Research Report
KTC-06-16/SPR290-05-1F

KENTUCKY TRANSPORTATION CENTER

QUANTIFICATION OF THE BENEFITS OF ACCESS MANAGEMENT FOR KENTUCKY

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QUANTIFICATION OF THE BENEFITS OF ACCESS MANAGEMENT FOR KENTUCKY

(Final Report)

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16. Abstract

This report describes the benefits quantification performed for the proposed access management plan for Kentucky. This study evaluates the capacity, safety and economic impacts associated with access management programs. The proposed Kentucky access management program will seek to standardize driveway and traffic signal spacing on all state maintained roadways in the state. The TRB Access Impact Calculator developed as a part of by NCHRP Report 420, was used to evaluate the potential benefits of the proposed plan on a sample of Kentucky roadways. The results of this analysis were then extrapolated to the statewide system to estimate total annual savings in delay and crash reductions. Based upon this analysis, it is estimated that proposed access management plan could save Kentucky road users approximately 950 million dollars per year.

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Executive Summary

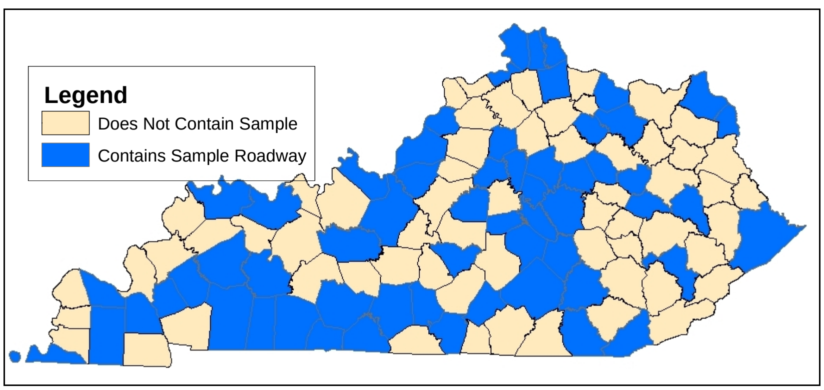
Over the past decade, a surge of growth across the nation in both the residential and commercial sector has been observed; however, it has been accompanied by what most feel is a less desirable increase in traffic volumes. The traffic generated by such developments often leads to increased congestion and decreased safety. The concept of access management was developed to address these issues. Access management balances the competing needs of mobility and accessibility on roadways, to reduce crashes, increase capacity and enhance economic benefits to surrounding areas.

Given these issues, a study was initiated in 2002 by the Kentucky Transportation Cabinet and the Kentucky Transportation Center to examine current practices in Kentucky and propose an access management plan. Based upon the findings of this report an Access Management Task Force was formed to develop guidelines and propose access management policies for Kentucky. As of December 2005, the Task Force has proposed a comprehensive statewide access management plan for Kentucky.

Access Management policies have been repeatedly shown in national research to 1) increase roadway capacity, eliminating or delaying the need for roadway widening and 2) improve safety by decreasing access related crashes. The benefits of access management as determined by national research as well as shown through Kentucky case studies in Louisville and Somerset are presented. However, the primary purpose of this study is to quantify both the safety and mobility benefits that could be realized by Kentucky if the proposed access management plan is implemented.

This study identified 20 miles of roadway for each of the eight access management roadway classifications. Figure A below shows the distribution of sample roadways by county. Data for these sample roadways was then collected which included Average Daily Traffic (ADT), number of driveways, number of traffic signals, number of lanes and three-year crash history. The "hypothetical" number of driveways and traffic signals was also determined using the standards established by the proposed access management plan. Using the "Access Impact Calculator" which was developed by the Transportation Research Board, travel delay and crashes were determined for the existing access conditions and the proposed access conditions for the sample roadways (1).

Figure A: Sample Roadway by County



The crash and delay reduction rates demonstrated on the sample sections were then applied to the statewide system, which produced the following results:

- A total statewide annual crash reduction of 10,750 crashes, from 67,200 crashes to 52,825 crashes per year; a reduction of over 20 percent.

- A reduction of delay on the surface street system of 46 Million hours per year with the largest delay savings on Urban Class I and II roadways.

Based on these figures a total cost savings of **$950 Million** per year is estimated. This includes $240 Million savings from a 21% reduction in surface street crashes, and a $700 Million savings from a 32 percent reduction in operational delay.

The estimated user cost savings indicate the general magnitude of benefits that would have been realized had an access management program been implemented before rapid urban development and growth took place. As such, it provides an evaluation of the potential savings that could be realized if an access management program is implemented today, compared to the continuation of past access permitting practices. Without the implementation of a statewide access management plan traffic signal and driveway access densities on Kentucky's roadways will continue to increase causing higher delays and increasing statewide crashes. The benefits identified above will be achieved by proactively managing future roadway access through a comprehensive statewide program and through efforts to improve current access spacing in conjunction with highway improvement projects.

