Brent Spence Bridge

Replacement/Rehabilitation Project

U.S. Department of Transportation
Federal Highway Administration

Access Point Request Document

ODOT PID No. 75119
HAM-71/75-0.00/0.22
KYTC Project Item No. 6-17

August 2011

Prepared by:
PARSONS BRINCKERHOFF

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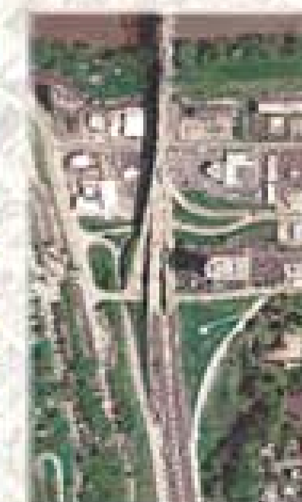

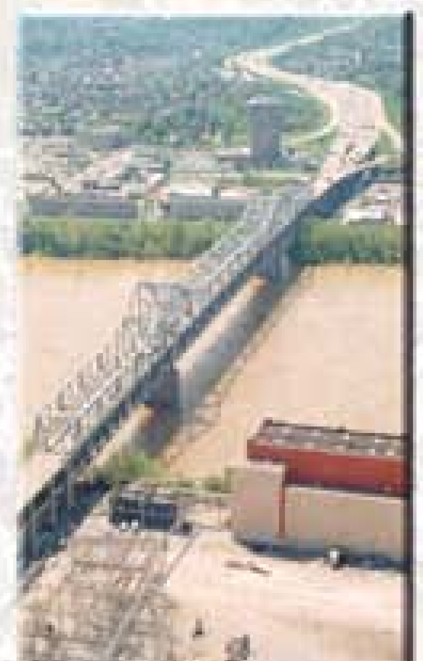

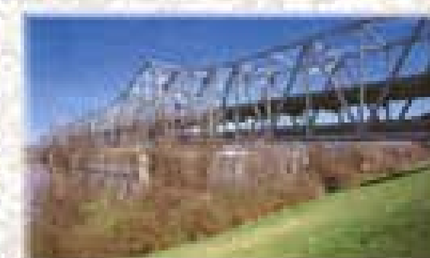

The traffic engineering data, analysis, findings, and recommendations contained herein and originally produced by PB Americas, Inc. have been prepared in accordance with acceptable engineering practice and set standards and represent anticipated future conditions to the best of our knowledge and belief.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF EXHIBITS

LIST OF APPENDICES

Additional Study Documents at www.brentspencebridgecorridor.com.

Executive Summary

An Access Point Request Document is a report required by the Federal Highway Administration (FHWA) for the approval of proposed new or revised access point modifications to the Interstate System. This Access Point Request Document will assist the Kentucky Transportation Cabinet (KYTC), the Ohio Department of Transportation (ODOT), and FHWA in assessing the impacts to safety and mobility resulting from new interchange locations and major changes to existing interchanges. This document provides the justification and documentation necessary to substantiate that the proposed changes in access to the Interstate System will not degrade its operation or safety when compared to the existing Interstate System.

The policy for *Interstate System Access Information Guide* (August 2010) contains eight policy statements which must be addressed in the Access Point Request Document. All eight policy requirements have been addressed in this Access Point Request Document, but are not in the consecutive order as listed in the Information Guide. Please refer to the index for any specific requirement.

Background

The Brent Spence Replacement/Rehabilitation Project was initiated from a proposal by KYTC and ODOT in cooperation with FHWA to improve the operational characteristics of I-71, I-75, and the Brent Spence Bridge in the Greater Cincinnati/Northern Kentucky region. This project is being undertaken to improve the operational characteristics through the corridor for both local and through traffic by adding capacity, improving safety, and correcting geometric deficiencies, while maintaining connections to key regional and national transportation corridors.

The I-71/I-75 corridor in the Greater Cincinnati/Northern Kentucky region suffers from congestion and safety-related issues as a result of inadequate capacity to accommodate current traffic demand and geometric design deficiencies. The I-75 corridor is a major north-south transportation corridor through the Midwestern United States and one of the region's busiest trucking routes. Traffic volumes have increased far beyond what was originally envisioned when the corridor was constructed in the 1950s, and traffic volumes are anticipated to continue to increase. This increase in traffic volume has caused the I-75 corridor to be characterized as having poor levels of service which threaten the overall efficiency of moving people and goods throughout the region. A key link in the I-71/I-75 corridor is the Brent Spence Bridge.

Through the planning process, conceptual alternatives, which are described in detail in the *Conceptual Alternatives Study Report* (April 2009), were studied and narrowed down to two feasible alternatives. The two feasible alternatives were further studied in additional detail, which resulted in a recommended preferred alternative. The recommended preferred alternative is Alternative I as identified in the *Preferred Alternative Verification Report* (May 2011) along with the Tight Urban Diamond Interchange at Western Hills Viaduct. Based on the geometrics of the recommended preferred alternative and the projected traffic volumes for the design year (2035), capacity calculations were made for all freeway segments, entrance and exit ramp terminals, weaving sections, and the intersections that were part of the interchange crossroads within the study area. Similar capacity calculations were conducted for the existing freeway system using projected traffic volumes for the design year to develop baseline data for the No Build Alternative. Capacity analyses were conducted for the intersections and interchanges adjacent to the intersections and interchanges included within the recommended preferred alternative where revisions would be made to the existing conditions. Capacity calculations at these adjacent locations were also made for the No Build Alternative.

There are three projects which extend end-to-end from the Ohio River to I-275 are the Brent Spence Replacement/Rehabilitation Project, the Mill Creek Expressway, and Thru-the-Valley, all of which are being implemented to relieve congestion and improve traffic flow through the I-75 corridor. Ramp metering was used throughout the Mill Creek Expressway and Thru-the-Valley projects, and will also be implemented on the Western Hills Viaduct Interchange (northernmost interchange within the Brent Spence Replacement/ Rehabilitation Project.

Traffic demand to use I-75 is substantially higher than the carrying capacity of the lanes on I-75. Therefore, the metering rate was set to the maximum number possible. If one more vehicle would enter I-75 the freeway would be over capacity (Level of Service F).

Traffic Analyses

An Access Point Request Document must show that the recommended preferred alternative, at a minimum, will not degrade the Interstate System's operations below the level of service (LOS) which would have existed in the design year for the No Build Alternative. The design guidelines for both Kentucky and Ohio recommend that a new or reconstructed roadway operate at LOS D or higher. The level of service goal for the Ohio, Kentucky, Indiana Regional Council of Governments (OKI) Metropolitan Planning Organization is LOS D. A level of service below LOS D is acceptable for the recommended preferred alternative provided the level of service is not degraded from what it is in the No Build Alternative. To provide a level of service comparison, the capacity calculations for the recommended preferred alternative were compared to those for the No Build Alternative in the project's design year 2035.

Based on the comparison of capacity analyses, nearly every location's level of service will be improved in the recommended preferred alternative over that of the No Build Alternative. Where the level of service was degraded, attempts were made to improve the level of service, but improvements were not possible due to either geometric constraints or the context under which the improvements would be made.

At the point where the project's roadway is expanded from the existing three lanes at the southern limits of the project to the full complement of six lanes around Kyles Lane in Kentucky, all of the freeway segments of the recommended preferred alternative will operate at LOS D or better except for two freeway segments in Kentucky as well as five freeway segments and one collector distributor (C-D) roadway segment in Ohio. These eight freeway segments/locations will operate at LOS E. While the level of service for these freeway segments will be below the desired threshold of LOS D, these locations could not be improved to LOS D without enormous cost due to problems maintaining lane balance and lane continuity within the overall design.

The recommended preferred alternative and the No Build Alternative have geometric differences in their design which makes it difficult to directly compare the level of service at all locations between the two alternatives. However, for all of the locations where the full complement of lanes have been added, the recommended preferred alternative will achieve a level of service that is either equal to or improved over that of the No Build Alternative.

In Kentucky, the southbound off-ramp terminal to Kyles Lane will operate at LOS E under the recommended preferred alternative, which is the same level of service that would exist in the No Build Alternative. In Ohio, the collector-distributor (C-D) roadway ramp to I-71 northbound will operate at LOS F; however this ramp does not exist in the No Build Alternative. Its comparable movement in the No Build Alternative would be the Pike Street entrance ramp in Kentucky which would also operate at LOS F. Due to constrained traffic volumes, the C-D roadway ramp to I-71 northbound will operate at LOS D. Neither

Kentucky nor Ohio has any intersections which will operate below LOS D in the recommended preferred alternative.

In summary, for both the states of Kentucky and Ohio, the existing freeway system within the project limits is overcapacity and is the primary cause of congestion on the freeways. Roadways that are overcapacity and congested typically have a higher than normal rate of rear-end and angle accidents. The proposed project adds additional freeway lanes, as well as C-D roadways and service roads to gather, distribute, and relocate traffic that would otherwise be forced to exclusively use the high speed mainline freeway lanes. The additional types of roadways coupled with the additional freeway lanes should eliminate congestion and minimize accidents. Where congestion existed on the existing freeway system, it was caused by the lack of freeway lanes; not by the lack of capacity within the local street network to receive existing traffic from the freeway. With the addition of C-D lanes and additional freeway lanes, the freeway system will be vastly improved over the No Build Alternative in the design year and the local street network will still be able to receive all exiting traffic from the freeway without being overcapacity.

Level of Service at Project Limits
Projects which add capacity to the Interstate System almost always have a low level of service at the project limits where the expanded number of lanes within the project corridor are reduced to tie back into the existing number of lanes beyond the project's limits. I-71/I-75 operates at LOS F south of the Dixie Highway Interchange in the northbound direction for both the recommended preferred alternative and the No Build Alternative. In the southbound direction, I-71/I-75 operates at LOS F between the Kyles Lane and Dixie Highway interchanges in the recommended preferred alternative. For this same freeway segment, the No Build Alternative operates at LOS E. The No Build Alternative operates at a better level of service at this location because less traffic is able to reach this location due to constrained traffic conditions in the northern freeway segments. At the project's northern limits, north of the Western Hills Viaduct Interchange, the level of service for the recommended preferred alternative will be improved over the No Build Alternative.

A degradation of the level of service will occur on I-71 northbound at the eastern limits of the project where US 50 splits from I-71 northbound on FWW through downtown Cincinnati. While both the recommended preferred alternative and the No Build Alternative will have a LOS F at this location in the design year, approximately 12 percent more vehicles will reach this location with the recommended preferred alternative, making this a substantially reduced LOS F. At some time in the design life of the project, congestion at this location could potentially cause long queues to develop which could obstruct the mainline of I-71 northbound as well as the northbound C-D roadway system, which provides access to and from the cities of Covington. Possible solutions to reduce congestion at this location have been identified, but would require substantial additional cost and are beyond the scope of this project. ODOT and the FHWA (Ohio) are concerned with increases in the cost of the Brent Spence Bridge Replacement/Rehabilitation Project and have been cautioned about "scope creep." A potential solution could involve the modification to the Lytle Tunnel at the eastern end of the FWW. The Lytle Tunnel has a city park and buildings on top of it which would likely be impacted, and this solution would also likely require the removal of an existing entrance ramp from OH 2nd Street to I-71 northbound. Such a solution could potentially violate the terms of the Major Investment Study (MIS) that was conducted for I-71, *I-71 Corridor Transportation Study* (1998).

The *I-71 Corridor Transportation Study* (1998) requires that additional capacity within the I-71 corridor would be created by a light rail system rather than by adding lanes to I-71. Therefore, no additional through lanes could be added to the I-71 corridor within the MIS's project limits, which includes the FWW and I-71 continuing further north.

Due to these reasons, ODOT and FHWA (Ohio) at a joint meeting on August 12th, 2010 recommended that the degradation in the level of service which is anticipated to occur on I-71 northbound where US 50 splits from I-71 northbound on FWW will not be addressed as part of the Brent Spence Bridge Replacement/Rehabilitation Project. Both ODOT and FHWA (Ohio) agreed to maintain the existing conditions at this location and will determine at a later date if a separate project will need to be proposed to address the congestion in this area.

Safety
An Access Point Request Document must demonstrate that safety will not be degraded when compared to the existing conditions on the Interstate System. Safety discussions generally revolve around two types of safety: (1) nominal safety and (2) substantive safety. Highway engineers are used to thinking about safety in terms of adherence to design criteria such as those published in the AASHTO "Green Book" or their State Design Manual. This is referred to as nominal safety. A road is considered nominally safe if it meets the minimum standard of care and is current with respect to published standards and guidelines. The performance of a highway as determined by crash frequency and severity is referred to as substantive or quantitative safety. Substantive safety is the actual or expected performance of a highway in terms of its crash rate and the resulting severities. Substantive safety is a function not only of the basic characteristics of the road, but also a function of maintenance, law enforcement, and other resources devoted to its operations.

Until recently, there was no recognized document or procedure for calculating substantive safety. However, with the release of the AASHTO Highway Safety Manual (2010), expected future crashes and their severities on existing or proposed roadways can now be calculated for two-lane roadways, rural multi-lane highways, and urban and suburban arterials. Research is currently underway to develop a methodology and procedures for predicting future crashes on freeways and their interchanges. This is expected to be included in the 2nd Edition of the Highway Safety Manual. As a result, it is not possible at this time to predict and quantify future crashes for the existing or proposed freeway sections and their interchanges. Lacking the ability to predict future substantive safety for the freeway sections, safety is addressed in terms of past accidents and nominal safety for the existing and proposed freeway sections.

The safety analysis of the recommended preferred alternative was accomplished by studying the number and type of design exceptions required. While there are a number of requested design exceptions, all of the design exceptions, except two, provide design speeds equal to or higher than the existing conditions. The two exceptions have design speeds within three miles per hour of the existing conditions and both exceptions involve insufficient horizontal stopping sight distance due to shoulder widths which would need to be widened to be eliminated. Most of the design exceptions will provide an increased speed when compared to the existing conditions.

The overall design of the recommended preferred alternative will eliminate a substantial number of conflict points compared to the No Build Alternative. Because there is not a freeway section in the Highway Safety Manual that provides a methodology for addressing safety on a freeway, conflict points serve as a surrogate for safety with the lesser number of conflict points being considered to provide safer conditions. Overall, conflict points have been reduced with the recommended preferred alternative. Weaves, which are one of the worst types of conflicts in terms of safety, have been substantially reduced with the design of the recommended preferred alternative with no weaves in Kentucky and only three weaves in Ohio. The weaves in Ohio meet the guidelines for recommended level of service. There is also a direct relationship between congestion and crashes. As congestion increases; crashes increase. The recommended preferred alternative also meets the recommended guidelines in the AASHTO “Green Book” and in Ohio’s Location and Design Manual for level of service. For freeway segment, freeway entrance and exit terminals and intersections, the recommended preferred alternative provides a higher level of service for the design year than the resultant level of service that would have existed with the No Build Alternative, meaning less congestion which should result in fewer crashes.

1.0 Introduction

1.1 Project Background

Interstate 75 (I-75) within the Greater Cincinnati/Northern Kentucky region is a major thoroughfare for local and regional mobility. Locally it connects to I-71, I-74, and US Route 50. The Brent Spence Bridge provides an interstate connection over the Ohio River and carries both I-71 and I-75 traffic (Exhibit 1). The bridge also facilitates local travel by providing access to downtown Covington, Kentucky and Cincinnati, Ohio. Safety, congestion, and geometric problems exist on the structure and its approaches. The Brent Spence Bridge, which opened to traffic in 1963, was designed to carry 80,000 vehicles per day. Currently, approximately 160,000 vehicles per day use the Brent Spence Bridge and traffic volumes are projected to increase to approximately 200,000 vehicles per day in 2035.

The I-75 corridor within the Greater Cincinnati/Northern Kentucky region is experiencing problems which threaten the overall efficiency and flexibility of this vital trade corridor. Areas of concern include, but are not limited to, growing traffic demand and congestion, land use pressures, environmental concerns, adequate safety margins, and maintaining linkage with key mobility, trade, and national defense highways.

The I-75 corridor has been the subject of numerous planning and engineering studies over the years and is a strategic link in the region's and the nation's highway network. As such, the Kentucky Transportation Cabinet (KYTC) and the Ohio Department of Transportation (ODOT), in cooperation with the Federal Highway Administration (FHWA), are proposing to improve the operational characteristics of I-75 and the Brent Spence Bridge in the Greater Cincinnati/Northern Kentucky region through a major transportation project.

1.2 Project History

1.2.1 Federal Project Designations

The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) identified High Priority Corridors on the National Highway System (NHS). This listing of high priority corridors included the Ohio sections of both I-75 and I-71 (Table 1-1).

Table 1-1. Interstates 75 and 71 as Listed Under Section 1105(c) ISTEA (P.L. 102-240), as amended through P.L. 109-59

Item Number	Corridor	Location
76	Interstate Route 75	Ohio
78	Interstate Route 71	Ohio

Source: FHWA, 2005

More recent federal surface transportation legislation (the 1998 Transportation Equity Act for the 21st Century [TEA] and the 2005 Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users [SAFETEA-LU), continued to identify projects along these high priority corridors to be eligible for federal funding. Table 1-2 identifies six of the high priority projects listed under SAFETEA-LU that are in the vicinity of the Brent Spence Bridge Replacement/Rehabilitation Project.

Table 1-2. High Priority Projects Listed Under SAFETEA-LU Located in or near the Brent Spence Bridge Replacement/Rehabilitation Project

Item Number	State	Project Description	Amount
685	OH	Study and design of modifications to I-75 interchanges at Martin Luther King, Jr. Boulevard, Hopple Street, I-74, and Mitchell Avenue in Cincinnati	$2.4 million
3385	KY	Replace Brent Spence Bridge, Kenton County	$1.6 million
4217	KY	Transportation improvements to Brent Spence Bridge	$34 million
4621	OH	On I-75 toward Brent Spence Bridge, Cincinnati	$10 million
4623	OH	Reconstruction, widening, and interchange upgrades to I-75 between Cincinnati and Dayton	$5 million
4624	OH	Replace the Edward N. Waldvogel Viaduct, Cincinnati, (US Route 50)	$6 million

1.2.2 Kentucky Project Designations

In 1999, KYTC completed its current long-range multimodal transportation plan (Kentucky Transportation Cabinet, Statewide Transportation Plan FY 1999–2018, December 1999). The transportation plan is a 20-year plan for all modes of transportation. The plan consists of two phases – the short range element, which is the Six-Year Transportation Plan, and the long-range element, which is a 14-year plan beyond the six year plan. The long-range element is the principal source for new projects added to the Six-Year Transportation Plan. The statewide plan was updated in 2006 in the 2006 Kentucky Long-Range Statewide Transportation Plan. The 2006 plan is a 25-year multimodal plan for the Commonwealth of Kentucky. The current plan is a policy-only plan that identifies a vision and set of goals.

