing the key capital project alternative to the no-build scenario, suggesting that travel will be somewhat less congested if the projects are implemented (in other words, the models were able to "load" more vehicles into the network with additional capacity provided by the key capital projects). Additionally, average travel speeds will increase and delay will decrease.

In terms of user costs associated with delay, **Table VI-3** presents a summary of the peak hour delay costs per year assuming an average salary of $15 per hour and 250 working days per year.

Table VI-3. Estimated Future Peak Hour User Costs

Time Period		Delay (hours)	Annual Cost
AM Peak	Existing	340.6	$ 1,277,250
	No-Build	1,170.4	$ 4,389,000
	Key Capital Projects	1,035.8	$ 3,884,250
	Difference		*$ (504,750)*
PM Peak	Existing	294.4	$ 1,104,000
	No-Build	785.2	$ 2,944,500
	Key Capital Projects	698.9	$ 2,620,875
	Difference		*$ (323,625)*

The key capital projects result in a total savings of approximately $830,000 during the AM and PM peak hours each year compared to the no-build scenario. While this figure may not seem like a significant savings, much of the delay accrued during the AM peak is associated with the operations at the gates. As these recommendations do not include modifications to or expansion of the gates, much of that delay will remain. Discussions with Fort Knox personnel have revealed a need to evaluate the operations at each gate in order to maximize efficiency in the inspection process.

In the PM peak, the primary source of modeled delay is traffic operations along US 31W. Short of providing additional capacity along US 31W (i.e. adding more travel lanes), the only opportunities to decrease delay are optimizing signal timings or providing alternative travel

routes. Within the scope of this study, additional travel routes were not considered as potential alternatives.

A primary objective of this study was to improve access between the existing roadway system (especially US 31W) and the Fort Knox Military Reservation. The traffic simulation models demonstrated that insufficient gate capacity will cause considerable traffic back-up's during the AM peak, particularly with the increased traffic anticipated as a result of the BRAC implementation. Even with the implementation of the recommended changes, significant peak hour congestion – AM and PM – will remain, particularly in the US 31W-Wilson Road area of Radcliff.

The recommended projects will have a measurable impact and definitely are needed to improve both capacity and safety, but additional measures to reduce travel demand along US 31W and/or provide increased capacity should be explored. While the Fort Knox Highway Access Study was successful in identifying measures to improve access to the post, reduce congestion and delay, and improve safety, it also demonstrated that traffic problems should be addressed on a regional scale as well in order to identify long-term, comprehensive solutions and strategies. Limitations with the three existing gates, including their reliance on US 31W, will require consideration of new access points in the future. Additionally, procedural or infrastructure improvements should be considered at the existing gates in order to increase efficiency and maximize the capacity for vehicles entering post.

Project Implementation

Given the timeframe for the implementation of the BRAC recommendations, it is not likely that the key capital projects can be constructed prior to significant employment increases occurring at Fort Knox. However, design-build alternatives could be considered to fast-track the process in order to have these needed improvements in place as soon as possible.

Each of the key capital projects will have a significant impact on the capacity for the three existing gates, and therefore each project should be considered to be high priority. However, with the anticipated Human Resources Command being located off North Wilson Road inside post, the North Wilson Road improvements should be considered first priority. The Bullion Boulevard improvements should be considered second priority in that the Chaffee Gate at Bullion Boulevard is considered the "primary" gate for access to Fort Knox and the project can be implemented within existing Fort Knox right-of-way and at a relatively low cost. The Brandenburg Station Road improvements should be considered third priority. Fort Knox has suggested the possibility of improving the Brandenburg Station gate (through a partial relocation of the checkpoint or by adding additional inspection gates), and until that occurs, the facility will suffer from a lack of inspection capacity. Improving Brandenburg Station Road will not result in significant operational improvement until gate inspection capacity is increased; however, the proposed ramp improvements will increase safety and efficiency at the interchange.

With this prioritization in mind, consideration for inclusion of these projects into the MPO's Transportation Improvement Program (TIP) should be discussed immediately. A number of funding sources can be considered for the implementation of the recommended projects. The Access Management recommendations may be eligible for Hazard Elimination-Safety (HES) funding as most are located in areas with high crash rates. KYTC has already agreed to assist with funding for the employee shuttle service.

Funding for the key capital projects will be more difficult to obtain because of the costs. Ideally, BRAC-specific funding would be available to assist in improving the infrastructure required to accommodate the changes at Fort Knox. In absence of such funding, other sources may be considered. As the Brandenburg Station Road improvements are largely within the boundaries of Fort Knox, Military Construction (MILCON) funding is one potential source for funds. The ramp improvements may be accomplished through a combination of MILCON and traditional highway funding sources. That is also the case with the proposed improvements to Bullion Boulevard.

With the high crash rates on North Wilson Road, it may be possible to use HES funding for some of the improvements to the corridor. However, it is more likely that traditional highway or other local funding sources will be required to accomplish the recommended improvements as this is not a state-maintained facility.

Conclusions

It has been demonstrated that the BRAC recommendations will have a sizeable impact on the transportation needs surrounding Fort Knox. The existing

three gates at Brandenburg Station Road, Bullion Boulevard, and North Wilson Road are not capable of providing the capacity to provide efficient access into the post each day.

Ideally, a new gate should be constructed that would provide access to a facility other than US 31W, such as KY 313 (Joe Prather Highway). KY 313 has an interchange with I-65 east of Fort Knox and access to the roadway is limited as much of the adjoining property is owned by the Federal government. However, the long-term costs associated with a new gate (namely staff required to man such a facility) make that an unattractive alternative for Fort Knox. Therefore, alternatives have been developed that will improve conditions on the roadways serving the existing gates.

If a new gate is not considered feasible, another option would be to further promote the Elizabethton-to-Radcliff Connector (E2RC) project. The Logsdon Parkway currently provides a good connection between KY 313 and Bullion Boulevard. The E2RC project, if constructed, will connect KY 313 and the US 31W Bypass in Elizabethtown, providing a parallel route to US 31W. This new option will provide commuters another alternative for travel to and from Fort Knox and will reduce the demand for travel on US 31W.

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