1. Introduction

Over the past decade, a surge of growth across the nation in both the residential and commercial sector has been observed. This growth is particularly important for economic development and prosperity, however, it has been accompanied by what most feel is a less desirable increase in traffic volumes. The traffic generated by such developments often leads to increased congestion and decreased safety. Therefore, it is desirable to find solutions to increased congestion and delays as well to address methods to increase the safety and mobility of vehicular movement on roadways. The concept of access management was developed to address these issues.

Access management is a method of controlling roadway access, while serving as an important tool for improving the functionality of roadways. At the same time, it aims at balancing the mobility and accessibility of roadways, while maintaining safety. This concept has been proven effective in reducing crashes, increasing capacity and enhancing economic benefits to surrounding areas (1).

Given these issues, a study was initiated in 2002 by the Kentucky Transportation Cabinet and the Kentucky Transportation Center to examine current practices in Kentucky and propose an access management plan. The report "Access Management for Kentucky," provided pertinent background information for developing an access management system, including an examination of the practices of other states utilizing access management, the identification of different types of classification schemes, and a discussion of potential techniques that can be used (2). Based upon the findings of this report an Access Management Task Force was formed to develop guidelines and propose access management policies for Kentucky. As of December 2005, the Task Force had established eight roadway access classifications and had developed access type and spacing standards for each classification. In addition, variance processes and review standards have been established to provide a comprehensive statewide access management plan.

The first access management policy was established by New Jersey in 1902, which denied the construction of cross streets on "speedways" established for horses and light vehicles. The first "modern" access management policy was enacted by Colorado in 1979 to preserve the capacity of the state's highways (3). However, despite the long history of access management practices, there is still some opposition from the public and elected officials to enact a comprehensive access management plan. Concerns often arise from land owners believing that access management practices will harm property values or decrease accessibility to their business and that direct access to the arterial street system is a property right. Furthermore, citizens are sometimes concerned about the safety and travel time impacts associated with access management strategies due to measures such as the need to perform an indirect left turn (4).

The purpose of this report is to address many of these myths and to demonstrate the potential benefits of access management for Kentucky. In addition to a discussion of general benefits of access management, two Kentucky case studies are examined to document the impacts on safety, congestion and economic impact where aggressive access management strategies have been implemented. A benefits analysis was also conducted to quantify the safety and mobility improvements associated with the proposed access management plan for Kentucky.

2. Background

Access management is the careful planning of the location, design, and operation of driveways, median openings, interchanges, and street connections. The purpose of access management is to provide access to land development in a manner that preserves the safety and efficiency of the transportation system (5). Furthermore, access management (2):

- provides land access without degrading safety or traffic flow,
- utilizes the fundamentals of traffic engineering to determine the appropriate location and design of access,
- evaluates the consequences of new access points, and
- outlines appropriate guidelines or standards, in addition to addressing administrative issues.

Table 1: Effects of Common Access Mgmt Strategies

Treatment	Effect
1. Add continuous Two-Way Left Turn Lane (TWLTL)	- 35% reduction in total crashes - 30% decrease in delay - 30% increase in capacity
2. Add nontraversable median	- 35% reduction in total crashes - 30% decrease in delay - 30% increase in capacity
3. Replace TWLTL with a nontraversable median	- 15%-57% reduction in crashes on 4-lane roads - 25%-50% reduction in crashes on 6-lane roads
4. Add a left-turn bay	- 25%-50% reduction in crashes on 6-lane roads - up to 75% reduction in total crashes at unsignalized access - 25% increase in capacity
5. Type of left-turn improvement	
(a) painted	- 32% reduction in total crashes
(b) separator or raised divider	- 67% reduction in total crashes
6. Add right-turn bay	- 20% reduction in total crashes - limit right-turn interference with platooned flow, increased capacity
7. Increase driveway speed from 5 mph to 10 mph	- 50% reduction in delay per maneuver - Less exposure time to following vehicles
8. Visual cue at driveways, driveway illumination	- 42% reduction in crashes
9. Prohibition of on-street parking	- 30% increase in traffic flow - 20%-40% reduction in crashes
10. Long signal spacing with limited access	- 42% reduction in total vehicle-hours of travel - 59% reduction in delay - 57,500 gallons fuel saved per mile per year