KYTC initiated an engineering feasibility study to investigate replacement options for the Brent Spence Bridge in 2003. The results of this study are documented in the *Feasibility and Constructability Study of the Replacement/Rehabilitation of the Brent Spence Bridge* (May 2005). The study area for this analysis began south of Kyles Lane in Kentucky and extended to the Western Hills Viaduct in Ohio. Concurrently, ODOT evaluated a number of alternatives for improving segments of I-75 in Ohio, from the area north of the Western Hills Viaduct, to a point north of I-275.

Kentucky's *Recommended Six-Year Transportation Plan FY 2007-2012* lists six "Mega-Projects" that are expected to cost in excess of $1 billion. The I-71/I-75 Brent Spence Bridge Replacement/Rehabilitation Project is one of the six "Mega-Projects". The plan notes that the I-71/I-75 Brent Spence Bridge "is the focal point for some of the heaviest traffic volumes in Kentucky", which not only provides a link between two major urban centers (Covington, Kentucky and Cincinnati, Ohio) but also connects the region to one of the nation's busiest airports, the Cincinnati/Northern Kentucky International Airport located in Boone County, Kentucky.

1.2.3 Ohio Project Designations

ODOT completed a statewide transportation study and strategic plan, *Access Ohio* in 1993. This plan was updated in 2004. *Access Ohio* identified "Transportation Efficiency and Economic Advancement Corridors" also known as "macro corridors" throughout the State of Ohio. These corridors are defined as "highways with statewide significance that provide connectivity to population and employment centers in Ohio and the nation by accommodating desired movements of persons and goods". The I-75 corridor is included in the list of macro corridors.

In 2000, the Ohio-Kentucky-Indiana Regional Council of Governments (OKI) and the Miami Valley Regional Planning Commission (MVRPC) formed a partnership with ODOT and KYTC to undertake a large scale analysis of the I-75 corridor. The limits of this analysis stretched from the I-71/I-75 Interchange in northern Kentucky to Piqua, Ohio. Known as the *North-South Transportation Initiative* (February 2004), this traditional Major Investment Study (MIS) was conducted as part of the merged National Environmental Policy Act (NEPA) process. One goal of this study was to identify strategies to ensure that the I-75 corridor remains effective and efficient at moving people and goods through the region. The study addressed major improvements to all existing modes of transportation and identified appropriate transportation alternatives that need to be incorporated into the regional transportation plans. A preferred program of projects was defined based upon a thorough assessment of transportation needs and a consensus of the region's ambitions for the future.

The *North-South Transportation Initiative* recommended a number of capacity and safety improvements for the I-71 and I-75 corridor in Kentucky and I-75 in Ohio. A number of major replacements and rehabilitations were recommended for advancement into the NEPA process. One key recommendation was the Brent Spence Bridge Replacement/Rehabilitation Project (PID 75119) in order to provide for improved capacity, access, and safety in this portion of the corridor.

Two projects north of the Brent Spence Bridge were also recommended by the *North-South Transportation Initiative.* These recommendations resulted in ODOT's Thru-the-Valley project (PID 76256) and the Mill Creek Expressway (PID 76257). Both of these projects have incorporated ramp metering to maintain level of service. These two ODOT projects are being conducted as part of an overall program to improve I-75. The primary goals of this program are preserving right of way and assuring that improvements made to the corridor are coordinated and build on each other to ensure improved capacity over the long term.

1.2.4 Metropolitan Planning Organization Project Designations

The Ohio Kentucky Indiana Regional Council of Governments (OKI) is the region's MPO and is responsible for planning and programming the region's transportation improvements. The Brent Spence Replacement/Rehabilitation Project is included in OKI's 2030 Regional Transportation Plan which serves as the region's federally mandated Long Range Transportation Plan update. It is also included in the FY 2008 to FY 2011 Transportation Improvement Program (TIP). This plan lists both fiscally constrained projects and those needed but not funded taking into account currently expected funding levels. Funding for the Brent Spence Bridge Replacement/Rehabilitation Project is included in the plan's fiscally-constrained list. Inclusion of the project in OKI's TIP indicates the project's eligibility for federal funding and that it is incorporated into the Statewide Transportation Improvement Programs (STIP) in both Kentucky and Ohio.

Due to the bi-state nature of the project, funding is divided between the two states in the TIP. The Ohio portion of the TIP includes a total of $38.83 million in Preliminary Engineering funds for Ohio bridge approaches; $13.83 million in FY2008 and $25.0 million in FY2010. The Kentucky portion of the TIP includes three separate project line items totaling $35.0 million. There is $10 million for design activities in fiscal years previous to 2008 and $25.0 million for right of way and utility coordination activities in FY2009. A total of $2.92 billion is listed as a funded line item for Kenton County, Kentucky. This line item is intended to cover construction costs for the entire project.

The OKI 2030 Regional Transportation Plan also indicates the results of its initial air quality analysis. The Brent Spence Bridge Replacement/Rehabilitation Project is included in the 2020 conformity analysis. In addition, several highway segments within the project study limits are identified in the OKI Congestion Management Process (CMP). The CMP assessed the region's transportation system performance through the collection of traffic data and an evaluation of congestion. The CMP also projected future travel conditions and developed a matrix of strategies to address future congestion levels.

Specific congestion "hot spot" segments in the project limits that were identified in the CMP are:

- I-71/I-75 in Northern Kentucky from Dixie Highway to Kyles Lane
- I-71/I-75 in Northern Kentucky from Kyles Lane to KY 12th Street in Covington
- I-71/I-75 in Northern Kentucky from KY 12th Street to KY 5th Street in Covington

The CMP identified other "hot spot" highway segments in both states, but these three specific segments were among the most congested in the region.

Planning for regional light rail was developed as part of OKI's *North-South Transportation Initiative* (February 2004). The planned regional light rail line would follow the I-75 corridor and provide service to Cincinnati and northern Kentucky. It is anticipated that light rail would use the Clay Wade Bailey Bridge corridor to cross the Ohio River and not the Brent Spence Bridge, however each of the feasible alternatives has been designed to not preclude light rail in the future as identified in the rail plan.

1.3 Purpose of Report

An Access Point Request Document is a report required by FHWA for the approval of proposed new or revised access point modifications to the Interstate System. This Access Point Request Document will assist KYTC, ODOT, and FHWA in assessing the impacts to safety and mobility resulting from new interchange locations and major changes to existing interchanges. This document provides the justification and documentation necessary to substantiate that the proposed changes in access to the Interstate System will not degrade its operation or safety when compared to the existing Interstate System.

2.0 Purpose and Need

The purpose and need statement for the Brent Spence Bridge Replacement/Rehabilitation Project was completed in May 2006. The purpose and need was updated during Step 5 of the Ohio Department of Transportation's (ODOT's) Project Development Process (PDP) and reported in the Purpose and Need section of the *Conceptual Alternatives Study Report* (April 2009).

The Brent Spence Bridge Replacement/Rehabilitation Project will improve the operational characteristics within the I-71/I-75 corridor for both local and through traffic. In the Greater Cincinnati/Northern Kentucky region, the I-71/I-75 corridor suffers from congestion and safety–related issues as a result of inadequate capacity to accommodate current traffic demand. The purpose of this project is to:

- Improve traffic flow and level of service,
- Improve safety,
- Correct geometric deficiencies, and
- Maintain connections to key regional and national transportation corridors.

Specific problems of I-71 and I-75 within the study area include, but are not limited to, growing demand, congestion, and design deficiencies.

3.0 Study Area

The overall project corridor (Exhibit 2) is located along a 7.8-mile segment of I-75 within the Commonwealth of Kentucky (state line mile 186.7) and the State of Ohio (state line mile 2.7). The southern limit of the project is 5,000 feet south of the midpoint of the Dixie Highway Interchange on I-71/I-75 in Fort Wright, south of Covington, Kentucky. The northern limit of the project is 1,500 feet north of the midpoint of the Western Hills Viaduct Interchange on I-75 in Cincinnati, Ohio.

The eastern and western limits of the study area generally follow the existing alignment of I-75. From the south, the study area is a 1,500-foot wide corridor centered on I-75 northward towards the city of Covington. At Covington, the eastern and western study area boundaries widen and follow city streets as described below:

- Western project limits (from south to north):
  - At KY 5th Street in the city of Covington, the western boundary extends in the northwesterly direction across the Ohio River to US 50, approximately 1,000 feet west of the Freeman Avenue Interchange.
  - The western limit extends northerly parallel to Dalton Avenue to Hopkins Street.
  - The western limit extends westerly along Hopkins Street to the western limits of Union Terminal, where it then extends northerly along the western limits of Union Terminal to Kenner Street.
  - The western limit follows easterly along Kenner Street to the intersection with Dalton Avenue.
  - The western limit parallels Dalton Avenue to north of Findlay Street, where it follows in the northerly direction with a consistent 750-foot offset from the I-75 centerline.
- Eastern project limits (from south to north):
  - In the city of Covington, the eastern boundary follows Philadelphia Street to its intersection with KY 5th Street.
  - The eastern boundary follows KY 5th Street to its intersection with Main Street and then follows Main Street to the Ohio River.
  - The eastern boundary parallels the Clay Wade Bailey Bridge across the Ohio River to Pete Rose Way in the city of Cincinnati.
  - Through downtown Cincinnati, the eastern boundary follows OH 2nd Street and US 50 eastbound to approximately the I-71/US 50 Interchange over Broadway Avenue, north on Broadway Avenue then westerly along OH 4th Street to Plum Street, then northward until it reaches West Court Street.
  - From West Court Street, the eastern boundary extends west to Linn Street, where it follows Linn Street to Central Parkway.
  - The eastern boundary extends north paralleling Central Parkway to Linn Street.
  - From Linn Street, the eastern boundary extends westerly to Bank Street.
  - From Bank Street, the eastern limits extend in the northerly direction with a consistent 750-foot offset from the I-75 centerline.

4.0 Existing Conditions

Several of the existing design features of the I-71/I-75 corridor located in the Greater Cincinnati/Northern Kentucky area do not meet currently acceptable design criteria for interstate highways as defined by the American Association of State Highway and Transportation Officials (AASHTO), KYTC, and ODOT. This can be attributed to the age of the facilities, which were early interstate construction projects completed in the 1950s. Since that time, design standards for interstate highways have changed. As a result, the design of the I-71 and I-75 facilities at many locations within the study area do not meet current design standards for numerous features including lane widths, shoulder widths, horizontal and vertical clearances, left hand entrances and exits, and horizontal and vertical geometry. The operational design of the Brent Spence Bridge, with its reduced travel lane and shoulder widths, is the most frequently noted substandard feature. The Brent Spence Bridge was opened in 1963, as a double-deck truss structure designed to carry three 12-foot travel lanes in both directions over the Ohio River. In 1985, increased traffic volumes resulted in the need for the bridge to accommodate an additional travel lane in each direction to add capacity. To accomplish this, the original safety curb on the bridge was retrofitted to New Jersey Barrier style barrier and the existing travel lanes were reduced in width to accommodate four 11-foot lanes with one-foot shoulders.

In addition to the design deficiencies on the bridge, the approaches on either side are also characterized by design deficiencies, such as narrow travel lanes and reduced shoulder widths. The substandard lane widths and lack of shoulders result in unacceptable operational deficiencies and create potential safety hazards for motorists. The Brent Spence Bridge was designed to carry 80,000 vehicles per day. Currently, approximately 160,000 vehicles per day use the Brent Spence Bridge and traffic volumes are projected to increase to approximately 200,000 vehicles per day in 2035.

Information on existing characteristics of the study area was collected throughout the previous steps of the Brent Spence Bridge Replacement/Rehabilitation Project. The following subsections summarize the existing conditions including road geometry and access locations, physical conditions, safety, crash data, demographics, land use, and environmental conditions.

Due to existing characteristics of the study area, the existing interchanges to the interstate, and the local roads and streets in the corridor, can neither provide the desired access, nor can they be reasonably improved to satisfactorily accommodate the design-year traffic demands.

4.1 Road Geometry and Access Locations

Table 4-1 and Table 4-2 summarize the total number of existing lanes as well as the design and legal speeds for Kentucky and Ohio respectively by functional classification of the roadways within the study area that may be affected by the recommended preferred alternative.

Table 4-1. Kentucky - Design Designations of Roadways within the Study Area

Route	Existing Number of Lanes	Functional Classification	Posted Legal Speed (mph)
I-71/I-75	7	Urban Interstate	55
West KY 4th Street	2	Urban Principal Arterial	30
West KY 5th Street	2	Urban Principal Arterial	30
KY 12th Street	2	Urban Principal Arterial	30
Pike Street	4	Urban Principal Arterial	30
Kyles Lane	4	Urban Minor Arterial	35
KY 9th Street	2	Urban Local	25
Bullock Street	3	Urban Local	25
Jillians Way	3	Urban Local	25

Table 4-2. Ohio - Design Designations of Roadways within the Study Area

Route	Existing Number of Lanes	Functional Classification	Posted Legal Speed (mph)
I-71	8	Urban Interstate	55
I-75	4 - 8	Urban Interstate	55
US 50	8	Urban Other Freeway and Expressway	50
OH 2nd Street	5	Urban Principal Arterial	25
OH 3rd Street	5	Urban Principal Arterial	25
OH 7th Street	4	Urban Principal Arterial	25
OH 9th Street	4	Urban Principal Arterial	25
Central Avenue	4 - 6	Urban Principal Arterial	25
Clay Wade Bailey Bridge	3 - 4	Urban Principal Arterial	35
Western Hills Viaduct	4	Urban Principal Arterial	35
Freeman Avenue	4-6	Urban Minor Arterial	35
Western Avenue	3	Urban Minor Arterial	35
Winchell Avenue	3	Urban Minor Arterial	35
4th Street	3	Urban Collector	25
5th Street	4	Urban Collector	25
6th Street	4	Urban Collector	25
Ezzard Charles Drive	4	Urban Collector	30
Gest Street	4	Urban Collector	30
Linn Street	5	Urban Collector	35
Court Street	2	Urban Local	25

4.2 Physical Conditions

The topography in the study area ranges from steep hillsides to level terrain. In Kentucky the topography is generally characterized by a severely to moderately undulating terrain. Northern Kentucky, near the Ohio River, and north of the Ohio River in Ohio the terrain is generally characterized by a more gentle topography.

Beginning at Kyles Lane in Kentucky, existing site grades along the I-71/I-75 corridor generally range between 850 and 900 feet. Northward towards Covington and the Ohio River, the existing topography generally slopes downward to elevation 450 to 500 feet at the river. From the Kyles Lane Interchange to the KY 12th Street Interchange, the topography within the study area is relatively level along existing I-71/I-75, with moderately to steeply sloping hillsides and ridges adjacent to the interstate. From KY 12th Street to the Ohio River, the west side of the study area exhibits similar moderately to steeply sloping hillsides. The eastern side of the corridor is relatively level in comparison to the existing terrain along the western side of the corridor.

The existing grades from the Ohio River northward to the Western Hills Viaduct gradually slope upward from approximately elevation 450 feet adjacent to the Ohio River, to about 550 feet near Western Hills Viaduct. The corridor area is relatively flat beyond the existing highway corridor.

The study area has been affected by major glaciations occurring during the Pleistocene Epoch. These glacial advances caused profound drainage changes and were responsible for the deposition of a variety of soils lying beneath the Covington/Cincinnati area. *The Brent Spence Bridge Replacement/Rehabilitation Project Red Flag Summary Report* (December 2005) provides a detailed discussion of the geotechnical issues as they relate to the project study area.

4.3 Safety

Safety discussions generally revolve about two types of safety: (1) nominal safety and (2) substantive safety. Highway engineers are used to thinking about safety in terms of adherence to design criteria such as those published in the AASHTO “Green Book” or their State Design Manual. This is referred to as nominal safety. A road is considered nominally safe if it meets the minimum standard of care and is current with respect to published standards and guidelines. The performance of a highway as determined by crash frequency and severity is referred to as substantive or quantitative safety. Substantive safety is the actual or expected performance of a highway in terms of its crash rate and the resulting severities. Substantive safety is a function not only of the basic characteristics of the road, but also of road maintenance, law enforcement, and other resources devoted to its operations.

Until recently there was no recognized document and procedures for calculating substantive safety. However, with the release of the AASHTO Highway Safety Manual (2010), expected future crashes and their severities on existing or proposed roadways can now be calculated for two-lane roadways, rural multi-lane highways, and urban as well as suburban arterials. Research is currently underway to develop a methodology and procedures for predicting future crashes on freeways and their interchanges and is expected to be included in the 2nd Edition of the Highway Safety Manual. As a result, it is not possible at this time to predict and quantify future crashes for the existing or proposed freeway sections and their interchanges. Lacking the ability to predict future substantive safety for the freeway sections, safety is addressed in terms of past accidents and nominal safety for the existing freeway sections, and nominal safety for the proposed freeway sections.

A discussion of crash rates (2001-2003) and safety issues is detailed in the *Planning Study Report* (September 2006), *Purpose and Need Statement* (May 2006), and *Existing and Future Conditions Report* (February 2006). Crash rates for the I-71/I-75 corridor exceed the Kentucky and Ohio statewide averages. This is due in part to congested traffic conditions in addition to deficient and substandard roadway geometry.

Based on the crash reports (2001-2003) received, the I-71/I-75 corridor within Kenton County, Kentucky has a crash rate higher than the statewide average of 0.78 accidents per million vehicle miles traveled. The overall crash rate for this section is 1.30, which is nearly 1.67 times higher than Kentucky's statewide average crash rate for interstate highways.