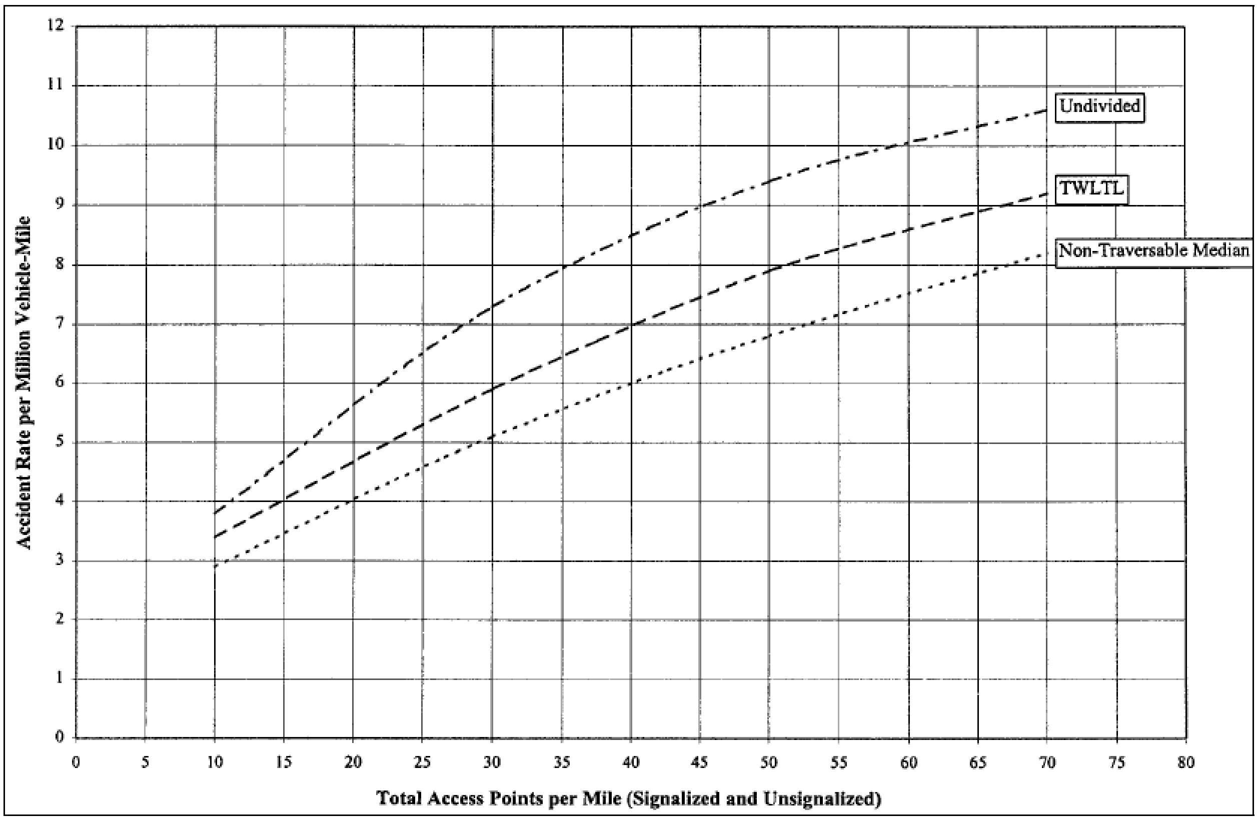
Typically access management plans place higher levels of access restrictions and control over location and design criteria for access connections to major freeways and arterials, while access control is less restrictive for lower roadway classes. In a broader context, access management is infrastructure protection, as it is a way to anticipate and prevent roadway safety problems and congestion, while still meeting the access needs of the surrounding land use (2).

Table 1 summarizes national research on the effects of common access management strategies (6). As can be seen, almost every measure has a positive impact on roadway safety as well as improvements in capacity and delay. The following sub-sections discuss these general effects as well as impacts on economic activity, which are often a concern of adjacent business owners.

2.1 Roadway Safety

Past research has demonstrated a relationship between crash rates and the number of access points along an arterial (7, 8, 9). **Figure 1** shows the estimated crash rate by access points for different urban and suburban roadways based on the median type. Based upon this figure, each access point (or driveway) is shown to increase the estimated crash rate by approximately 5 percent on undivided highways (1).

Figure 1: Estimated Crash Rate by Access Point Density (Ref. 1)



Previous research has shown that this increase in crashes is directly related to additional conflict points introduced by the access point. Conflict points are locations along a roadway where two vehicle's paths can legally cross. At a typical unsignalized driveway 11 conflict points exist (**Figure 2a**); as many as 36 conflict point can exist at a four-way intersection. Each conflict point is a location where a crash can occur.

Access management addresses these safety issues in two ways; 1) access management reduces the access density eliminating the potential for a conflict; and 2) access management introduces access point designs that limit the number of conflict points along a roadway by restricting certain movements and separating turning traffic with turn lanes and the introduction of medians and channelization. **National research**

indicates that crash reductions up to 50 percent can be expected with the implementation of an access management project (2).

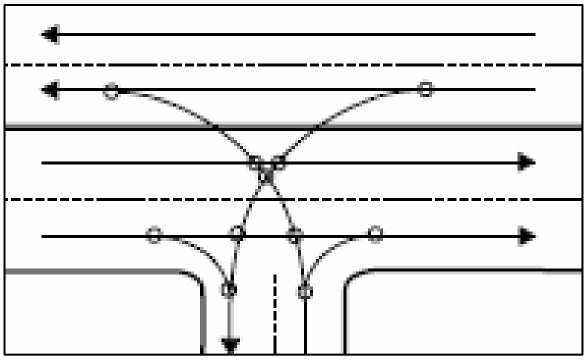


Figure 2a: Before Access Mgmt (11 conflict Points)

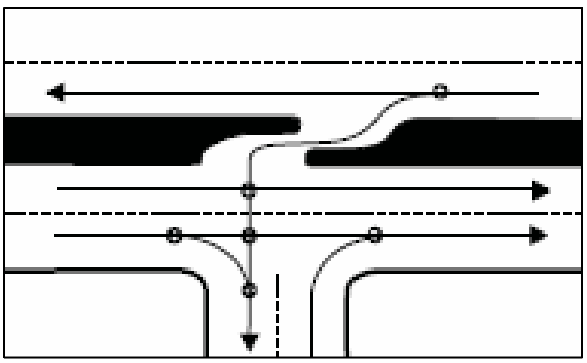


Figure 2b: After Access Mgmt (6 conflict Points)

The figure to the left shows the number of conflict points at a typical unsignalized three-leg intersection. As can be seen, the number of conflict points at this location is reduced by over 45 percent, from 11 to 6, with the implementation of access management strategies (5). Using similar strategies, conflict points at four-way intersections can be reduced from 32 to 8; a 75 percent reduction (6).

2.2 Traffic Operations

A large number of access points also can create operational problems and congestion. Since through traffic needs to slow down behind vehicles entering or exiting access points, overall traffic speeds are reduced, decreasing the capacity of the roadway (10, 11). Previous research indicates that the greater the frequency of access points, the larger the speed reduction to the through traffic will be. The operational benefits of improved access management are attributable to a reduction in delays at signalized intersections and a reduction in delays caused by vehicles turning into and from the

Table 2: Effect of Access Point Density on Travel Speed (Ref. 6)

Access Points per Mile	Reduction in Free-Flow Speed (mph)
0	0.0
10	2.5
20	5.0
30	7.5
40+	10.0

Table 3: Effect of Signal Density on Travel Time (Ref. 6)

Signals per Mile	Percent increase in Travel Time
2.0	0
3.0	9
4.0	16
5.0	23
6.0	29
7.0	34
8.0	39

traffic stream. It has been estimated that proper access control can increase capacity by 23 to 45 percent, delaying or eliminating the need to widen the roadway (12).

Tables 2 and 3 show the estimated impacts of high access density and high traffic signal density on a corridor (6). As can be seen from the tables, uncontrolled access points and a high density of traffic signals can have a detrimental impact on operations of a corridor. As an example, consider a 1 mile suburban roadway with a posted speed limit of 40 mph. Assume an average access density of 20 access points per mile and 5 traffic signals. Based upon the values from Tables 1 and 2, this corridor would be expected to have an average travel speed of approximately 28 mph. By implementing access management techniques, such as consolidating access points and moving traffic along frontage or backage roads, it would be possible to remove access points and traffic signals, achieving a travel speed closer to the 40 mph limit, decreasing the travel time by as much as 43 percent.

2.3 Economic Impacts

Studies of the economic impacts of access management on businesses have largely focused on medians and the potential impacts of left-turn restrictions on business activity (6). National research generally indicates that median projects have little overall adverse impact on business activity. Although some businesses report increases in sales and some report decreases, the majority of businesses report no change in business activity following an access management project. Destination type businesses, such as certain restaurants and specialty stores, appear less sensitive to access changes than businesses that rely primarily on pass-by traffic, such as gas stations or convenience stores. In addition, because the likelihood of left-turns into a business declines as opposing traffic volumes increase, medians or other access changes will have less effect on the frequency of left turns into businesses on high volume roadways or during peak travel periods. Studies conducted in Florida, Iowa, and Texas are summarized below.

A series of surveys were conducted by the Florida DOT to evaluate the success of access management projects. Business owners report that the actual impacts to their properties were much less than they anticipated. The overwhelming majority of motorists stated that they liked the changes and felt the roadway was safer because of the changes, and that the selection of businesses they frequented was not affected by the changes. Seventy-eight percent of the respondents reported that they “felt safer” and 84 percent “felt traffic moved better” (5).