Based on the most recently available crash reports (2001-2003), the overall crash rate for the Ohio section of I-71 in the study area is 3.22 accidents per million vehicle miles traveled, which is approximately 1.7 times higher than the Ohio statewide average rate of 1.887 accidents per million vehicle miles traveled. Overall, I-75 within the study area has a crash rate of 2.91, which is approximately 1.5 times higher than the statewide average rate.

ODOT's safety management databases indicate that the I-75 corridor has been designated as a corridor with safety concerns. The 2009 Highway Safety Program (HSP) List for years 2007-2009 includes three highway segments within the study area, which are ranked in the top 100. The section of I-75 from mile post 0.91 to mile post 3.23 is ranked #7, the section of I-75 from mile post 0.47 to mile post 0.90 is ranked #22, and the section of I-71 from mile post 0.60 to mile post 1.10 is ranked #40. The 2009 Hot Spot Freeway List for years 2007-2009 ranks the section of I-75 from mile post 0.90 to mile post 2.90 as the #1 Hot Spot Location with 807 crashes in the three year period.

4.4 Crash Data

Crash data for the study area were provided by the Kentucky Transportation Cabinet (KYTC) Division of Traffic Operations Traffic Safety Data Service, and ODOT's Office of Roadway Safety and Mobility and Ohio Department of Public Safety. The data detail crashes occurring in the study area between 2001 and 2003.

4.4.1 Kentucky Transportation Cabinet Crash Reports

Crash reports from KYTC were analyzed to determine crash rates throughout the study area and to provide support for observations. Along the I-75 corridor within the study area, 676 accidents were logged between the years 2001 and 2003. The crash data show each accident for I-75 and included severity, location, date, time of day, weather condition, light condition, road condition, and accident type.

Along I-75, the crash severity rate (fatality accidents + injury accidents/total accidents) is 0.1953. Of the 676 total crashes, 349 of the accidents (51.6 percent) were attributed to rear-end type crashes; while another 219 (32.4 percent) were attributed to sideswipes.

Approximately 67.3 percent of the crashes occurred during daylight, and about 74.3 percent occurred on dry pavement. The data suggest that road and light conditions may not be large factors in influencing accidents since the majority of them took place during favorable situations.

Crash rates (accidents per million vehicle miles traveled) were also determined by the KYTC Division of Traffic Operations Traffic Safety Data Service. The overall crash rate for the I-71/I-75 corridor was found to be 1.30. The study area has a crash rate nearly 1.33 times higher than the average of .93 for the years 2000 to 2003 for similar types of roadways in Kentucky.

The Critical Rate Factor calculated by the KYTC Division of Traffic Operations Traffic Safety Data Service for this corridor was found to be 1.304. This number is nearly 7.67 times higher than the average of 0.17 in Kentucky for similar roadway types.

4.4.1.1 Kentucky Crash Data Observations

After reviewing the crash reports from KYTC and plotting the accidents in GIS, several observations were made about I-75 in the Kentucky portion of the study area.

I-75 Northbound Observations

- Approximately 56.4 percent of accidents that occurred on I-75 happened in the northbound lanes.
- There is a high concentration of single vehicle crashes near straight line mile (SLM) 189.7 on a curve.
- There is a high concentration of rear-end accidents at SLM 188.8 and 188.9 north of the Kyle's Lane Interchange.
- There is a high concentration of rear-end accidents at SLM 191.0 near the KY 12th Street/Pike Street Interchange.
- There is a high concentration of rear-end accidents at SLM 191.2 near the KY 5th Street Interchange.

I-75 Southbound Observations

- Approximately 43.6 percent of accidents that occurred on I-75 happened in the southbound lanes.
- There is a high concentration of rear-end accidents near the southbound KY 12th Street/Pike Street exit ramp.
- There is a high concentration of rear-end accidents near the KY 5th Street exit ramp from I-75 southbound.
- There is a high concentration of sideswipe accidents near the 5th Street exit ramp southbound.

The I-75 corridor through the study area within Kentucky has a crash rate higher than the statewide average. Additionally, the crash rate for the corridor is over seven times higher than the statewide average. There are high concentrations of crashes at the KY 12th Street/Pike Street and KY 5th Street exits. Along I-

75, more than half of the crashes are rear-end type accidents, which is an indicator of congestion already present along the corridor.

4.4.2 Ohio Department of Transportation Crash Reports

Traffic Crash data were obtained from ODOT's Office of Roadway Safety and Mobility for the study area, including I-75 from the Kentucky/Ohio border (SLM 0.0) to just north of the Western Hills Viaduct Interchange (SLM 2.9), and I-71 from the I-75 Interchange (SLM 0.32) to near Walnut Street (SLM 0.90). The data include ODOT's Highway Safety Program (HSP) High Crash Location Identification System (HCLIS), ODOT's list of Safety Hot Spots, a summary of crashes in the study area from ODOT and OH-1 reports for all crashes occurring between 2001 and 2003 within the study area.

4.4.2.1 Ohio Safety Hot Spots and Highway Safety Program Listings

Sections of I-71/I-75 on the HCLIS are shown in Table 4-3. This system is used to identify high hazard locations throughout Ohio. Many sections and interchanges located in the study area are on this list. Overall, four sections on I-75 and three sections on I-71 appear on the list. Three sections on I-75 in the Ohio portion of the study area rank in the top one hundred on the HCLIS list.

Table 4-3. Highway Safety Program Listings in the Study Area

Location	Begin Mile	End Mile	Location Type	HCLIS Rank
I-75 Corridor Segments and Interchanges	0.00	0.49	Section	22
	0.50	0.99	Section	28
	1.00	2.90	Section	36
	3.04	4.14	Section	170
I-71 Corridor Segments and Interchanges	0.00	0.29	Section	96
	0.30	0.59	Section	559
	0.60	1.10	Section	53

Source: ODOT Office of Roadway Safety and Mobility High Crash Location Identification System 2005-2007

Safety Hot Spots were identified using data from the Office of Roadway Safety and Mobility. The Hot Spot locations are based on the total number of accidents over a three year period in an area regardless of traffic volume and other factors. Ohio roadways are divided into two-mile segments, and the number of crashes is compared to a given frequency to determine if a hot spot exists. The entire study area in Ohio is included as a Safety Hot Spot. Table 4-4 lists the Safety Hot Spots in the Ohio portion of the study area.

Table 4-4. Safety Hot Spots

Location	Begin Mile	End Mile	Number of Crashes	Number of Fatal	Number of Injuries
I-75 Corridor Segments	0.22	2.22	1005	4	239
	2.22	4.22	802	2	206
I-71 Corridor Segments	0.00	2.00	721	2	162

Source: ODOT Office of Roadway Safety and Mobility Safety Hot Spot List, 2001-2003

4.4.2.2 Ohio Congestion Rankings

One section of I-75 within the Ohio portion of the study area and two sections of I-71 are among the most congested in the State of Ohio. Congested areas are determined by calculating a roadway's volume to capacity ratio. Roadways with a ratio greater than 1.00 are considered congested and overcapacity. The section of I-71 from SLM 0.48 to 0.50 is ranked third and one of the I-75 sections from SLM 0.71 to 0.90 is ranked second. Table 4-5 displays the congested highway sections within the study area.

Table 4-5. Highway Safety Program Listings in the Study Area

Location	Begin Mile	End Mile	Statewide Ranking
I-75 Corridor Segments and Interchanges	0.71	0.90	2
	1.35	17.47	31
I-71 Corridor Segments and Interchanges	0.00	0.22	62
	0.48	0.50	3
	1.15	1.34	4

Source: ODOT Office of Roadway Safety and Mobility Congestion List 2005-2007

4.4.3 Ohio Department of Public Safety Crash Reports

Crash reports from the Ohio Department of Public Safety (ODPS) were analyzed to determine crash rates and to provide support for observations made throughout the study area. Along I-75 within the Ohio portion of the study area, 1,049 accidents were logged between the years 2001 and 2003. 150 accidents were logged on I-71 in the study area during this same time period.

Along I-75, the crash severity rate (fatality accidents + injury accidents/total accidents) is 0.233. Of the 1,049 total crashes, 504 of the accidents (48 percent) were attributed to rear-end type crashes; while another 256 (25.3 percent) were attributed to sideswipes. Approximately 67.8 percent of the crashes occurred during daylight and about 69.4 percent occurred on dry pavement. The data suggest that road and light conditions may not be primary factors in influencing accidents, since the majority of them occurred during favorable situations.

Along I-71, the crash severity rate is 0.188. Of the accidents on I-71, 37.3 percent were rear-ends, 16.7 percent were sideswipe, and 14.7 percent were fixed object crashes. Approximately 58 percent of the crashes that occurred along I-71 happened on dry pavement (approximately 40 percent on non-dry pavement), and approximately 54.7 percent occurred during daylight hours (approximately 45 percent during evening and night). These data suggest that road and light conditions are not primary factors in influencing accidents, since crashes were nearly evenly spread between favorable and non-favorable conditions (with the majority of accidents happening during daylight hours on dry pavement).

Crash rates (accidents/million vehicle miles traveled) were also determined for segments along the I-75 and I-71 corridors in the study area. Each corridor was divided into smaller segments. Based on 2002 Average Daily Traffic Volumes (ADT), crash rates were calculated for each segment and compared to the statewide average. Crash rates for each corridor were calculated with an ADT that used a weighted average of the ADTs throughout the corridors. These crash rates are shown in Table 4-6.

Table 4-6. Ohio Crash Rates by Segment*

Location	Begin Mile	End Mile	Statewide Ranking
I-75 Corridor Segments and Interchanges	0.71	0.90	2
	1.35	17.47	31
I-71 Corridor Segments and Interchanges	0.00	0.22	62
	0.48	0.50	3
	1.15	1.34	4

*Intersection accidents are not included

The overall crash rates for all segments along both northbound and southbound I-75 were higher than the average crash rates for similar facilities in Ohio. The worst segment has a crash rate more than six times greater than the statewide average. Overall, the corridor has a crash rate of 3.54, which is more than two times greater than the Ohio statewide average rate of 1.338.

Along I-71, the crash rates for all of the segments are greater than the statewide average rates. The worst segment has a crash rate more than 19 times the statewide average. The overall crash rate for the corridor is 5.26 accidents per million vehicle miles traveled (acc/mvmt), which is nearly four times the statewide average rate of 1.338 acc/mvmt.

4.4.4 Ohio Crash Data Observations

After reviewing the crash reports from ODPS and plotting the accidents in GIS, several observations were made about the I-75 and I-71 corridors in the Ohio portion of the study area.

I-75 Northbound Observations

- Approximately 44 percent of the accidents that occurred on I-75 happened in the northbound lanes.
- There is a high concentration of rear-end accidents at SLM 0.10 between the bridge and the I-71/I-75 Interchange.
- There is a high concentration of rear-end accidents at SLM 1.90 near the Findlay Street bridge.
- There is a high concentration of sideswipe accidents at SLM 0.20 near the I-71/I-75 Interchange.
- High concentrations of sideswipe crashes were observed at SLM 1.00 near the OH 9th Street entrance ramp.
- High concentrations of sideswipe crashes were observed at SLM 1.20 near the Gest Street entrance ramp.
- There is a high concentration of wet road conditions and fixed object accidents at SLM 1.30 on a curve near the ramp bridges for Gest Street.
- There is a high concentration of wet road conditions and fixed object accidents at SLM 1.70 on a curve near the entrance ramp from Ezzard Charles Drive.

I-75 Southbound Observations

- Approximately 56 percent of the accidents that occurred on I-75 happened in the southbound lanes.
- There is a high concentration of rear-end accidents at SLM 0.10 where I-75 and I-71 merge together.
- There is a high concentration of rear-end accidents at SLM 1.00 near the OH 9th Street exit ramp.
- There is a high concentration of wet road condition and rear-end accidents at SLM 1.50 near the Ezzard Charles Drive exit.
- There is a high concentration of rear-end accidents at SLM 1.80 near the Western Hills Viaduct exit.
- There is a high concentration of fixed object accidents at SLM 1.40 near the Ezzard Charles Drive exit.
- There is a high concentration of sideswipe accidents on southbound I-75 at SLM 0.10 and 0.20 near the I-71/I-75 Interchange.
- There is a high concentration of sideswipe accidents near SLM 2.70 near the Western Hills Viaduct exit ramps.

I-71 Northbound Observations

- Approximately 57 percent of the accidents on I-71 were northbound.
- A high concentration of sideswipe crashes were observed near SLM 0.50, the area includes entrance traffic merging from US 50 southbound and the OH 2nd Street exit.
- A high concentration of rear-end and sideswipe accidents were observed near SLM 0.80 between the Race Street and Vine Street bridges.

I-71 Southbound Observations

- A high concentration of fixed object crashes were observed near SLM 0.50 this area has merging traffic from 3rd Street and exit ramps to US 50 northbound.
- There are high concentrations of rear-end accidents between SLM 0.70 and 0.80 between Elm Street and Vine Street.

Both the I-75 and I-71 corridors have been identified by ODOT as safety priorities. The entirety of both corridors (I-71 and I-75) in the study area appears on ODOT's Safety Hot Spot list. In addition, many segments on these corridors also appear on the HCLIS list. Most of the segment crash rates for individual years as well as overall exceed the Ohio statewide average rates. There are high concentrations of crashes near the I-71/I-75 Interchange. Congestion through the study area corridors are among the highest in Ohio. The segment on I-75 from SLM 0.71 to 0.90 ranked second and the segment on I-71 from SLM 0.48 to 0.50 ranked third in the state. Along I-75, almost half of the crashes are rear-end type accidents, which is an indicator of congestion already present along the corridor. As congestion continues to increase, the likelihood of additional accidents also increases.

4.5 Demographics

Demographic data for the study area were obtained from the US Census Bureau. Census tract data were used to assess population conditions within the study area in both Kentucky and Ohio. There are 22 Census tracts within the study area. Table 4-7 presents a summary of demographic information by county and city. Table 4-8 presents a summary of demographic data by Census tract.

Table 4-8 illustrates that population has decreased throughout the majority of the study area resulting in a net decrease between 1990 and 2000. Overall, the decline was more than 11 percent or approximately 5,200 persons. The percentage decline in the study areas is greater than that of the city of Cincinnati (9 percent decline) or Hamilton County (2.4 percent decline). In Kentucky, the city of Covington (0.2 percent increase) and Kenton County (6.6 percent increase) have both experienced population growth.

Table 4-7. Demographic Information by City/County (2000)

Location	2000 Population	Percent Population White	Percent Population Minority	Median Age	Number of Households	Median Household Income
Kentucky						
Kenton County	151,464	94	6	34	59,444	$43,906
Fort Mitchell	8,089	96.9	3.1	36	3,530	$46,335
Fort Wright	5,681	97.3	2.7	39	2,430	$52,394
Park Hills	2,977	96.6	3.4	37	1,382	$42,227
Covington	43,370	87	13	33	18,257	$30,735
Ohio						
Hamilton County	845,303	72.9	27.1	35	346,790	$40,964
Cincinnati	331,285	52.5	47.5	32	148,095	$29,493

Table 4-8. Demographic Information By Census Tract

Census Tract	Population 1990	Population 2000	Percent Change	Median Age	Number of Households	Median Household Income
Kentucky						
064800	3,485	3,364	-3.47	36	1,500	$46,563
065200	3,699	4,125	11.52	42	1,795	$47,586
064900	3,341	2,991	-10.48	37	1,393	$41,992
065100	3,985	3,594	-9.81	26	1,465	$25,054
061600	1,684	1,420	-15.68	32	592	$36,250
065000	4,166	4,015	-3.62	33	1,608	$30,565
060700	2,405	1,964	-18.34	34	901	$25,618
060300	1,963	1,809	-7.85	33	886	$19,884
063800	3,088	3,080	-0.26	35	1405	$38,281
067000	-	3,253	-	39	1,800	$25,591
Ohio						
000100	13	641	4830.77	26	2	$0.00
000400	763	1,114	46.00	43	818	$12,260
000600	853	550	-35.52	41	374	$35,278
000200	1,378	1,335	-3.12	32	593	$15,938
000302	2,630	963	-63.38	19	384	$7,969
000800	277	547	97.47	31	250	$30,625
000301	2,664	1,232	-53.75	21	574	$6,748
001400	641	663	3.43	27	252	$26,964
001500	3,017	2,261	-25.06	35	1,087	$7,311
001600	2,312	1,712	-25.95	27	803	$8,175
002800	1,763	1,506	-14.58	31	502	$23,352
002700	1,658	1,685	1.63	27	860	$30,446

Employment data for the study area are shown in Table 4-9. Within the study area, the largest employment sector is Educational and Health Services which is consistent with the region. The unemployment rate for the greater Cincinnati area as of March 2010, according to the Bureau of Labor Statistics, is 10.6 percent, nearly half a percent higher than the national average of 10.2 percent.

Commuting trends within the study area are shown in Table 4-10. According to the Census data, more than 23 percent of Cincinnati households do not own a car, while Covington has only a slightly higher rate of vehicle ownership with 22 percent of Covington households not owning a car. Households in the study area that do not own a car is much higher, averaging 35 percent. The majority of employees within the study area use their automobile to travel to their place of work. As shown in Table 4-10, the percent of workers that use public transportation in the study area is higher in Cincinnati than Covington.

4.6 Land Use

The study area is both urban and suburban in nature and consists of established residential neighborhoods and commercial properties. The primary land uses within the study area are commercial, industrial, residential, institutional, and existing roadway right of way. No farmland is present within the study area in Ohio.

Land use in the Kentucky portion of the study area is residential, and commercial with pockets of industrial and limited agriculture uses. Commercial uses are concentrated at the KY 5th Street and Pike Street exits of I-71/I-75. Open space uses include agricultural, parks, and golf courses.

Land use in the Ohio portion of the study area is mostly commercial, residential and industrial. The Cincinnati central business district (CBD) is partially located within the study area and is currently accessible by I-75.

West of I-75, land use is primarily industrial with commercial and office uses located near Gest Street. East of I-75, land uses are almost entirely residential and institutional.