A comprehensive study by the Iowa State University on the economic impacts of access management projects showed similar promising results. The survey conducted with this project showed that 80 percent of businesses along access management corridors reported sales at least as high after the project was in place. Comparison of these businesses to statewide performance showed that business failure rates along access managed corridors were at or below the statewide average for Iowa (13). A complementary study in the mid 1990’s by the Texas Transportation Institute showed that the vast majority of land values along access managed corridors stayed the same or increased after the completion of the project (14).

3. Kentucky Case Studies

While KYTC does not utilize a comprehensive access management plan, access management techniques have been implemented throughout the state on various projects in order to address specific safety or operational issues. This section examines the success of two of these projects. These locations are:

- US 27, Somerset
- Hurstbourne Lane (KY 1747), Louisville

3.1 US 27; Somerset, KY

The Somerset project along US 27 extends from Boat Dock Road (MP 11.374 and signal 29) to KY 80 Business (MP 16.782 and signal 4). The project is approximately 5.4 miles with 26 signalized intersections. At the time of the project average daily traffic along this corridor ranged from 22,000 to 36,000 vehicles per day with a weighted average daily traffic of 31,000. Actual vehicle usage is estimated to be higher, as reported ADTs reflect weekday conditions and are not representative of heavy tourism/recreational weekend traffic on this corridor accessing the Lake Cumberland area.

Before the project US 27 in this area was a four-lane road with a continuous two-way left-turn lane with a high density of full access points to adjacent businesses. The access management project widened the road to six lanes and removed the continuous turn lane, replacing it with a non-traversable depressed median. Left turning traffic was redirected to U-turn locations at each of the 26 signalized intersections on the corridor. U-turns at these intersections operate during the protected left-turn phase of the signal; the opposing three-lane section allows for a substantial turning radius to passenger and light truck traffic. This project was completed in 1998.

The crash history at this location was examined to determine the safety impact from the access management project. The data showed a 16 percent reduction in total annual crashes in the 5.4-mile section in five years after construction compared to two years prior to construction. Crash rates were also calculated for this location, which indicated an approximate 10 percent reduction in the crash rate after completion of the project. This reduction was attributed to a reduction in non-intersection (driveway/access point) crashes. During the five year period after the completion of the project there were only eight U-turn crashes. Six of the eight crashes involved another driver disregarding the red indication as a driver was making a U-turn on a green arrow (15).

Highway District personnel noted that prior to the project numerous business and property owners were concerned with the effect of the project on business and access. However, once the project was completed, complaints have been reported to be minimal.

A survey conducted by the Kentucky Transportation Center and the University of Kentucky College of Engineering also sought to develop an understanding of the public acceptance of the U-turn installation. The primary goal of this survey was to document potential economic and safety impacts on the properties along the corridor. Over 200 questionnaires were distributed to businesses along the corridor five years after project completion to determine long-term effects (15).

The questionnaire asked respondents to identify their type of business and provide comments regarding the U-turn installation and perceived problems or benefits as a result of the new design. A total of 200 questionnaires were mailed and 73 responses were received (36.5 percent response rate). A summary of the responses follows:

- 24 respondents (33 percent) thought the design had a negative impact on their business. All of these made a comment with the most common complaint related to a limit of access (14 comments). 16 respondents (23 percent) felt the design had a positive effect on their business while 42 percent felt the design had no effect on their business.

- 24 respondents (33 percent) thought they had noticed a problem with drivers understanding the design although most of the comments were more general in nature. The most common response stated that non-local drivers were confused (6 responses). Other comments were that the signals caused confusion and drivers disregarded the red signal (4 responses each).

- 18 respondents (25 percent) thought the design had a negative effect on safety. All these respondents provided a comment with the most common relating to running red lights (9 responses) and no emergency lanes (4 responses). 31 respondents (44 percent) felt the design had a positive effect on safety while 18 percent did not observe any effect on safety.

Based upon this data, it can be seen that after the project completion, the majority of users and business owners did not view the project negatively, with 65 percent reporting either a neutral or positive effect on business and 62 percent reporting a perceived positive or neutral effect on safety (15).

3.2 KY 1817 (Hurstbourne Lane); Louisville, KY

The Louisville project on Hurstbourne Lane extends from the I-64 westbound ramps (MP 11.918) north to the intersection with Linn Station Road/Timberwood Circle (MP 12.289). The project is 0.371 miles (approximately 2,000 feet) long with three signalized intersections. At the time of the project average daily traffic on Hurstbourne Lane was approximately 75,000 vpd.

Prior to the project 13 public and private access points were provided full access along this 7-lane section of the corridor. The access management project removed the previous two-way left-turn lane and replaced it with a 2,000 foot raised concrete median. Existing backage roads on both the east and west sides of the corridor were used to accommodate left-turn traffic into the adjacent businesses. Left-In, Right-In, Right-Out (LIRIRO) access points are also provided to both sides of the streets between the major signalized intersections. The LIRIRO at Caritas Way operates as a signalized intersection, which can provide perfect coordination within the coordinated signal system. The project was completed in 2000 for a total project cost of $700,000.