4.7 Environmental Conditions

The setting and environmental resources within the study area are discussed in the *Red Flag Summary* (December 2005), *Existing and Future Conditions* (September 2006), *Planning Study Report* (February 2006), and *Conceptual Alternatives Study* (April 2009). A brief overview of any pertinent environmental conditions is provided below. Additionally, the *Draft Environmental Assessment* (November 2010) is included in Appendix F, and provides additional details on the study area's environmental conditions.

4.7.1 Recreational Facilities

The recommended preferred alternative will impact both the parking lot and basketball courts at Kentucky's Goebel Park with a total impact of 1.9 acres or 12.8 percent of the park's total acreage. Noise levels are not anticipated to increase at Goebel Park according to the *Noise Report,* (December 2010). Noise levels are anticipated to remain consistent at Goebel Park but still within the noise abatement criteria (NAC) for the noise receptor location at the northern end of Philadelphia Street in Covington, Kentucky. Noise levels are anticipated to drop slightly and be below the NAC for the noise receptor location further south at KY West 9th Street and Philadelphia Street in Covington, KY. In Ohio, the Queensgate playground and ballfields will be impacted with the recommended preferred alternative requiring 0.9 acres or 17.1 percent of the park's total acreage. This land will be taken along the western edge of the project adjacent to I-75, and will not impact the existing ballfields.

4.7.2 Schools and Churches

In Kentucky, the Notre Dame Academy, a private girls' high school, will have 1.34 acres impacted by the recommended preferred alternative which will include portions of an existing ballfield and a parking lot. Beechwood Elementary and High Schools will also be impacted with a strip take for new right of way. A total take of 0.44 acres will be required from the parking lot I of the Central Church of the Nazarene, which is located near the Dixie Highway Interchange in Kentucky. The church building will not be impacted by the recommended preferred alternative.

4.7.3 Displacements and Relocations

Within Kentucky, the recommended preferred alternative will potentially displace 43 residential units and eight businesses. In Ohio, the recommended preferred alternative will not displace any residences, but will displace seven businesses. Land converted to right of way for the recommended preferred alternative will result in decreased revenues from lost property taxes. The property value of those residences close to the I-71/I-75 corridor could decrease due to change in views and/or proximity to the corridor. The estimated property value loss (in 2010 dollars) for the recommended preferred alternative in Kentucky is $12.7 million and in Ohio it is $12.3 million.

Table 4-9. Study Area Employment

Census Tract	Agriculture	Construction	Manufacturing	Wholesale Trade	Retail Trade	Transportation/ Warehousing/ Utilities	Information	Fire/Insurance/Real Estate	Professional/ Scientific/ Management/ Administrative/ Waste Management Services	Educational/ Health/ Social Services	Arts/ Entertainment/ Recreation/ Accommodations/ Food Services	Other Services	Public Administration	Unemployment
Kentucky														
064800	0.00%	3.18%	10.54%	3.68%	14.05%	8.40%	5.10%	8.07%	12.84%	15.70%	8.34%	4.06%	6.04%	1.46%
065200	0.00%	6.33%	7.57%	4.19%	10.86%	6.33%	3.59%	10.16%	13.30%	21.62%	5.13%	4.24%	6.68%	1.47%
064900	0.95%	4.43%	10.20%	3.92%	9.36%	6.27%	2.91%	11.32%	11.04%	20.45%	9.69%	6.44%	3.03%	1.49%
065100	0.22%	5.11%	12.31%	6.62%	15.19%	7.27%	1.94%	8.50%	9.00%	11.66%	9.79%	4.54%	7.85%	10.33%
061600	0.00%	9.52%	16.62%	5.26%	6.82%	4.12%	3.13%	15.34%	6.96%	12.50%	12.36%	4.12%	3.27%	7.61%
065000	0.76%	9.07%	17.45%	4.63%	11.89%	6.79%	1.41%	6.03%	4.80%	19.20%	10.36%	4.04%	3.57%	7.12%
060700	0.66%	8.93%	12.35%	5.13%	9.69%	6.93%	0.66%	5.32%	9.21%	14.06%	17.57%	4.56%	4.94%	8.27%
060300	1.50%	4.63%	14.00%	2.38%	19.88%	2.75%	1.75%	1.13%	7.00%	10.25%	29.38%	2.75%	2.63%	7.195
063800	0.91%	6.62%	12.85%	4.93%	12.72%	7.85%	4.93%	8.70%	7.85%	10.97%	9.93%	3.11%	8.63%	2.41%
067000	0.48%	6.06%	10.74%	3.10%	10.05%	8.81%	4.75%	7.50%	14.59%	14.52%	10.46%	4.20%	4.75%	8.27%
Ohio														
000100	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%
000400	0.00%	6.34%	5.63%	2.82%	3.76%	10.09%	3.05%	11.50%	23.24%	14.79%	8.22%	5.63%	4.93%	18.86%
000600	0.00%	1.53%	4.86%	5.37%	3.32%	6.65%	9.72%	13.81%	22.51%	16.62%	7.16%	3.07%	5.37%	11.34%
000200	0.00%	7.65%	5.46%	0.00%	11.48%	9.02%	1.64%	6.28%	11.48%	19.40%	17.76%	8.20%	1.64%	19.03%
000302	0.00%	0.00%	23.20%	0.00%	18.40%	0.00%	16.80%	5.60%	5.60%	12.80%	6.40%	6.40%	4.80%	38.12%
000800	0.00%	4.18%	15.97%	7.98%	3.42%	13.69%	2.66%	10.27%	1.52%	19.39%	11.41%	9.51%	0.00%	8.68%
000301	0.00%	0.00%	7.69%	0.00%	2.83%	6.88%	0.00%	2.43%	24.70%	30.77%	15.79%	0.00%	8.91%	27.35%
001400	0.00%	6.70%	12.95%	0.00%	9.82%	4.91%	0.00%	3.57%	14.73%	26.34%	11.16%	6.70%	3.13%	11.46%
001500	0.00%	4.62%	11.04%	3.82%	7.63%	11.65%	2.81%	6.22%	8.84%	19.68%	11.65%	3.41%	8.63%	24.77%
001600	0.00%	5.92%	10.14%	2.25%	11.83%	5.35%	0.00%	0.00%	26.20%	11.83%	21.69%	4.79%	0.00%	30.53%
002800	0.00%	18.25%	10.66%	3.08%	15.88%	2.37%	0.00%	1.66%	6.87%	13.51%	18.01%	2.84%	6.87%	13.52%
002700	0.00%	2.10%	9.19%	4.54%	9.41%	2.33%	3.88%	4.21%	13.73%	29.01%	16.28%	4.21%	1.11%	7.57%

Table 4-10. Commuting Trends Within the Study Area

Census Tract	Total Employed	Car, Truck, or Van	Drive Alone	Carpool	Public Transportation	Walk	Other Means	Work at Home
Kentucky								
064800	1,786	93.67%	88.58%	5.10%	1.85%	0.95%	1.29%	2.24%
065200	1,999	92.90%	86.99%	5.90%	3.55%	1.25%	0.95%	1.35%
064900	1,773	87.31%	75.69%	11.62%	4.51%	1.92%	0.68%	5.58%
065100	1,346	87.52%	72.07%	15.45%	7.13%	0.97%	1.26%	3.12%
061600	704	90.34%	64.49%	25.85%	5.82%	0.85%	2.27%	0.71%
065000	1,684	89.67%	75.83%	13.84%	5.52%	3.03%	0.53%	1.25%
060700	1,015	71.82%	55.76%	16.06%	14.98%	10.05%	2.56%	0.59%
060300	778	72.11%	48.20%	23.91%	6.68%	17.10%	1.80%	2.31%
063800	1,506	92.83%	79.75%	13.08%	5.64%	0.80%	0.00%	0.73%
067000	1,439	77.35%	67.48%	9.87%	12.37%	7.99%	0.83%	1.46%
Ohio								
000100	12	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%
000400	426	40.85%	31.69%	9.15%	16.67%	36.85%	0.00%	5.63%
000600	391	30.43%	28.90%	1.53%	6.91%	57.03%	0.00%	5.63%
000200	366	50.55%	48.63%	1.91%	36.89%	12.57%	0.00%	0.00%
000302	125	63.20%	63.20%	0.00%	10.40%	20.00%	0.00%	6.40%
000800	263	68.06%	58.56%	9.51%	18.63%	9.89%	0.00%	3.42%
000301	233	24.89%	14.16%	10.73%	57.08%	18.03%	0.00%	0.00%
001400	218	57.80%	35.78%	22.02%	38.99%	0.00%	0.00%	3.21%
001500	455	56.70%	49.67%	7.03%	31.21%	9.45%	1.54%	1.10%
001600	341	47.51%	18.77%	28.74%	27.86%	23.17%	0.00%	1.47%
002800	422	83.18%	53.55%	29.62%	3.79%	12.09%	0.00%	0.95%
002700	866	72.52%	59.82%	12.70%	7.27%	16.97%	1.85%	1.39%

4.7.4 Wetlands

There are six wetlands in the Kentucky portion of the study area, which total 1.57 acres. All of the wetlands are low quality palustrine emergent wetlands. There are no wetlands in the Ohio portion of the study area. The recommended preferred alternative would impact 1.38 acres of the Kentucky wetlands.

4.7.5 Threatened and Endangered Species

The study area lies within the ranges of several federal and state-listed species. However, there are no documented populations of threatened and endangered species or critical habitat within the study area. Threatened and endangered species habitat surveys conducted in 2006 and 2009 determined that potential habitat characteristics for the Indiana bat, running buffalo clover, riverbank paspalum, Kirtland's snake, Virginia mallow, several bird species, and freshwater mussels exist within the study area. According to state and federal resource agencies, the majority of the Ohio River species have not been collected or identified within the Ohio River since 1966 and are believed to no longer exist in the River.

4.7.5.1 Indiana Bat

Approximately 137 acres of potential Indiana bat habitat and 187 acres of marginal Indiana bat habitat were identified within the study area in Kentucky. The survey for Indiana bat habitat was not conducted for Ohio. The recommended preferred alternative will impact 28 acres of potential Indiana bat habitat and an additional 28 acres of marginal Indiana bat habitat.

4.7.5.2 Running Buffalo Clover

Only one partially shaded woodlot was identified within the survey corridor as possessing potential running buffalo clover habitat. This 10-acre woodlot is located along the west side of I-71/I-75 east of the Kyles Lane Intersection and along Intermittent Stream 6. The recommended preferred alternative will impact two acres of this woodlot. However, based on reviews by KYTC-Division of Environmental Analysis and the United States Fish and Wildlife Service for running buffalo clover, the project is not likely to adversely impact this species and no further studies should be required within the Kentucky portion of the project.

4.7.6 Terrestrial Resources

In the Kentucky portion of the study area, terrestrial habitats are urban in nature but have a mixed-age woods component that likely has not been cleared in the past 30 to 40 years. North of the Ohio River terrestrial habitats are limited to a narrow, wooded riparian zone consisting of young trees and shrubs located along portions of the Ohio River and scrub shrub areas along the existing interstate right of way. The recommended preferred alternative will impact 28 acres of mixed-age woods, 10 acres of young woods, and 14 acres of old field.

4.7.7 Hazardous Materials

The May 2010 Environmental Site Assessment (ESA) Screening recommended that a Phase I ESA be conducted for the Harrison Terminal site (1220 Harrison Avenue) due to historic land uses and listings in multiple databases. The WHV improvements would involve a strip of right of way at the northern boundary of this property.

Seventeen sites are recommended for Phase II ESA investigations. Two sites are located in Kentucky and 15 sites are located in Ohio. The existing Brent Spence Bridge is not a listed site since it is a right of way property and a condition exists associated with the structure.

4.7.8 Cultural Resources

The project's direct impacts to cultural resources would include direct acquisition of residences in the Lewisburg Historic District in Covington and structural changes to the Longworth Hall building in Cincinnati. These project impacts would contribute the cumulative loss of cultural resources when considered in conjunction with those identified under the I-75 Mill Creek Expressway and KY 1120 Widening projects. With respect to indirect impacts, the project would require changes to Longworth Hall which could lead to a revision in the building's various uses.

The recommended preferred alternative will require the acquisition of 2.8 acres of land within the Lewisburg Historic District boundary, affecting 33 of the 430 properties that are considered to be contributing elements to the Lewisburg Historic District. Sixteen parcels would be acquired as total right of way acquisitions with demolition of structures; 17 additional parcels would be affected through partial right of way acquisition.

Additionally, the historic district would experience changes in access with the recommended preferred alternative requiring the elimination of 1,500 feet of Crescent Avenue, realigning Crescent Avenue to connect to Bullock Street to the south. Access to the historic district would be provided by Bullock and KY 9th streets. Alternative access would be available via Western Avenue which runs parallel to Crescent Avenue, approximately 200 feet to the west. Additionally, Lewis Street which provides access to the historic district would be closed at Pike Street.

The eastern section of Longworth Hall would be directly impacted as the recommended preferred alternative would pass through 198 feet of the eastern end of the building, eliminating 20,000 square feet of floor space.

While the Harriet Beecher Stowe Elementary School would not be directly impacted, the parking garage east of the building would be directly impacted by the recommended preferred alternative. The OH 9th Street ramp would impact a 700 square foot portion of the northeast corner of the parking garage. This impact could require the demolition or reconstruction of 2,400 square feet of the parking garage.

4.7.9 Air Quality

The Brent Spence Bridge Replacement/Rehabilitation project is a conforming project in the both Kentucky's and Ohio's Transportation Improvement Plans (TIP), and will have air quality impacts consistent with those identified in the State Implementation Plans for achieving the National Ambient Air Quality Standards (NAAQS). The technical studies completed for the project included a Mobile Source Air Toxics (MSAT) analysis, $PM_{2.5}$ Hot Spot Analysis, and a Carbon Monoxide (CO) analysis. The results of these analyses are documented in the following technical reports, which are located in Appendix F of the *Environmental Assessment* (November 2010):

- *Air Quality Technical Report: Mobile Source Air Toxics* (November 2010),
- *Air Quality Technical Report: Carbon Monoxide* (November 2010), and
- *Draft Qualitative $PM_{2.5}$ Hot-Spot Analysis (April 2011)*

The air quality analyses conducted for the proposed project determined that neither feasible alternative would cause or exacerbate an exceedance of the carbon monoxide NAAQS or increase regional emission burdens or mobile source air toxin levels. An interagency consultation has been initiated (May 2011) to determine if the project is a project of air quality concern in regard to particulate matter ($PM_{2.5}$). Based upon the projected VMT estimates for the No Build Alternative, the project would slightly reduce MSATs in the overall study area.

4.7.10 Noise

The principal sources of noise in the study area are motor vehicles traveling on the I-75 and I-71 mainlines, adjoining service roads and connecting roadways. Residential areas and community facilities adjacent to these roadways are exposed to moderate to high levels of existing road traffic noise. Existing peak-hour noise levels approached or exceeded the KYTC and ODOT Category B impact threshold I of 66 dBA at 35 of the 48 monitoring locations. Noise measurements ranged from a low reading of 54 dBA at Site M-34 during the peak AM time period to a high reading of nearly 78 dBA at Site M-3 during the peak PM time period. Additional details on the noise study are available in Appendix F of the *Environmental Assessment* (November 2010).

In general, noise levels for the recommended preferred alternative are higher than for the No Build Alternative because of the higher travel speed and reduced congestion predicted for 2035.

Under the recommended preferred alternative, 55 properties would be expected to experience noise levels at or above the noise abatement criteria (NAC) as compared to 42 properties identified under the No Build Alternative in 2035. Predicted noise levels for the recommended preferred alternative would be between one and five decibels higher than those reported for the No Build Alternative. The noise levels would range from a maximum of 74 dBA at Sites M-3 and R-7 to a minimum of 56 dBA at Site M-47. No locations would be expected to experience a noise level increase of 10 or more dBA above the corresponding existing noise level.

In Kentucky, the highest concentration of properties with noise levels above the NAC would occur between Kyles Lane and Dixie Highway and in the southbound direction between KY 5th and Hermes Streets. In Ohio, the highest concentration of properties with noise levels above the NAC would be projected to occur from Bank Street to just south of Ezzard Charles Drive.

5.0 Alternatives Considered

Development of conceptual alternatives for the Brent Spence Bridge was initiated in 2003 by the Kentucky Transportation Cabinet (KYTC). These initial alternatives were documented in the *Feasibility and Constructability Study of the Replacement/Rehabilitation of the Brent Spence Bridge (Feasibility and Constructability Study)* (May 2005). This report recommended a series of potential feasible build alternatives for replacement and/or rehabilitation of the Brent Spence Bridge structure and improvement to its approaches and surrounding transportation system. Six conceptual alternatives were recommended for further study.

In 2006, 25 conceptual alternatives, including the No Build Alternative, were developed in Step 4 of the Ohio Department of Transportation's (ODOT's) Project Development Process (PDP). These 25 conceptual alternatives included the six alternatives from the *Feasibility and Constructability Study.* The 25 conceptual alternatives were evaluated using a two-phased screening process based on a comparative analysis. Phase one of the analysis was an evaluation of the conceptual alternatives based on the goals of the purpose and need and comments received from local governments. In phase two of the analysis, the conceptual alternatives that were not eliminated in phase one were evaluated using stakeholder goals and measures of success; design compatibility with the I-75 Mill Creek Expressway project (HAM-75-2.30) to the north; and concurrence among government agencies obtained through a series of meetings. Some alternatives were combined into hybrid alternatives and then evaluated in phase two of the analysis.

The two-phased comparative analysis eliminated 19 of the 25 conceptual alternatives from further study and evaluation as these 19 conceptual alternatives failed to meet the purpose and need goals of the project and did not adequately address the stakeholder's goals and measures of success. Additionally, these alternatives would not be compatible with the I-75 Mill Creek Expressway project (HAM-75-2.30) and the five travel lanes needed to provide a seamless connection between the two projects.

The *Planning Study Report* (September 2006) documents the 25 conceptual alternatives and the two-phased comparative analysis.