No formal before/after study was ever completed for this project; however, the following information was gathered from district and central office personnel.

- Crash data indicates that during the 6 months immediately following the project completion, monthly crash rates dropped to 4.4 crashes per month compared to 7.6 crashes per month previously.
- District personnel report that feedback from the traveling public is generally positive indicating that there have been significantly fewer conflicts within the corridor and that the mobility within this congested area has improved with the implementation of the access management measures.
- The majority of complaints surround the fact that the lengths for the turn lanes are not adequate to contain the long queues on the corridor, and turning traffic frequently backs up into the through lanes. It may be possible to extend the existing turn lanes by removing some concrete without complete removal of the barrier.

4. Access Impact Quantification

In addition to case study evidence supporting access management, it was deemed beneficial to quantify the benefits of Kentucky's access management plan recommendations. NCHRP Report 420 identifies methods to quantify safety and operational benefits based upon roadway ADT, access density and traffic signal density. This report identified the relationships between crash rate, travel speed and delay and access density, which were used to develop the Access Impact Calculator distributed by the Transportation Research Board (TRB). The underlying equations behind this tool were used in quantifying the benefits of the proposed access management plan for Kentucky (1).

Kentucky's proposed access management plan identifies eight access management classifications; four classes (I through IV) for urban roadways and four classes (I-IV) for rural roadways. Based upon the guidelines established by the proposed policy, each state-maintained roadway in Kentucky was assigned a preliminary access classification. **Table 4** summarizes the total mileage and average ADT of each of the access management classifications (2).

Table 4: Statewide Roadway Summary

Access Mgmt. Class	Total Mileage	Average ADT		Access Mgmt. Class.	Total Mileage	Average ADT
Urban I	898	20,150		Rural I	2,210	9,150
Urban II	681	9,322		Rural II	3,056	4,762
Urban III	415	3,885		Rural III	13,201	1,449
Urban IV	150	2,169		Rural IV	5,430	608

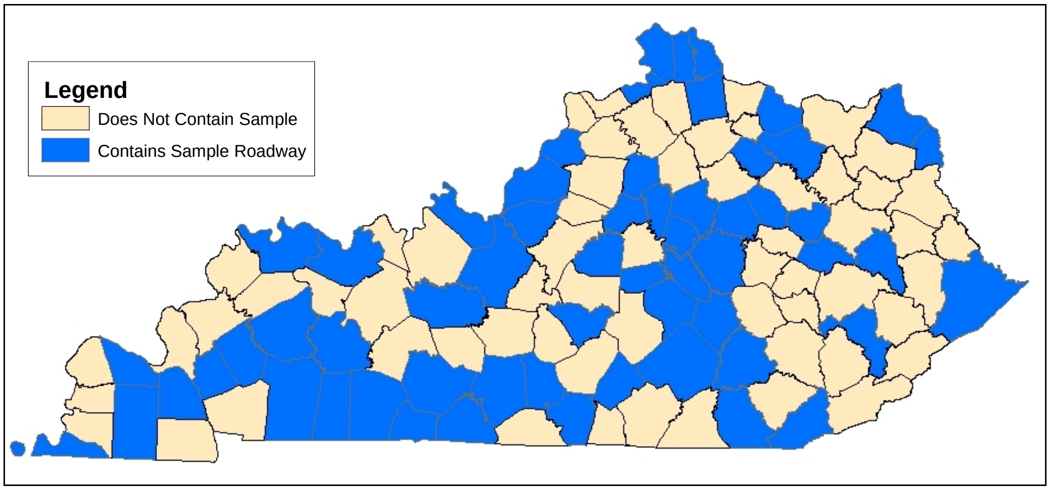
In order to quantify the benefits of the proposed plan it was necessary to document the existing access density for each access classification on Kentucky roadways to provide a baseline for comparison to the "managed" access condition. The absence of an access point database in conjunction with the large number of miles of state-maintained roadways required that access density be collected for only a sample of roadways within each access classification. A random sampling technique was used to select a minimum of 20 miles of roadways in each access classification. This sample selection of 160 miles of roadway provides a margin of error of +/- 10 percent with a 99 percent confidence interval.

Table 5 summarizes the roadway and traffic characteristics of the sample for each access classification and **Figure 3** summarizes the sample distribution throughout the state by county.