5.1 Conceptual Alternatives

At the end of Step 4 of the PDP, a total of six conceptual alternatives were recommended for further study, including the No Build and five mainline build alternatives. The No Build Alternative, which consists of minor and short-term safety and maintenance improvements to the Brent Spence Bridge and I-75 corridor, was retained as a baseline for evaluation of the build alternatives. From the five mainline alternatives, a variety of sub-alternatives were developed, resulting in eight conceptual alternatives to provide options for key intersection and traffic flow areas within the project corridor. These eight conceptual alternatives were identified as Alternatives A though H. Detailed descriptions of the mainline alternative and the various sub-alternatives are presented in the *Planning Study Report*. These eight alternatives were further developed and refined during Step 5 of the PDP. Evaluation efforts included environmental studies, traffic analysis, refinement of horizontal and vertical alignments, cost estimates, utilities coordination, and stakeholder coordination.

All of the conceptual alternatives were the same at the southern and northern ends of the project corridor. The differences among the conceptual alternatives were in the design configuration, access points, and number of lanes that occur between 12th Street in Kentucky to Ezzard Charles Drive in Ohio. In Kentucky, south of KY 12th Street, I-71/I-75 has six lanes northbound and southbound. North of Western Hills Viaduct in Ohio, I-75 has five lanes northbound and southbound. The configurations of the Dixie Highway, Kyles Lane, and Western Hills Viaduct interchanges were the same for all conceptual alternatives, except

Alternative H which did not incorporate a collector-distributor (C-D) roadway system. For conceptual alternatives A through G, the Dixie Highway and Kyles Lane interchanges would need modified slightly to accommodate a C-D roadway system, which would be constructed along both sides of I-71/I-75 between the two interchanges.

Alternatives A through G also improved Western and Winchell avenues to facilitate traffic flow and increase capacity. For each of these alternatives, the Western Hills Viaduct Interchange would be reconfigured.

5.2 Feasible Alternatives

The *Conceptual Alternatives Study* (April 2009) report from Step 5 of the PDP recommended feasible alternatives for further study in Step 6 and Step 7 of the PDP. During Step 5, Alternatives A, B, F, G, and H were eliminated from further consideration.

A hybrid alternative consisting of a combination of Alternatives C and D, identified as Alternative I, along with Alternative E from the *Conceptual Alternatives Study* (April 2009), were recommended to be developed for further study in Step 6 and Step 7 as feasible alternatives.

Alternatives C and D were very similar in overall design. Based on the comparative analysis in Step 5, with respect to horizontal and vertical alignments, impacts, and the flow of traffic of Alternatives C and D, it was determined that a hybrid alternative that included the northbound portion of Alternative C and the southbound portion of Alternative D would be advanced for further consideration. It was recommended to increase the number of lanes for I-75 to three lanes in each direction to support the improved level of service this alternative would provide. The hybrid alternative consisting of a combination of Alternatives C and D was identified as Alternative I and was later determined to be the recommended preferred alternative.

The recommendation to further develop Alternative E was based on the access provided to the cities of Covington and Cincinnati and the minimal amount of community impacts it had in comparison to the other alternatives. It was recommended to maintain the number of lanes for I-75 to three lanes in each direction to support the improved level of service this alternative would provide.

While Alternative G was recommended to be eliminated from further consideration due to its high costs and residential and business displacements, many of the beneficial design features were carried forward. This decision was made based upon the analyses completed and feedback as part of community input. The following beneficial design features of Alternative G were carried forward for further analysis and incorporated into the feasible alternatives:

- Access to north end of Clay Wade Bailey Bridge from I-75 southbound using a C-D roadway and US 50 eastbound;
- Two access points into Covington;
- Access from a northbound C-D roadway from Kentucky to I-71 northbound in Ohio; and
- Access ramp just north of Ezzard Charles Drive for Freeman Avenue and local traffic to I-75 northbound.

5.2.1 No Build Alternative

The No Build Alternative consists of minor, short-term safety and maintenance improvements to the Brent Spence Bridge and I-75 corridor, which would maintain continuing operations. All safety and maintenance improvements will be performed within existing right of way.

The No Build does not meet the purpose and need for this project. This alternative does not improve traffic flow and existing congestion will worsen. The No Build does not provide improvements for safety. Lane widths would remain deficient and the lack of shoulders on the bridge would continue. Geometric deficiencies would not be corrected. The No Build would maintain existing connections to local, regional, and national transportation corridors but does not improve these connections.

The No Build Alternative is retained as a baseline alternative to compare with the feasible Build Alternatives.

5.2.2 Alternative E

Alternative E utilizes the existing I-71/I-75 alignment from the southern project limits at the Dixie Highway Interchange north to the Kyles Lane Interchange (Exhibit 3 and Appendix A). The Dixie Highway and Kyles Lane interchanges will be modified slightly to accommodate a C-D roadway, which will be constructed along both sides of I-71/I-75 between the two interchanges. North of the Kyles Lane Interchange, the alignment shifts to the west to accommodate additional I-71/I-75 travel lanes. Between Kyles Lane and KY 12^{th} Street, six lanes will be provided in each direction for a total of 12 travel lanes.

Near KY 12^{th} Street, the northbound alignment separates into two routes; one for interstate traffic and one for a local C-D roadway. Between Pike Street and KY 9^{th} Street, the interstate separates into I-71 and I- 75 only routes. The C-D roadway will carry local traffic northbound and provide access to Covington at KY 12^{th} and 5^{th} streets and access from KY 9^{th} and 4^{th} streets. The southbound C-D roadway will carry traffic from Ohio, cross over I-71 and I-75, and provides access to both the interstate and into Covington at KY 9^{th} Street.

A portion of Crescent Avenue will be closed with a new connection to Bullock Street. Access from Covington for southbound interstate traffic is located at KY 12^{th} Street. Bullock Street will be extended north from Pike Street to KY 9^{th}, 5^{th}, and 4^{th} streets and Jillians Way will be extended north from Pike Street to KY 9^{th}, 5^{th}, and 4^{th} streets. Bullock Street and Jillians way will function as one-way pair local frontage roadways.

A new double deck bridge, the new Ohio River Bridge, will be built just west of the existing Brent Spence Bridge to carry northbound and southbound I-71 and I-75 traffic. On the upper deck, I-71 southbound will have three lanes and I-71 northbound will have two lanes. On the lower deck, I-75 will have three northbound and three southbound lanes. The existing Brent Spence Bridge will be rehabilitated to carry northbound and southbound local traffic with two lanes in the southbound direction and three lanes in the northbound direction and will meet the standards and requirements for maintaining interstate traffic.

In Ohio, Alternative E reconfigures I-75 through the I-71/I-75/US 50 Interchange and eliminates some of the existing access points along I-75. Existing ramps to I-71, US 50 and downtown Cincinnati will be reconfigured. The existing direct connections between I-75 to westbound and from eastbound US 50 will be maintained in Alternative E. US 50 will be reconfigured to eliminate left-hand entrances and exits. The OH 5^{th} Street overpass will be eliminated and the OH 6^{th} Street Expressway will be reconfigured as a two-way, six-lane elevated roadway with a new signalized intersection for US 50 access and egress. Access between southbound I-71 (Fort Washington Way) and northbound I-75 will be provided near OH 9^{th} Street as a direct connection. Both I-75 southbound and US 50 (OH 6^{th} Street Expressway) will have access to northbound I-71 (Fort Washington Way).

A local C-D roadway will carry local traffic northbound from the existing Brent Spence Bridge and provide access to OH 2nd, 5th, and 9th streets, Winchell Avenue and access from OH 4th before reconnecting to I-75 just south of the Linn Street overpass. The northbound ramps from OH 6th and 9th streets to I-75 will be removed requiring traffic from these points to utilize a new local roadway parallel to I-75 connecting to Winchell Avenue and access the interstate at Bank Street. Southbound I-75 traffic will separate from the local C-D roadway near Ezzard Charles Drive. The southbound C-D roadway will carry traffic over I-75 to OH 7th Street, allowing traffic to either; access downtown at 7th Street, travel south to OH 5th and 2nd streets, or travel across the existing Brent Spence Bridge into Covington. Access to the local southbound C-D roadway will be provided at Western Avenue and at OH 4th and 8th streets.

Alternative E also improves Western and Winchell avenues to facilitate traffic flow and increase capacity. The ramps to Western Avenue and from Winchell Avenue just north of Ezzard Charles Drive will be removed. The ramp from Freeman Avenue to I-75 northbound and the ramp from I-75 southbound to Freeman Avenue will remain. Between Ezzard Charles Drive and Western Hills Viaduct, southbound I-75 will have six lanes, northbound I-75 will have five lanes. The Western Hills Viaduct Interchange will be reconfigured to provide a full movement interchange. The improved interchange will be a single point urban interchange (SPUI) design.

5.2.3 Alternative I

The plan set for Alternative I is included in Appendix A. A comparison between Alternative I and the No Build Alternative is provided in Table 5-1.

Alternative I, which was identified as the recommended preferred alternative in the *Preferred Alternative Verification* Report (March 2011), is a combination of Alternatives C and D with certain design elements of Alternative G. Alternative I utilizes the existing I-71/I-75 alignment from the southern project limits at the Dixie Highway Interchange north to the Kyles Lane Interchange. The Dixie Highway and Kyles Lane interchanges will be modified slightly to accommodate a C-D roadway, which will be constructed along both sides of I-71/I-75 between the two interchanges. North of the Kyles Lane Interchange, the alignment shifts to the west to accommodate additional I-71/I-75 travel lanes. Between Kyles Lane and KY 12th Street, six lanes will be provided in each direction for a total of 12 travel lanes. Near KY 12th Street, the alignment separates into three routes for I-71, I-75, and a local C-D roadway in the northbound direction.

In Alternative I, access into Covington from the I-71/I-75 interstate will be provided by the local C-D roadway. Access into Covington from the C-D roadway will be provided at KY 12th Street for northbound traffic and at KY 5th and KY 9th streets for southbound traffic. Direct access to I-71 northbound from Covington will be provided at KY 9th Street. Access to I-75 northbound from Covington will require using the C-D roadway through downtown Cincinnati and connecting to I-75 northbound at the Ezzard Charles merge. Access from Covington to I-71/I-75 southbound is located at KY 12th Street. Access from Covington to downtown Cincinnati will be provided by the C-D roadway system which will be accessible from KY 9th and KY 4th streets. Bullock Street will be extended north from Pike Street to KY 9th, KY 5th, and KY 4th streets and Jillian's Way will be extended north from Pike Street to KY 9th and KY 5th streets.

A new double deck bridge will be built just west of the existing Brent Spence Bridge to carry northbound and southbound I-75 traffic with three lanes in each direction. Two additional lanes will be provided for southbound I-71 traffic and three other lanes will carry southbound local traffic as part of the C-D roadway system. The existing Brent Spence Bridge will be rehabilitated to carry two lanes for northbound I-71 traffic and three lanes for northbound local traffic as part of the C-D roadway system.

Alternative I reconfigures I-75 through the I-71/I-75/US 50 Interchange and eliminates all access to and from I-75 from KY 12th Street to the US 50/ OH 6th Street overpass in the northbound direction. Alternative I also eliminates access to and from I-75 southbound between KY 12th Street and the Freeman Avenue exit.

In Ohio, a local C-D roadway will be constructed along both sides of I-75. The local northbound C-D roadway will carry local traffic from the existing bridge and provide access ramps to OH 2nd Street, I-71 northbound, US 50 westbound, OH 5th Street, and Winchell Avenue before reconnecting to I-75 just south of Ezzard Charles Drive. The northbound ramps from OH 6th and 9th streets to I-75 will have an indirect connection to I-75 via the new local roadway which runs parallel to the northbound C-D roadway, providing access to I-75 northbound around the Western Hills Viaduct Interchange. The northbound ramps from OH 4th Street will utilize the new local northbound C-D roadway for access to I-75. The southbound C-D roadway begins near the Ezzard Charles Drive overpass and carries both downtown Covington and Cincinnati traffic. The southbound C-D roadway will provide access to OH 7th, OH 5th, OH 3rd, and OH 2nd streets, as well as connecting to access ramps from Western Avenue, OH 9th Street, and US 50 eastbound. The C-D roadway will continue south over the new bridge into Covington.

Between Ezzard Charles Drive and the Western Hills Viaduct, northbound I-75 will have five lanes and southbound I-75 will have six lanes, for a total of 11 travel lanes. The ramps to Western Avenue and from Winchell Avenue just north of Ezzard Charles Drive to the Interstate will be eliminated. These ramps are being removed because the other ramps can absorb their movements and the divergence/convergence of the C-D roadway and I-75 are occurring in these segments. The southbound ramp to Freeman Avenue and the northbound ramp from Freeman Avenue to I-75 will remain. Alternative I also improves Western and Winchell avenues to facilitate traffic flow and increase capacity. Ramps to Western Avenue and from Winchell Avenue will be provided around the Western Hills Viaduct Interchange, which will be reconfigured to be a tight diamond design.

Table 5-1. Feasible Alternatives Evaluation Matrix

Evaluation Feature	No Build Alternative	Alternative E	Alternative I
Brief Description of Alternative	The No Build Alternative maintains the existing configuration of the I-75 corridor and consists of minor, short-term safety and maintenance improvements to the interstate which would maintain its continuing operation	Alternative E utilizes the existing I-71/I-75 alignment from the southern project limits at the Dixie Highway Interchange, north to the Kyles Lane Interchange. A collector distributor (C-D) roadway will be constructed along both sides of I-71/I-75 between the two interchanges. A new double deck bridge will be build just west of the existing Brent Spence Bridge. In Ohio, I-75 will be reconfigured through the I-71/I-75/US 50 interchange and some access points along I-75 will be eliminated. A local C-D roadway will provide local access in Ohio.	Alternative I is a combination of Alternatives C and D with certain design elements of Alternative G. Alternative I utilizes the existing I-71/I-75 alignment from the southern project limits at the Dixie Highway Interchange north to the Kyles Lane Interchange. A C-D roadway will be constructed along both sides of I-71/I-75 between the two interchanges. A new double deck bridge will be built just west of the existing Brent Spence Bridge. The existing Brent Spence Bridge will be rehabilitated to carry two lanes for northbound I-71 and three lanes for northbound local traffic. In Ohio, a local C-D roadway will be constructed along both sides of I-75.
Local access to/from the interstate	No changes to existing access	Provides indirect access to interstate by way of local C-D road • I-75 access between KY 12th Street and Ezzard Charles Drive Provides direct access to interstate • 1 direct access point to I-71 NB at KY 9th Street • 1 direct access point to I-75 NB in KY 9th Street • Direct access to I-71/I-75 SB at KY 12th Street • 1 direct access point to/from I-75 NB and SB at Freeman Avenue	Provides indirect access to interstate by way of local C-D road • I-75 access between KY 12th Street and Ezzard Charles Drive Provides direct access to interstate • 1 direct access point to I-71 NB in KY at Pike Street • Direct access to I-71/I-75 SB at KY 12th Street • 1 direct access point to/from I-75 NB and SB at OH 3rd Street • 1 direct access point to/from I-75 NB and SB at Freeman Avenue
Access to Covington from I-75	No changes to existing access	Provides direct access to Covington • I-75 SB and I-71 SB access at KY 9th Street Provides indirect access to Covington by C-D road • NB access at KY 5th and 12th Street	Provides indirect access to Covington from I-75 by a C-D roadway • NB access at KY 12th Street SB access at KY 5th and 9th Street
Existing access points to I-75 in Cincinnati	No changes to existing access	Alters existing access to I-75 • Existing I-75 NB and SB access eliminated or reconfigured between KY 9th Street to just north of Western Hills Viaduct • Existing direct access to/from I-75 will remain but reconfigured at US 50	Eliminates direct access to/from I-75; Access provided by C-D roadway • I-75 NB access eliminated between KY 12th Street to just south of Ezzard Charles Drive • I-75 SB access eliminated between KY 9th Street and the Western Hills Viaduct • Access provided by C-D roadway
Separates local and regional traffic	Does not separate local and regional traffic	• A new bridge just west of the existing Brent Spence Bridge will be constructed to carry I-75 and I-71 NB and SB traffic • The existing Brent Spence Bridge will be rehabilitated to carry local NB and SB traffic	• A new bridge just west of the existing Brent Spence Bridge will be constructed to carry I-75 NB and SB, I-71 SB, and local SB traffic • Existing Brent Spence Bridge will be rehabilitated to carry I-71 NB and local NB traffic
Design Exceptions	Not applicable	42 locations in total (5 in KY; 37 in OH)	43 locations in total (3 in KY; 40 in OH)
Existing (2005) levels of service and average daily traffic	Approximately 160,000 vehicles per day LOS C to F	Not applicable	Not applicable
Future (2035) levels of service along mainline segments	I-75: • 16 NB and 15 SB LOS E or worse I-71: • 3 NB and 6 SB LOS E or worse	I-75: • 9 NB and 10 SB LOS E or worse I-71: • 5 NB and 3 SB LOS E or worse	I-75: • 6 NB and 10 SB LOS E or worse I-71 • 6 NB and 2 SB LOS E or worse

Table 5-1. Feasible Alternatives Evaluation Matrix

Evaluation Feature	No Build Alternative	Alternative E	Alternative I
Future (2035) design hourly volumes along mainline segments (NB = northbound; SB = southbound)	I-75: • NB ranges from 2,360 – 8,860 • SB ranges from 2,760 – 10,170 I-71/I-75: • NB ranges from 5,310-8,650 • SB ranges from 940-9,160 I-71: • NB ranges from 1,900 – 7,400 • SB ranges from 2,420 – 6,330	I-75: • NB ranges from 2,870 – 8,680 • SB ranges from 2,940 – 9,360 I-71/I-75: • NB ranges from 6,440 – 8,910 • SB ranges from 6,440 – 10,390 I-71: • NB ranges from 2,240 – 7,690 • SB ranges from 2,660 – 6,490	I-75: • NB ranges from 2,010 – 8,870 • SB ranges from 2,730 – 9,750 I-71/I-75: • NB ranges from 5,700 – 8,910 • SB ranges from 6,440 – 10,390 I-71: • NB ranges from 2,240 – 7,690 • SB ranges from 2,310 – 6,490
Right-of-way Impacts – (acres within construction limits)	No Impact	36.90 total acres KY – 24.45 acres OH – 12.45 acres	31.37 total acres KY – 21.76 acres OH – 9.61 acres
Parcels – (total estimated parcels impacted)	No Impact	KY – 162 parcels OH – 111 parcels	KY – 123 parcels OH – 68 parcels
Compatibility with existing community land use plans	• Not compatible with economic development plans • Does not preclude future light rail plans • No changes to existing land uses	Compatible with plans • Supports redevelopment and economic plans in Queensgate and Cincinnati • Keeps land uses conducive with Northern Kentucky comprehensive plans • Makes provisions for future light rail plans	Compatible with plans • Supports redevelopment and economic plans in Queensgate and Cincinnati • Keeps land uses conducive with Northern Kentucky comprehensive plans • Makes provisions for future light rail plans
Community Cohesion	No impact	Loss of residences in Lewisburg neighborhood and historic district and West McMicken Avenue neighborhood	Loss of residences in Lewisburg neighborhood and historic district
Facilities and Services	No impacts	• Goebel Park (3.7 acres - parking lot, portion of walking trail, and basketball court) • Queensgate Playground and Ball Fields (strip take – 0.6 acres) • Notre Dame Academy School (1.34- portion of parking lot and ball field) • Beechwood Schools (strip take) • Central Church of the Nazarene (KY) (0.44 acres – portion of parking lot)	• Goebel Park (1.9 acres - basketball court, parking lot) • Queensgate Playground and Ball Fields (strip take – 0.9 acres) • Notre Dame Academy School (1.34 acres - portion of parking lot and ball field) • Beechwood Schools (strip take) Central Church of the Nazarene (KY) (0.44 acres – portion of parking lot)
Residential – (total estimated structures and residences displaced)	No Impact	89 Total (89 – 356 persons) KY – 74 structures (74 – 296 persons) OH – 15 structures (15 - 60 persons)	43 Total (43-172 persons) KY – 43 structures (43-172 persons) OH – no residential displacements
Business – (total estimated businesses and employees displaced)	No Impact	17 Total (408 – 529 employees) KY – 8 businesses (100-130 employees) OH – 9 businesses (308 – 399 employees)	15 Total (341 – 382 employees) KY – 8 businesses (90-115 employees) OH – 7 business (251 – 267 employees)

Table 5-1. Feasible Alternatives Evaluation Matrix

Evaluation Feature	No Build Alternative	Alternative E	Alternative I
Environmental Justice – (impacts to neighborhoods and Census tracts with high percentage of low income and minority populations)	No impact	• No minority population impacts in KY • Medium impact to low-income populations (residences displaced in Lewisburg) in KY • Impact to parking lot, basketball court, and portion of walking path in Goebel Park • Medium impact to low-income population in Ohio (residences displaced on McMicken Avenue) • Strip taken of land in Queensgate Playground and Ball Fields in EJ community • No disproportionate impacts	• No minority population impacts in KY • Low impact to low-income populations (residences displaced in Lewisburg) in KY • Impact to parking lot and basketball court in Goebel Park • Low impact to low-income population in Ohio (residences displaced on McMicken Avenue) • Strip taken of land in Queensgate Playground and Ball Fields in EJ area • No disproportionate impacts
Intermittent Streams	No impact	3,335 linear feet	3,340 linear feet
Ephemeral Streams	No impact	0 linear feet	0 linear feet
Wetlands	No impact	1.38 acres	1.38 acres
Indiana bat habitat (Potential /Marginal)	No impact	28/27 acres	28/28 acres
Potential Running Buffalo Clover habitat	No impact	2 acres	2 acres
Floodplains	No impact	Piers for new Ohio River Bridge	Piers for new Ohio River Bridge
Farmland	No impact	No impact	No impact
Number of sites recommended for Phase II Environmental Site Assessment	No Impact	10 in total	11 in total
Number of sites recommended for Phase I Environmental Site Assessment at Western Hills Viaduct	No Impact	0	1
Individual properties eligible for listing or listed in the National Register of Historic Places (NRHP)	No impact	Longworth Hall – 198 feet	Longworth Hall – 198 feet
Historic Districts (HD) directly impacted	No impact	• Lewisburg Historic District (53 contributing buildings) • West McMicken Avenue Historic District (8 contributing buildings)	• Lewisburg Historic District (33 contributing buildings)
Potential Archaeological Sites	No impact	1	0
Air Quality	Conforming	Conforming	Conforming
Number of receptor sites where 2035 noise levels will approach or exceed the NAC of 66 dBA for Category B land use (residential)	40	45	52
Number of receptor sites where 2035 noise levels will approach or exceed the NAC of 71 dBA for Category C land use (industrial/commercial)	2	6	3
Section 4(f) Resources	No Impact	• Goebel Park (3.7 acres – basketball court and portion of walking trail) • Lewisburg Historic District (53 contributing buildings) • Queensgate Playground and Ball Fields (0.6 acres) • Longworth Hall (198 feet of building) • West McMicken Avenue Historic District (8 contributing buildings)	• Goebel Park (1.9 acres – basketball court) • Lewisburg Historic District (33 contributing buildings) • Queensgate Playground and Ball Fields (0.9 acres) • Longworth Hall (198 feet of building)
Section 6(f) Parks	No Impact	Goebel Park (3.7 acres)	Goebel Park (1.9 acres)

Table 5-1. Feasible Alternatives Evaluation Matrix

Evaluation Feature	No Build Alternative	Alternative E	Alternative I
Maintenance of Traffic and Constructability	No impact	• The project will be constructed in five phases • Construction will last seven years. • I-71 will be re-shielded to I-471 • Access to the CBDs in Covington and Cincinnati will be maintained at all times	• The project will be constructed in four primary phases with several sub-phases. • Construction will last eight years utilizing standard practice construction methods and durations. • I-71 will be re-shielded to I-471 • Access to the CBDs in Covington and Cincinnati will be maintained at all times
Utilities	No Impact	57	57
Cost Estimates (in millions)	Not applicable	Kentucky $700.2 Ohio $971.6 WHV $269.6 Existing Bridge $73.5 New Bridge $730.2 Total $2,745.1	Kentucky $641.4 Ohio $896.7 WHV $141.8 Existing Bridge $73.5 New Bridge $730.2 Total $2,483.6

5.3 Western Hills Viaduct Interchange

5.3.1 Interchange Alternative Development

The Western Hills Viaduct (WHV) is a multi-level structure that spans across the Mill Creek Valley connecting I-75, Central Parkway, West McMillan Street, and Spring Grove Avenue on the east with Queen City Avenue, Harrison Avenue, and State Avenue on the west. The WHV carries local traffic between the west side of Cincinnati and downtown and provides connections to I-75 northbound and southbound from the west side of Cincinnati. Interstate and local traffic movements are intermixed between the upper deck, which consists of four travel lanes, and the lower deck, which consists of three travel lanes. The WHV provides pedestrian access with a sidewalk on the south side of the upper deck; however, it does not have any shoulders or bike lanes along the travel lanes for bicycle access.

The existing interchange is a full movement interchange to the west only with a left-hand exit. Southbound I-75 traffic exits to the lower deck and enters from the lower deck while northbound I-75 traffic exits to the upper deck and enters from the upper deck.

Ramp metering is not currently being utilized, but is being designed into the recommended preferred alternative at the WHV interchange in order to keep freeway lanes flowing at near capacity where the demand traffic to enter the freeway exceeds its capacity. Ramp meters will be placed on entrance ramps to restrict the flow of traffic entering the freeway. The WHV is the northern most interchange within the Brent Spence Bridge Replacement/Rehabilitation Project and traffic demand is substantially higher than the carrying capacity of the lanes on I-75 in the vicinity of WHV. Because of this, the metering rate was set to the most restrictive level possible to avoid the level of service on I-75 dropping to an LOS F.

In Step 4 of the PDP, several sub-alternatives were evaluated for the WHV Interchange. Three of these sub-alternatives were recommended for further study in the *Planning Study Report*. These three sub-alternatives were studied in the *Conceptual Alternatives Study* during Step 5 of the PDP: an offset roundabout diamond; a single roundabout diamond; and a single-point urban interchange (SPUI) with an at-grade intersection with Central Parkway.

During Step 5, all three sub-alternatives were dismissed from further study because analyses showed each concept did not have the capacity to handle the projected future traffic. A fourth alternative was considered during Step 5 which connected Spring Grove to I-75 by adding a third level to the interchange under I-75. This full movement interchange was also dismissed after further investigation due to several fatal flaws both operationally and geometrically.

The primary conceptual design constraints were:

- Incorporating the existing WHV multi-level configuration into the proposed design to avoid replacing the entire structure to the west.
- Number of existing travel lanes on both levels of WHV.
- Limited storage capacity between the I-75/WHV Interchange and the intersection to the east with Central Parkway and West McMillan Street.
- Large traffic demand created when adding additional movements to make a full movement interchange.
- Close proximity between the existing WHV and Hopple Street interchanges precluded designs which required two lane entrance ramps or ramp braiding from WHV to the north.
- Topography of the general area, particularly to the east of I-75 restricted possible realignment of side roads and intersection locations.

In Step 7 of the PDP, a full movement, SPUI alternative and a tight urban diamond interchange (TUDI) alternative with restricted access to and from the west were developed for the WHV Interchange. The two interchange alternatives were developed independently from the rest of the Brent Spence Replacement/Rehabilitation Project. This was done to achieve the best configuration for the WHV Interchange. The geometric layout of either interchange will work with Alternative I. For analysis purposes, the SPUI design is shown with Alternative E and the TUDI design is shown with Alternative I, refer to Appendix A

5.3.2 Single Point Urban Interchange (grade-separated with Central Parkway)

A SPUI provides a single intersection located in the center of the interchange for all ramps, versus a traditional diamond interchange which has two ramp intersections located to the right and to the left of the highway mainline. The SPUI option is shown in Exhibit 7**.**

The SPUI alternative is a full movement interchange. Both northbound and southbound interstate traffic would have access to WHV eastbound and westbound. Local traffic from the east and from the west would also have access to both northbound and southbound I-75, providing several movements not provided for in the existing condition. There is however one existing movement that would not be provided in this proposed condition. Westbound traffic on West McMillan Street would no longer have access to northbound Central Parkway as the left turn movement onto the Connector Road would be prohibited. This movement accounts for a very small number of vehicles.

An earlier SPUI design was removed from consideration during Step 5 of the PDP. This original design did not provide the necessary storage at the Western Hills interchange with Central Parkway and was therefore removed from consideration. The SPUI was later redesigned to its current configuration to bridge Central Parkway and loop back around, connecting to the east side of Central Parkway, thereby providing sufficient storage at the interchange of Western Hills and Central Parkway.

For this alternative, WHV would be realigned to intersect West McMillan Street at the existing West McMillan Street/West McMicken Avenue intersection. This realignment also includes grade separating the intersection of WHV and Central Parkway. A new bridge would replace the existing WHV structure from approximately 900 feet west of Spring Grove Avenue to just east of I-75. An additional structure would be required to carry WHV traffic over Central Parkway. WHV would be connected to Central Parkway by a new two-way Connector Road. The addition of this new road would provide storage between the WHV and Central Parkway necessary for acceptable traffic operations at this interchange. In several locations multi-lane turning movements would be required including one triple left turn movement from I-75 southbound to WHV eastbound.

On the upper deck of the WHV, traffic would be a mix of both local and interstate traffic. The lower deck connection to and from Spring Grove Avenue would remain; however, the existing access between I-75 and the lower deck would be removed. Pedestrian access on the south side of the upper deck would be maintained on the new structure with a connection to Central Parkway along the inside of the new Connector Road.

5.3.3 Tight Urban Diamond Interchange

A TUDI is characterized by having two ramp intersections like a traditional diamond but located much closer to each other. This creates a much smaller footprint than a traditional diamond interchange. The TUDI option is shown in Exhibit 8.

The TUDI alternative is a full movement interchange to the west only. This alternative replaces the same movements provided in the existing condition but removes the undesirable left-hand exit from I-75 and splits the existing function of the WHV by separating the local traffic movements from the interstate traffic movements between the upper and lower decks. The local traffic movement between the west side of Cincinnati and downtown would be located on the upper deck of the WHV, while interstate traffic movements would be located on the realigned lower deck. Because the TUDI would tie into the existing double deck configuration of the WHV structure, the WHV structure would not require any changes beyond the immediate tie in with the TUDI. Should the WHV be modified from a double deck structure to a single deck structure, a traffic signal and interchange would be required on the east side to coordinate traffic flow from what was originally two decks down to a single deck.

This TUDI interchange alternative would provide a replacement structure in the existing structure location from just east of Spring Grove Avenue to the existing abutment location, east of I-75. This replacement structure would connect to the existing upper deck of the WHV at Spring Grove Avenue. The lower deck would be realigned beginning west of the current I-75 southbound ramp diverge location. It would follow a new alignment which crosses Spring Grove Avenue and I-75 south of the WHV upper deck location. This new lower deck structure would be constructed along a new alignment to accommodate two lanes in each direction to carry WHV interstate traffic over I-75 to the lower deck of the WHV.

This new lower deck structure would provide the basis for the interchange which would have the I-75 northbound and southbound ramps tying into it, and would accommodate two lanes of traffic in each direction. The two lanes of traffic in the westbound direction would taper down utilizing pavement markings to one lane west of the interchange and would tie into the outside lane on the north side of the lower deck. This tapering down from two lanes to one lane will be accomplished by pavement markings and not be actual structure narrowing. The remaining two lanes on the lower deck of the WHV would be used to move eastbound traffic to the new I-75 interchange. This configuration requires reversing the direction of traffic in the center lane on the lower deck from the existing condition (westbound) to eastbound.

Realigning the lower deck would remove the existing connection to and from Spring Grove Avenue. In order to restore this connection, two one-way connections are proposed in the TUDI Option 1. One connection would replace the movement from Spring Grove Avenue to the west and the other replaces the movement from the west to Spring Grove Avenue. Both connections utilize the footprints of the existing loop ramps which would be removed as part of this interchange alternative. Pedestrian access to and from the upper deck would be provided along the inside of these two connections. The connection to carry traffic to the west is proposed north of the interchange. This connection would have an intersection at Spring Grove Avenue and pass under I-75 and form a merge with WHV to the east of I-75, closely following the alignment of the existing loop ramp. Similarly, in the eastbound direction, the connection would follow the alignment of the existing loop ramp for approximately several hundred feet and then align to become the fourth leg of an intersection with Harrison Avenue and Winchell Avenue to the southeast of the new interchange.

The two one-way connections to Spring Grove Avenue were removed in the TUDI Option 2. The connections were removed in this option to reduce construction and utility relocation costs. The connection from Spring Grove Avenue to westbound WHV would pass under I-75, which would require bridge structures to be constructed. There are underground utilities which may need to be relocated in the vicinity of the proposed bridge structures.

5.4 Recommended Preferred Alternative

Alternative E and Alternative I were compared to one another in detail as part of the *Preferred Alternative Verification Report* (May 2011), and the *Environmental Assessment* (November 2010). Alternative I will provide greater operational improvements and have less overall impacts than Alternative E. As a result of this analysis, Alternative I was recommended as the preferred alternative (Exhibit 3).

Alternative I is the recommended preferred alternative with the inclusion of the Western Hills Viaduct Tight Urban Diamond Interchange (TUDI) Option 1. The Western Hills viaduct TUDI Option 1 was chosen because it creates a much smaller footprint than a traditional diamond interchange and therefore would result in less impact to the surrounding community and existing structures. Additionally this option provides the same movements that are provided by the existing conditions, with the added benefit of removing the undesirable left-hand exit from I-75 and separating local and interstate traffic movements between the upper and lower decks. This recommendation is based on the design features, local access features, traffic operations, environmental impacts, and estimated costs.
In Kentucky, Alternative I will provide a direct connection to KY 5th Street in Covington in the southbound direction, but in the northbound direction, motorists will only have direct access to I-71. In Ohio, Alternative I's design is based on a C-D roadway system which provides free-flow movements. For example, Alternative I will provide a direct connection via a C-D roadway system in Ohio to northbound I-75 and I-71, which is free-flow.

Alternative I will have fewer displacements and requires slightly less acres than other previously studied alternatives. Alternative I will be compatible with existing land use plans, will support the Queensgate redevelopment plans, and help Cincinnati facilitate its economic renewal goals. Overall, the impacts to resources caused by Alternative I are fewer than the previously studied alternatives.

The total cost for Alternative I with the TUDI design at the WHV is estimated to be $2,443.7 million. Bridge cross sections are provided in Exhibit 5.

5.5 Design Criteria

The recommended preferred alternative was developed in accordance with the geometric design criteria requirements of both KYTC and ODOT. The Kentucky section was designed in accordance with the most current version of KYTC's *Highway Design Manual* and the Ohio section was designed in accordance with the most current version of ODOT's *Location and Design Manual.*

In Kentucky, three categories of design requirements were applied to the recommended preferred alternative; mainline, service ramps, and local streets. In Ohio, four categories of design requirements were applied to the recommended preferred alternative; mainline, directional ramps, service ramps, and local streets. Each of these categories has a roadway classification and design speed. The functional classification of the mainline roadway is "Principal Arterial – Interstate (Urban)" with a design speed of 60 miles per hour (mph). The directional ramps and service ramps for both Kentucky and Ohio are classified as "Collector (Urban)" with design speeds varying from 30 to 60 mph; and the local streets are classified as "Local (Urban)" with a design speed of 30 mph in Kentucky and 25 to 40 mph in Ohio. The required criteria for the nine categories of design features, with detailed subcategories, and the location of reference information in the respective design manuals, are detailed in Table 5-2.

A central part of the project is the rehabilitation of the existing Brent Spence Bridge and the construction of the new Ohio River Bridge. The new structure would include an open span to preserve the navigation channel of the Ohio River. Coordination with the US Coast Guard (USCG) was initiated to determine locations of bridge piers in the Ohio River.