Table 5: Sample Roadway Summary

Access Mgmt Class.	Section Count	Total Length	Min. Length	Max. Length	Avg. ADT	Min. ADT	Max. ADT
Urban I	26	20.223	0.271	1.872	20,446	10,300	38,100
Urban II	28	20.156	0.280	1.976	8,495	1,870	23,200
Urban III	28	20.237	0.252	1.616	3,605	789	8,750
Urban IV	28	20.365	0.263	3.183	2,075	71	10,600
Rural I	14	22.443	0.295	3.826	11,620	2,740	32,700
Rural II	13	20.589	0.333	4.958	4,992	1,680	14,900
Rural III	10	21.032	0.494	4.407	1,122	379	4,060
Rural IV	13	21.422	0.418	3.439	469	12	1,630

Figure 3: Sample Roadway by County



Aerial photos were used to identify the number of access points and traffic signals on each of the sample roadways to determine access and signal densities for each roadway in the sample. This condition was evaluated as the "before" condition to identify existing levels of delay and safety.

Access and signal densities for the "after" condition for each roadway classification were determined from the proposed spacing standards that have been developed by the Kentucky Transportation Cabinet Access Management Implementation Task Force. These recommended spacings range from 2,400 ft. (Class I) to 1,200 ft. (Class IV) for signalized intersections and from 1,200 ft. to 150 ft. for unsignalized intersections and driveways. The proposed access density standards are shown in **Table 6**.

Table 6: Access Density Guidelines

Access Mgmt. Class.	Signal Density (Signals per mile)	Access Density (Access Points per Mile)		Access Mgmt. Class.	Signal Density (Signals per mile)	Access Density (Access Points per Mile)
Urban I	2.2	8.8		Rural I	2.2	4.4
Urban II	2.2	8.8		Rural II	2.2	8.8
Urban III	4.4	17.6		Rural III	2.9	11.7
Urban IV	4.4	35.2		Rural IV	4.4	35.2

On sample sections where access or signal density is currently at or below the proposed minimum standards, the existing condition was used to represent both the before and after conditions. These samples represent sections of roadway that would be unaffected by the access management standards, for the purposes of this analysis, since they already meet the requirements. **Table 7** summarizes the percentage of each access management classification that would be unaffected by the proposed standards based upon the sample data. Although it will be only briefly mentioned here, as a qualifying statement for this theoretical analysis, it should be understood that the access management standards are not intended to be applied retroactively. The standards will be applied to requests for new access and to changes in existing access. Legal access that exists at the effective date of the new access management policy would not be impacted unless a change in use occurs.

Table 7: Percentage of Corridors with Access and Signal Density that meet proposed standards

Access Mgmt. Class.	Percent Meeting Signal Density	Percent Meeting Access Density		Access Mgmt. Class.	Percent Meeting Signal Density	Percent Meeting Access Density
Urban I	61%	43%		Rural I	94%	30%
Urban II	66%	14%		Rural II	96%	25%
Urban III	100%	25%		Rural III	100%	55%
Urban IV	98%	100%		Rural IV	100%	100%

Table 8 summarizes the average before and after signal and access densities for each access classification for the sample.

Table 8: Sample Roadway Access and Signal density

Access Mgmt. Class	Traffic Signal Density		Access Point Density	
	Before	After	Before	After
Urban I	2.40	1.12	25.36	6.94
Urban II	3.46	0.96	40.05	8.60
Urban III	0.90	0.90	42.85	15.75
Urban IV	0.53	0.46	9.25	9.25
Rural I	1.05	0.77	21.18	3.96
Rural II	0.66	0.47	19.97	7.60
Rural III	0.15	0.15	13.84	7.79
Rural IV	0.05	0.05	2.01	2.01

4.1 Access Impact Quantification: Crash Reduction

A three year crash history was obtained for each sample roadway to represent the "before" crash conditions. Using the Access Impact Calculator procedures, estimated crashes were determined for each roadway in the sample for both the "before" and "after" conditions. The "after" crash condition was then determined by multiplying the before crashes by the ratio of the estimated after crashes and estimated before crashes. This methodology is consistent with procedures of NCHRP Report 420 and the Access Impact Calculator (1). **Table 9** summarizes the average predicted before and after crashes per mile for the roadway samples.

Table 9: Before and After Estimated Crashes per Mile by Access Classification

Access Mgmt. Class.	Average Crashes (Before)	Average Crashes (After)		Access Mgmt. Class.	Average Crashes (Before)	Average Crashes (After)
Urban I	41.1	27.6		Rural I	15.1	12.0
Urban II	11.3	7.0		Rural II	6.2	5.6
Urban III	3.4	2.7		Rural III	0.8	0.8
Urban IV	2.5	2.5		Rural IV	1.2	1.2

4.2 Access Impact Quantification: Travel Delay Reduction

Travel speed was estimated for all sample roadways based upon the existing signal densities using the access impact calculator procedures. The estimated travel speed was then converted to estimated delay in terms of vehicle-hours per day (veh-hr/day). **Table 10** summarizes the average travel speed and delay of the sample roadways by access classification. This estimate represents the "before" condition.