The recommended preferred alternative will cross the Ohio River on a new bridge, the new Ohio River Bridge, located approximately 120 feet west of the existing Brent Spence Bridge. In accordance with USCG requirements, the piers for this bridge must be placed “outside” of the existing Brent Spence Bridge piers. The piers would be placed in the Ohio River approximately 85 feet closer to the banks of the Ohio River than the current Brent Spence Bridge piers. The existing Brent Spence Bridge has a middle span length of 830.5 feet between existing piers. The new bridge would have a middle span length of approximately 1,000 feet from center to center of the proposed piers. The bridge abutments would be located approximately 400 feet north and south of the proposed piers.

Table 5-2. Geometric Design Criteria

Design Feature	Design Criteria – Ohio								Design Criteria - Kentucky						Notes
	Mainline (60 mph)		Directional Ramp[1] (60/45 mph)		Service Ramp[2] (50/40/30 mph)		Local Street (25 – 40 mph)		Mainline (60 mph)		Service Ramp[2] (50/40/30 mph)		Local Street (25 – 40 mph)		
Horizontal Alignment															
Max Centerline Deflection w/o Horizontal Curve	1°00'	Fig. 202-1E	1°00' 1°45'	Fig. 202-1E	1°15' 2°15' 3°45'	Fig. 202-1E	2°15'	Fig. 202-1E	n/a		n/a		n/a		
Maximum Degree of Curve	4°15'	Fig 202-2E	4°15' 9°00'	Fig 202-2E Fig 202-10E	6°45' 11°45' 24°45'	Fig 202-2E Fig 202-10E Fig 202-10E	10°45'	Fig 202-9E	1205'	Exhibit 3-23 161	835' 510' 275'	Exhibit 3-22 159	300'	Exhibit 3-21 157	
Max Curve without Super	0°33'	Fig 202-3E	0°33' 0°57'	Fig 202-3E Fig 202-10E	0°47' 1°10' 1°58'	Fig 202-3E Fig 202-10E Fig 202-10E	7°42'	Fig 202-9E	12000'	Exhibit 3-23 161	8000' 6000' 3500'	Exhibit 3-22 159	3500'	Exhibit 3-21 157	
Maximum Superelevation (e_{max})	6.00%	Fig 202-8E	6.00%	Fig 202-8E Fig 202-10E	6.00%	Fig 202-8E Fig 202-10E	4.00%	Fig 202-9E	8.00%		6.00%		4.00%		
Spiral Length	≥ Length of Runoff		---	---	---	---	---	---	Length of Runoff		---	---	---	---	
Vertical Alignment															
Maximum Grade[3]	4%	Fig 203-1E	6%	Fig 203-1E	6%	Fig 203-1E	10%	Fig 203-1E	4%	Exhibit 8-1 510	5%	pg. 833	11%		1% steeper may be used in extreme cases or for one-way downgrades.
Max Vertical Deflection without a Vertical Curve	0.30%	Fig 203-2E	0.30% 0.55%	Fig 203-2E	0.45% 0.75% 1.30%	Fig 203-2E	0.75%	Fig 203-2E	n/a		n/a		n/a		Min. distance between deflections is 100' for speed ≥ 50 MPH, 50' for speed < 50 MPH.
Pavement Cross Slopes (normal)	0.016	301.1.5	---	---	---	---	---	---	2.00%		---	---	---	---	
Use of Spirals	D > 3°	202-11 202-5	---	---	---	---	---	---	e > 3.0%		---	---	---	---	
Transition Length / Rate (drop line)	L= 60 x Lane Width	301.1.4	---	---	---	---	---	---	L = 50:1 to 70:1		---	---	---	---	
Pavement Slope Transition	222:1 max	Fig 202-4E	222:1 max 185:1 max	202-4E	200:1 max 172:1 max 152:1 max	202-4E	172:1	202-4E	222:1 max	Exhibit 3-27 170	200:1 max 172:1 max 152:1 max	Exhibit 3-27 170	152:1	Exhibit 3-27 170	For methods of transition see 202-5, 202-5a, 202-5b, 202-5c, 202-5d, 202-6.

Table 5-2. Geometric Design Criteria

Design Feature	Design Criteria – Ohio								Design Criteria - Kentucky						Notes
	Mainline (60 mph)		Directional Ramp[1] (60/45 mph)		Service Ramp[2] (50/40/30 mph)		Local Street (25 – 40 mph)		Mainline (60 mph)		Service Ramp[2] (50/40/30 mph)		Local Street (25 – 40 mph)		
Grade Point Position	Inside Edge		Inside/ Outside Edge		Inside/ Outside Edge		Outside Edge		Inside Edge		Inside/ Outside Edge		Outside Edge		
K-Values															
Crest Vertical Curve	151	Fig 203-3E	151 61	Fig 203-3E	84 44 19	Fig 203-3E	44	Fig 203-3E	151	Exhibit 3-76 274	84 44 19	Exhibit 3-76 274	19	Exhibit 3-76 274	
Sag Vertical Curve[4]	136	Fig 203-6E	136 79	Fig 203-6E	96 64 37	Fig 203-6E	64	Fig 203-6E	136	Exhibit 3-79 280	96 64 37	Exhibit 3-79 280	37	Exhibit 3-79 280	
Sight Distance															
Stopping Sight Distance (vertical curves)	570' min.	Fig 201-1E	570' 360'	Fig 201-1E	425' 305' 200'	Fig 201-1E	305'	Fig 201-1E	570' min.	Exhibit 3-1 112	425' 305' 200'	Exhibit 3-1 112	200'	Exhibit 3-1 112	
Min. Passing Sight Distance	---	---	---	---	---	---	1470'	Fig 201-3E	---	---	---	---	1090'	Exhibit 3-7 124	
Intersection Sight Distance	---	---	---	---	---	---	445' LT 385' RT	Fig 201-5E	---	---	---	---	335' LT 290' RT	Exhibit 9-55, 665 Exhibit 9-58, 668	See Fig. 201-4 also.
Decision Sight Distance	1150' (B) 1280' (E)	Fig 201-6E	1150' (B) 1280'(E) 800'(B) 930' (E)	Fig 201-6E	910' (B) 1030' (E) 690' (B) 825' (E) 490' (B) 620' (E)	Fig 201-6E	690' (B) 825' (E)	Fig 201-6E	1150' (B) 1280' (E)	Exhibit 3-3 116	910' (B) 1030' (E) 690' (B) 825' (E) 490' (B) 620' (E)	Exhibit 3-3 116	490' (B) 620' (E)	Exhibit 3-3 116	
Clearances (New & Reconstructed)															
Lateral On Bridge (≥ 200' long)	12' Rt. 12' Med. ≤ 2 lanes 12'RT, 4'LT	Fig 302-1E	**1-Lane / 2-Lane** 8' Rt. / 12' Rt. 6' Lt. / 6' Lt.	Fig 303-1E	8' Rt. 6' Lt.	Fig 303-1E	**Uncurbed / Curbed** 4'-10' / 1'-2'	Fig 301-4E	12' Rt. 12' Med.	pg. 765	8' Rt. 6' Lt.	pg. 765	**Uncurbed / Curbed** 4'-10' / 1'-2'		12' accommodates future MOT. 4' lateral on median allowed on four-lane alternative.
Lateral On Bridge (≤ 200' long)	12' Rt. 12' Med. ≤ 2 lanes 12'RT, 4'LT	Fig 302-1E	**1-Lane / 2-Lane** 8' Rt. / 12' Rt. 6' Lt. / 6' Lt.	Fig 303-1E	8' Rt. 6' Lt.	Fig 303-1E	**Uncurbed / Curbed** 4'-10' / 1'-2'	Fig 301-4E	12' Rt. 12' Med.	pg. 765	8' Rt. 6' Lt.	pg. 765	**Uncurbed / Curbed** 4'-10' / 1'-2'		12' accommodates future MOT. 4' lateral on median allowed on four-lane alternative.

Table 5-2. Geometric Design Criteria

Design Feature	Design Criteria – Ohio								Design Criteria - Kentucky						Notes
	Mainline (60 mph)		Directional Ramp[1] (60/45 mph)		Service Ramp[2] (50/40/30 mph)		Local Street (25 – 40 mph)		Mainline (60 mph)		Service Ramp[2] (50/40/30 mph)		Local Street (25 – 40 mph)		
Vertical	17.0' Pref. 15.5' Min.	Fig 302-1E	17.0' Pref. 15.5' Min.	Fig 302-1E	17.0' Pref 15.5' Min.	Fig 302-1E	15.0' Pref 14.5' Min.	Fig 302-1E	17.5' Pref.. 16.0' Min.	pg. 511	17.5' Pref.. 16.0' Min.	pg. 511	17' Pref.. 14.5' Min.	pg. 511	
Clear Zone	(>6000 ADT)		(>6000 ADT)		(>6000 ADT)		(>6000 ADT)		(>6000 ADT)		(>6000 ADT)		(>6000 ADT)		
Foreslope 6:1 or Flatter	30'	Fig 600-1E	30' 19'	Fig 600-1E	19' 15' 15'	Fig 600-1E	15'	Fig 600-1E	30'	Table 3.1 3-6[a]	22' 15' 15'	Table 3.1 3-6[a]	15'	Table 3.1 3-6[a]	
Foreslope Steeper than 6:1 to 4:1	30'	Fig 600-1E	30' 26'	Fig 600-1E	26' 17' 17'	Fig 600-1E	17'	Fig 600-1E	40'	Table 3.1 3-6[a]	26' 17' 17'	Table 3.1 3-6[a]	17'	Table 3.1 3-6[a]	
Backslope 6:1 or Flatter	27'	Fig 600-1E	27' 21'	Fig 600-1E	21' 15' 15'	Fig 600-1E	15'	Fig 600-1E	27'	Table 3.1 3-6[a]	22' 15' 15'	Table 3.1 3-6[a]	15'	Table 3.1 3-6[a]	
Backslope Steeper than 6:1 to 4:1	25'	Fig 600-1E	25' 19'	Fig 600-1E	19' 15' 15'	Fig 600-1E	15'	Fig 600-1E	25'	Table 3.1 3-6[a]	20' 15' 15'	Table 3.1 3-6[a]	15'	Table 3.1 3-6[a]	
Backslope Steeper than 4:1	21'	Fig 600-1E	21' 15'	Fig 600-1E	15' 15' 15'	Fig 600-1E	15'	Fig 600-1E	21'	Table 3.1 3-6[a]	15' 15' 15'	Table 3.1 3-6[a]	15'	Table 3.1 3-6[a]	
Lanes															
Number of Thru Lanes	>3 (by alt)		2 or 1		2 or 1		Varies		>3 (by alt)		2 or 1		Varies		
Lane Width	12'	Fig 301-4E	12' (2-lane) 16' (1-lane)	Fig 303-1E	12' (2-lane) 16' (1-lane)	Fig 303-1E	12' 11' (Min.)	Fig 301-4E	12'		12' (2-lane) 15' (1-lane)		12'		
Shoulders															
Treated Width	12' Rt. 12' Med ≤ 2lanes 12' Rt 4' Med	Fig 301-3E	10'Rt. / 4'Lt. 6'Rt. / 4'Lt.	Fig 303-1E[5]	6'Rt. / 3'Lt.	Fig 303-1E	2' Curb & Gutter	Fig 301-4E	12' Rt. 12' Med.		6'Rt. / 4'Lt.		2' Curb & Gutter		12' accommodates future MOT. 4' median shoulder allowed on four-lane alternative.
Graded Width with Barrier or Foreslopes Steeper Than 6:1	17' Rt. 17' Med.	Fig 301-3E	15'Rt. / 9'Lt. 11'Rt. / 9'Lt.	Fig303-1E	15'Rt. / 9'Lt. 11'Rt. / 9'Lt.	Fig 303-1E	---	---	See Clear Zone Criteria		See Clear Zone Criteria		---	---	Two lane (top) One lane (bottom)
Graded Width without Barrier and Foreslopes 6:1 or Flatter	12' Rt. 12' Med.	Fig 301-3E	10'Rt. / 6'Lt. 8'Rt. / 6'Lt.	Fig 303-1E	10'Rt. / 6'Lt. 8'Rt. / 6'Lt.	Fig 303-1E	---	---	See Clear Zone Criteria		See Clear Zone Criteria		---	---	Two lane (top) One lane (bottom)

Table 5-2. Geometric Design Criteria

Design Feature	Design Criteria – Ohio								Design Criteria - Kentucky						Notes
	Mainline (60 mph)		Directional Ramp[1] (60/45 mph)		Service Ramp[2] (50/40/30 mph)		Local Street (25 – 40 mph)		Mainline (60 mph)		Service Ramp[2] (50/40/30 mph)		Local Street (25 – 40 mph)		
Normal Barrier Offset[7]	14' Rt. 14' Med. 12' RT & Med if Conc Barr	Fig 301-3E Or 10' RT 4' LT for ≤ 2 lanes w/ Conc Barr	12'Rt. / 6'Lt. 8'Rt. / 6'Lt.	Fig 303-1E	12'Rt. / 6'Lt. 8'Rt. / 6'Lt.	Fig 303-1E	4' Min.	602.1.5.1	14' Rt. 14' Med.	pg. 319	8'Rt. / 6'Lt.		4' min.		Two lane (top) One lane (bottom)
Assumed Median Width	30' 27' 12+12+3	---	---	---	---	---	---	---	30'	---	---	---	---	---	
Shoulder Pavement Cross Slopes (normal)	4%	Fig 301-8	4%	Fig 301-8	4%	Fig 301-8	4%	Fig 301-8	4%	pg. 320	4%	pg. 320	4%	pg. 320	
Terminal Classification															
Freeway Terminal	---	---	High speed	Fig 503-2aE Fig 503-3aE	High speed	Fig 503-2aE Fig 503-3aE	---	---	---	---			---	---	
	---	---	Low Speed	Fig 503-4aE Fig 503-4bE	Low Speed	Fig 503-4aE Fig 503-4bE	---	---	---	---			---	---	
	---	---	C-D	Fig 504-1E Fig 504-2E	C-D	Fig 504-1E Fig 504-2E	---	---	---	---			---	---	
	---	---	Multi-Entrance	Fig 505-1aE Fig 504-2E	Multi-Entrance	Fig 505-1aE Fig 504-2E	---	---	---	---			---	---	
	---	---	Mulit-Exit	Fig 505-2aE Fig 505-2bE	Mulit-Exit	Fig 505-2aE Fig 505-2bE	---	---	---	---			---	---	

Ohio geometric design criteria provided in the current ODOT Location and Design Manual, Volume 1.
Kentucky geometric design criteria provided in the American Association of State Highway and Transportation Officials (AASHTO) Roadside Design Guide and the AASHTO "Green Book" (A Policy on Geometric Design of Highways and Streets, Fourth Edition).

Table notes:
1. For Directional Ramps, top line indicates upper range speed (60mph), second line indicates middle range speeds (45 mph).
2. For Service Ramps, top line indicates upper range speed (50 mph), middle line indicates middle range speed (40 mph), and bottom line indicates lower range speed (30 mph).
3. Grades may be increased by one percent for freeways in developed areas where a flatter grade is precluded.
4. Where street lighting is present, the minimum length of sag vertical curve is three times the speed.
5. For three lanes or more use: 10-foot right/10-foot left.
6. Local streets may have different criteria as required by the City of Cincinnati.
7. For Interstate 75 inside shoulder widths in Ohio, use an offset of 15 feet to the inside edge of the pavement.

5.6 Design Exceptions

Due to the constraints of the urban study area and required connections to existing roadways, some design exceptions were incorporated into the feasible alternatives. These design exceptions include the following categories:

- Increased grade: The degree of rise or descent of a vertical profile.
- Reduced shoulder: Reduction of shoulder width for the inside shoulders of the interstate mainline.
- Restrictions for horizontal stopping sight distance: When stopping sight distance is restricted horizontally. This occurs where the roadway curves to the left and the median barrier on the left restricts stopping sight distance from the driver's eye to the object.
- Restrictions for vertical stopping sight distance: When stopping sight distance is restricted vertically. This occurs at either a crest or sag vertical curve within the roadway.
- Degree of curve

Most of the anticipated design exceptions within Ohio were requested by the City of Cincinnati and are due to tying this project into existing conditions while minimizing any major impacts to adjacent properties including environmental and/or business impacts. In nearly every case, the design exceptions improve upon the existing conditions; however, eliminating all design exceptions would require significant impacts to adjacent properties due to the tight urban corridor. For the recommended preferred alternative, there will be a total of 42 design exceptions. The following is a summary of the anticipated design exceptions that will be required for the recommended preferred alternative in Kentucky and Ohio.

5.6.1 Kentucky

In Kentucky, there will be three design exceptions for the recommended preferred alternative, involving grade along an existing ramp and lane width and shoulder width on the existing Brent Spence Bridge. The design exception occurring at the ramp from I-75 southbound to Kyles Lane requires an 8.1 percent grade due to wide right of way limits required for the connection to the existing elevation at the ramp terminal. This steep slope is less than 500 feet long and provides an exit ramp to Kyles Lane on which traffic has to decelerate. This design exception could be eliminated by extending the ramp further south but this would require the acquisition of additional right of way. To eliminate the two design exceptions that occur on the lower deck of the existing bridge, the existing bridge would need to be replaced with a new structure that could accommodate the wider lane and shoulder widths. Table 5-3 identifies the three design exceptions along with their location.

Table 5-3. Design Exceptions - Kentucky

Roadway	Location	Design Exception	Standard	Proposed	Existing
I-75 SB to Kyles Lane	Sta. 445+00	Grade	6.0%	8.1%	6.5%
C-D NB	Existing Bridge (Lower Deck)	Lane Width	12' lanes	11' lanes	11' lanes
	Existing Bridge (Lower Deck)	Shoulder Width	14' left and 14' right	4' left and 8' right	1' left and 1' right

5.6.2 Ohio

In Ohio, there will be 39 design exceptions for the recommended preferred alternative. These design exceptions are classified as horizontal alignment degree of curve, horizontal stopping sight distance, vertical stopping sight distance, grade, shoulder width, and taper rate.

Horizontal Alignment, Degree of Curve.