Table 10: Estimated Delay by Access Classification (Sample Roadways)

Access Mgmt. Class.	Speed (mph)	Delay (veh-hr/day)		Access Mgmt. Class.	Speed (mph)	Delay (veh-hr/day)
Urban I	35.1	505.1		Rural I	45.0	96.5
Urban II	32.4	1385.8		Rural II	48.3	32.2
Urban III	36.0	77.2		Rural III	49.2	10.1
Urban IV	38.5	13.3		Rural IV	54.4	0.4

(Note: Average travel speed presented in the above table is estimated based on access conditions only; it does not account for other factors that may control free flow operating speeds such as geometry, lane width etc., which may be the controlling factors on rural roadways).

These procedures were also used to estimate delay on the sample roadway sections assuming implementation of the proposed signalized access spacing guidelines. This value was used to estimate the "after" condition. **Table 11** summarizes the average before and after delay estimates by access classification for the roadway sample.

Table 11: Before and After Estimated Delay by Access Classification (veh-hrs/day)

Access Mgmt. Class.	Delay (Before)	Delay (After)		Access Mgmt. Class.	Delay (Before)	Delay (After)
Urban I	505.1	281.7		Rural I	96.5	88.6
Urban II	1385.8	1222.7		Rural II	32.2	26.8
Urban III	77.2	77.2		Rural III	10.1	10.1
Urban IV	13.3	13.3		Rural IV	0.4	0.4

4.3 Access Impact Quantification: Statewide Estimates

The reduction in crash rates estimated for the sample roadways were then applied to the statewide system to determine the crash reduction potential of the proposed access management plan. Applying the crash reductions by access classification to the entire state-maintained system yields a total statewide annual crash reduction of 10,750 crashes, from 67,200 crashes (before) to 52,825 crashes per year (after); a reduction of over 20 percent. **Table 12** summarizes the before and after crashes for the statewide system.

Table 12: Estimated Statewide Annual Crash Reductions

Access Mgmt. Class.	Total Annual Crashes (Before)	Estimated Annual Crashes (After)	Potential Crash Reduction
Urban I	22,526	15,876	30%
Urban II	8,402	5,421	35%
Urban III	2,014	1,463	27%
Urban IV	424	418	1%
Rural I	9,308	7,109	24%
Rural II	9,987	8,566	14%
Rural III	12,552	11,984	5%
Rural IV	1,987	1,987	0%
Total	**67,201**	**52,825**	**21%**

Delay savings were also determined for the statewide system. Applying the sample delay savings to the statewide system, it is estimated that implementation of the proposed access management guidelines could reduce delay on the surface street system from over 146M hours per year to 100M hours per year a reduction of over 32 percent. The largest delay savings would occur on Urban Class I and II roadways where a reduction of 35 to 50 percent of delay could be expected. **Table 13** shows the estimated annual before and after delay by access management classification.

Table 13: Estimated Statewide Annual Delay Reductions

Access Mgmt. Class.	Total Annual Delay (Before) (hrs)	Total Annual Delay (After) (hrs)	Potential Reduction
Urban I	63,722,958	41,771,581	34%
Urban II	34,746,601	17,841,654	49%
Urban III	2,753,243	2,753,243	0%
Urban IV	324,751	305,002	6%
Rural I	28,794,488	23,857,986	17%
Rural II	11,405,364	9,172,914	20%
Rural III	4,144,828	4,144,828	0%
Rural IV	190,896	190,896	0%
Total	**146,083,129**	**100,038,103**	**32%**

Based upon the estimated reductions in crashes and travel time delay, annual user cost savings were estimated for the proposed access management program. For the purposes of this analysis, an average weighted cost per crash of $16,962 was used based on Kentucky PDO, injury and fatal crash frequency and associated costs. For user delay a cost of $14.50/veh-hr and $25.89/veh-hr was used for passenger car and heavy vehicle traffic, respectively. A weighted average cost per vehicle-hour of delay was estimated at $15.39 per veh-hr assuming 10 percent heavy vehicles.

Using these user costs and the estimated crash and delay reductions above, a cost savings was calculated. Based on these figures a total cost savings of **$950 Million** per year is estimated. This includes $240 Million savings from a 21% reduction in surface street crashes, and a $700 Million savings from a 32 percent reduction in operational delay.

The estimated user cost savings indicate the general magnitude of benefits that would have been realized had an access management program been implemented before rapid urban development and growth took place. As such, it provides a measure of the potential savings that could be realized if an access management program is implemented today, compared to the continuation of past access permitting practices. Without the implementation of a statewide access management plan traffic signal and driveway access densities on Kentucky's roadways will continue to increase causing higher delays and increasing statewide crashes. The benefits identified above will be achieved by proactively managing future roadway access through a comprehensive statewide program and through efforts to improve current access spacing in conjunction with highway improvement projects.

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