The recommended preferred alternative would require 11 design exceptions for horizontal alignment, degree of curve at the locations identified in Table 5-4. While the design speeds vary depending on the specific roadway (interstate, ramp, or local street), the interstate is designed for 60 mph. For interstate alignments, the only degree of curve deficiencies that occur on I-71 northbound and southbound occur just north of Brent Spence Bridge towards the east (FWW). This is still an improvement over the existing condition at these locations. The curve is needed to tie into the existing bridge abutment and still tie in with US 50 eastbound before entering FWW.

The majority of the remaining design exceptions for degree of curve in Ohio are needed to achieve clearance both over and under the surrounding roadways without causing additional impacts, particularly to the Dunhumby building in the vicinity of the US 50 tie in with the C-D roadway and at the connection of I-75 southbound and I-71 northbound. For all degree of curve design exceptions a combination of additional signage, lighting, and traffic signals will be incorporated as mitigation measures.

Table 5-4. Design Exceptions for Horizontal Alignment, Degree of Curve - Ohio

Roadway	Location	Standard	Proposed	Existing
I-75 SB to I-71 NB	PI Sta. 125+75.61	45 mph	40 mph	40 mph
I-71 SB	PI Sta. 16+31.45	60 mph	50 mph	35 mph
I-71 NB	PI Sta. 14+44.56	60 mph	50 mph	45 mph
US 50 EB	PI Sta. 109+73.97	50 mph	40 mph	30 mph
US 50 WB	PI Sta. 114+02.58	50 mph	40 mph	35 mph
	PI Sta. 128+38.49	50 mph	40 mph	35 mph
I-71 SB to C-D SB	PI Sta. 31+16.63	45 mph	35 mph	N/A
	PI Sta. 34+50.75	45 mph	35 mph	N/A
FWW to C-D NB	PI Sta. 17+51.02	45 mph	40 mph	35 mph[1]
C-D NB to US 50 WB	PI Sta. 33+69.33	45 mph	40 mph	35 mph[2]
US 50 EB to C-D SB	PI Sta. 108+02.34	45 mph	40 mph	N/A

1 Existing speed references existing movement from I-71 SB to I-75 NB.
2 Existing speed references existing movement from I-75 NB to US 50 WB.

Horizontal Stopping Sight Distance

The recommended preferred alternative would require 18 design exceptions for horizontal stopping sight distance at the locations identified in Table 5-5. Additional signage, lighting, and traffic control devices will be used as mitigation measures for all horizontal stopping sight distance design exceptions in Ohio, except for one of the two locations on the I-71 southbound connection to the southbound C-D roadway. At this location, the line of sight for the inside of the ramp radius is impeded by the bridge parapet and the proposed shoulder would need to be widened to meet the needed sight distance, therefore requiring an increase in structural width. This ramp from I-71 southbound to the C-D roadway southbound is a new connection which is utilizing the relocated I-71 southbound foot print which has existing design exceptions for stopping sight distance.

Table 5-5. Design Exceptions for Horizontal Stopping Sight Distance – Ohio

Roadway	Location	Standard	Proposed	Existing
I-75	PI Sta. 24+98.87 PI Sta. 33+88.15 PI Sta. 65+12.82	60 mph 60 mph 60 mph	57 mph 51 mph 52 mph	44 mph 50 mph 40 mph
I-75 SB to I-71 NB	PI Sta. 120+59.21 PI Sta. 125+75.61	45 mph 45 mph	43 mph 34 mph	N/A 33 mph
I-71 SB	PI Sta. 16+31.45	60 mph	42 mph	35 mph
I-75 SB Baseline at Ezzard Charles	PI Sta. 65+22.36	60 mph	54 mph	40 mph
I-71 NB	PI Sta. 14+44.56	60 mph	44 mph	41 mph
US 50 EB	PI Sta. 109+73.97	50 mph	36 mph	30 mph
US 50 WB	PI Sta. 114+02.58	50 mph	34 mph	30 mph
I-71 SB to C-D SB	PI Sta. 31+16.63 PI Sta. 34+50.75	45 mph 45 mph	31 mph 31 mph	N/A N/A
I-71 SB/US 50 WB to C-D NB	PI Sta. 17+51.02	45 mph	33 mph	35 mph
C-D NB to US 50 WB	PI Sta. 22+70.83 PI Sta. 33+69.33	50 mph 45 mph	44 mph 33 mph	N/A 32 mph
C-D NB to I-75 NB	PI Sta. 33+41.55	50 mph	41 mph	N/A
US 50 EB to C-D SB	PI Sta. 108+02.34	45 mph	34 mph	N/A
Gest Street	PI Sta. 14+34.53	40 mph	30 mph	33 mph

Vertical Stopping Sight Distance

The recommended preferred alternative would require two design exceptions for vertical stopping sight distance both located along the northbound C-D roadway connection to Winchell Avenue, identified in Table 5-6. These two design exceptions for vertical stopping sight distance on the C-D roadway are within nine mph of the required 40 mph design speed. Correcting these design exceptions would impact up to eight structures. Additional signage and lighting are proposed as mitigation measures.

Table 5-6. Design Exceptions for Vertical Stopping Sight Distance - Ohio

Roadway	Location	Standard	Proposed	Existing
C-D NB to Winchell	PI Sta. 65+75.00 PI Sta. 69+20.00	40 mph 40 mph	31 mph 31 mph	N/A N/A

Other Design Exceptions

The recommended preferred alternative would require eight additional design exceptions at eight other locations for reasons identified in Table 5-7. Eliminating the shoulder width design exception at the northbound C-D roadway connection to I-71 northbound as well as at I-71 southbound would require a widening of the I-71 trench. The remaining design exceptions are all related grade. Eliminating these remaining design deficiencies would generally cause a violation of clearance requirements either for railroads or surrounding road structures. These additional proposed design exceptions improve upon existing design exceptions for shoulder widths and grades within in the existing geometry.

Table 5-7. Other Design Exceptions - Ohio

Roadway	Location	Design Exception	Standard	Proposed	Existing
C-D NB to I-71 NB	Sta. 27+80 Sta. 9+50	Shoulder Width Grade	8' 5.0% max	4.9' 6.69%	N/A N/A
I-75	Sta. 23+00 to Sta. 27+00 (southbound only)	Grade	5.0% max	6.0%	None
I-75 SB to C-D SB	Sta. 26+00 to Sta. 30+50	Grade	5.0% max	6.5%	N/A
I-71 SB	Sta. 20+00 to Sta. 32+00 Sta. 25+00 to Sta. 35+00	Grade Shoulder Width	5.0% max 10'	5.9% 4'	6.0% 10'
I-71 NB	Sta. 25+00 to Sta. 29+00	Grade	5.0% max	6.0%	6.0%
C-D SB to 5th St.	Sta. 26+10 to Sta. 32+60	Grade	7.0% max	7.5%	None

6.0 Traffic Analysis

Capacity analysis for the No Build Alternative and the recommended preferred alternative were conducted for the Design Year of 2035 for freeway segments, ramp junctions, weave segments, collector distributor(C-D) roadways, and intersections. Turn lane storage calculations were only conducted for the recommended preferred alternative. Opening Year for the Brent Spence Bridge Replacement/Rehabilitation Project is 2015.

6.1 Traffic Methodologies

6.1.1 Traffic Volumes

The travel demand model and recent traffic count data were utilized to develop traffic projections for the No Build Alternative and the recommended preferred alternative in the 2035 design year. Certified traffic was used in the traffic analyses.

Traffic counts were performed on an average weekday within the Brent Spence Bridge study area in September, October, and November of 2005 in order to obtain existing weekday traffic volumes. Due to the project extending to the south and missing "check in" locations, additional traffic counts were conducted in January 2008 to collect traffic data at the Dixie Highway Interchange, along McMillan Avenue, and on I-71 near the I-471 Interchange. Traffic volumes for at-grade intersections were collected using turning movement counts, while ramp and mainline volumes on I-71, I-75, and US 50 were collected using portable machine counters. The AM and PM peak hours were identified from the traffic counts and were used in the 2005 analyses for the study area. The AM and PM peak hours are 7:30 to 8:30 AM and 4:30 to 5:30 PM, respectively. A review of the historical counts available from KYTC showed that the growth rate was flat between 2005 and 2008 for the routes that were not included in the 2005 traffic count effort. Because of this, the 2008 counts on these routes were assumed to be equal to the 2005 counts and an annual growth factor was not applied.

Design year (2035) traffic volumes were determined using the Ohio Kentucky Indiana Regional Council of Governments (OKI) regional travel demand model. In order to coordinate the traffic projections within the I-75 corridor and the region, traffic projections for all three adjoining I-75 projects (HAM-71/75-0.00/0.22 Brent Spence Bridge, HAM-75-2.30 Mill Creek Expressway, and HAM-75-10.10 Thru the Valley) were incorporated into the OKI regional travel demand model. The 2005 and 2008 volumes were used to project the peak hour volumes for design year 2035. In addition to the No Build condition, the OKI demand model was utilized to compute 2035 design hour traffic volumes for the recommended preferred alternative. Truck percentages for the study area were calculated based on existing traffic counts and growth rates generated from the travel demand model.

6.1.2 Capacity Analyses

The capacity analyses were performed for the recommended preferred alternative using Highway Capacity Software (HCS+) version 5.4. Capacity analyses are performed to estimate the maximum amount of traffic that can be accommodated by a roadway while maintaining prescribed operational qualities. This is accomplished using the level of service (LOS) concept. Level of service is an assessment of roadway and intersection performance, expressed LOS A to LOS F. Level of service for freeways is based on traffic density; whereas level of service for intersections is based on delay. LOS A for freeway represents free-flow conditions where vehicles are almost completely unimpeded in their ability to maneuver within the traffic stream. LOS E by contrast is defined as using all available capacity, where vehicles are closely spaced within the traffic stream and there are virtually no usable gaps to maneuver. LOS F exceeds the roadway's capacity and there is a breakdown of vehicle flow. Typically, in urban areas, a roadway component is deemed adequate if the corresponding level of service is LOS D or better, while LOS E and LOS F indicate near failure or failure respectively. The goal level of service for this region is LOS D; however, a level of service below LOS D is acceptable for the recommended preferred alternative provided the level of service is not degraded from what it is in the No Build Alternative.

Where the demand traffic flowing from one section of the freeway to another or from an entrance ramp to the mainline exceeds the maximum capacity of the freeway, the demand traffic will be constrained to reflect the actual traffic volumes which can be accommodated on the freeway (volume to capacity ratio equal to 1.00). The portion of the demand traffic that exceeds the capacity of the freeway would be constrained and not used in downstream calculations.

Freeway capacity is the maximum volume of traffic that a freeway can accommodate without resulting in a level of service of LOS F. As the volume of vehicles traveling on a freeway segment increases, the density of vehicles also increases, resulting in reduced speed. This increased density and reduction in speed will continue until the freeway reaches capacity. Once the volume of vehicles attempting to utilize the freeway exceeds the capacity of the freeway, the freeway reaches a "stop-and-go" operating condition. When a freeway becomes overcapacity, the capacity of a freeway lane shrinks to about one-third the carrying capacity that it had under free flow conditions. The capacity of a freeway segment is dependent upon several parameters: number of vehicles, free flow speed, number of lanes, and the peak hour factor.

In order to keep freeway lanes flowing at near capacity volumes when the demand to enter the freeway would exceed its capacity, and to attempt to reach the level of service goal for the region of LOS D, ramp meters may be used to restrict traffic flow onto the freeway from entrance ramps at interchanges. Entrance ramps at interchanges are the only means of adding new traffic to a freeway. Ramp metering is nothing more than placing traffic signals on the ramp to limit the amount of traffic which can enter the freeway. The traffic signals can be timed to limit the entering traffic volume to any number. Typically, highway agencies will limit the volume on the freeway to approximately 95% (100 vehicles per hour per lane less than ultimate capacity) of the ultimate carrying capacity of each freeway lane. This allows each freeway lane to move near capacity volumes with ramp metering, versus moving only a third of the ultimate capacity of each freeway lane if ramp metering was not installed.

The three projects which extend end-to-end from the Ohio River to I-275 are the Brent Spence Replacement/Rehabilitation Project, the Mill Creek Expressway, and Thru-the-Valley. Ramp metering was used throughout the Mill Creek Expressway and Thru-the-Valley projects, and will also be used on the Western Hills Viaduct Interchange (northernmost interchange within the Brent Spence Replacement/ Rehabilitation Project.

Since the demand to use I-75 is substantially higher than the carrying capacity of the lanes on I-75, the metering rate was set to the maximum number possible. If one more vehicle would enter I-75, the freeway would be over capacity (LOS F).

Freeways consist of three parts: basic freeway mainline segments, ramp (exit and entrance) segments, and weaving sections. The basic freeway mainline segments are those segments of the freeway that are free from merging, diverging, and weaving. Freeway segments were analyzed using the HCS Freeway module and included information pertaining to total traffic volume, number of freeway lanes, design speed of the facility, and truck percentages as part of the analysis. Weaving volumes were not included as part of the certified traffic. Due to not having weaving volumes available, all merging traffic was assumed to enter the mainline freeway segment, and all diverging traffic was assumed to exit from the mainline freeway segment. This concept was utilized to insure that the worst case scenario was analyzed, providing the highest weaving volumes. The capacity of a particular freeway segment is directly related to the number of lanes available, the truck percentage on that segment, and the design speed. The recommended preferred alternative was assumed to have a mainline design speed of 60 miles per hour (mph).

The C-D roadway analysis followed the same methodology used for the freeway segments, merges, and diverges. While the proposed design speed for a C-D roadway is 50 mph, HCS would only allow a minimum design speed of 55 mph. Therefore the 55 mph design speed was used in the analysis.

Ramp merge and diverge areas were analyzed using one of two methodologies. If the ramp did not create an add-lane or a drop-lane condition, the HCS Ramps module provided estimated densities for the merge or diverge area. This analysis incorporated information pertaining to total freeway volume upstream of the merge/diverge area, ramp volumes, number of freeway lanes, number of ramp lanes, design speeds of both the freeway and ramp, and truck percentages for both the freeway and ramp. The densities correlate with the level of service for the merge/diverge area.

The second methodology for ramp areas is used when there is an add-lane or drop-lane condition in the merge or diverge area. In this case, these areas are treated as “major merge” or “major diverge” areas and each freeway segment of the merge or diverge area had its own density calculation. The HCS Freeway module can only analyze segments with two or more lanes. Therefore, single-lane ramps were analyzed as two-lane segments with double their actual volumes.

The study area contains both signalized and unsignalized intersections on local streets. Intersections that had projected turning movements were analyzed using either the HCS Signals module for signalized intersections or the HCS Unsignalized module for unsignalized intersections, depending on whether a signal would be warranted in the design year. Operational analysis for the signalized intersections was provided by optimizing the signal cycle length and minimizing the number the signal phases to the extent possible for the design year for both the No Build Alternative and the recommended preferred alternative.

The Highway Capacity Manual intersection analysis procedures calculate an “average vehicle delay” based on traffic volumes, number of lanes, and traffic signal phasing and timing at each intersection. Signal coordination was performed initially using Synchro to assist in establishing a common cycle length at intersections that were in close proximity to each other. HCS+ was used to properly balance each signalized intersection. For intersections, LOS is defined by the average amount of control delay experienced by vehicles. At traffic signals, delay is calculated for each approach as well as for the overall intersection. The average vehicle delay calculation at each intersection is assigned a level of service ranging from LOS A, the best, to LOS F, the worst or failure. LOS C is considered acceptable, and in urban areas LOS D is generally considered acceptable.

The methodology used to calculate required turn lane storage lengths were based on the Kentucky Transportation Cabinet (KYTC) Highway Design – Auxiliary Turn Lane Policy for Kentucky intersections and on the Ohio Department of Transportation (ODOT) Location and Design (L&D) Manual sections 401.6.1 and 401.6.3 and figures 401-9E and 401-10E for Ohio intersections.

The existing Western Hills Viaduct interchange provides full movements to and from I-75 in both the northbound and southbound directions, but only permits traffic exiting and entering the interchange on Western Hills Viaduct to and from the west. When the Brent Spence Bridge project began, FHWA and ODOT requested the Western Hills Viaduct interchange, which needed to be reconstructed, be redesigned to also permit traffic to exit and enter the interchange from the east. Knowing an Interchange Modification Study (IMS) would ultimately be required for approval of the preferred alternative, certified traffic was developed for both the No Build Alternative (only movements to and from the west) and for the requested preferred Build Alternative (movements to and from both the west and the east), a requirement of the IMS. As new interchange designs were developed to comply with FHWA’s and ODOT’s request, it became apparent it would be very difficult to develop a design which would function operationally and meet all environmental concerns. Ultimately, the request by FHWA for movements to and from the interchange from both the east and west was dropped. However, in an effort to keep the project on schedule, time would not permit the development of design year traffic for new interchange traffic that also added a through lane in each direction to the I-75 mainline and only provided for movements to and from the west on Western Hills. As a result, the No Build Alternative traffic was used to design the recommended preferred alternative for the Western Hills Viaduct interchange, since it provided the same movements.

6.1.3 Certified Traffic

In the development of certified traffic, the existing four-hour turning movement counts were factored to average daily traffic (ADT) volumes using the ODOT hourly distribution and seasonal adjustment factors by functional class. The 72-hour and 48-hour ramp counts were converted to ADTs by applying the seasonal adjustment factor by functional class. The calculated ADT volumes were compared to historical count information and ODOT ramp counts. The existing traffic counts were then smoothed along the mainline and between intersections as appropriate for the AM, PM, and calculated ADT volumes. Finally, the AM and PM volumes were factored to the design hour (30^{th} highest hour) by applying a factor of 1.056, as was done for the HAM-75-2.30 PID 76257 (Mill Creek Expressway) and HAM-75-10.10 (Thru the Valley) projects, which are located at the northern limits of this project. This process for developing certified traffic was agreed to by the KYTC.

The OKI regional travel demand model was used to develop traffic assignments for the 2035 design year. Using the methods described in the National Cooperative Highway Research Program (NCHRP) 255 report, 24-hour model assignments were post-processed by comparing the ADT count data to the base year (2005) model assignment and applying the same over/under estimation to the future year (2035) model assignment. A hybrid mix of the ratio and delta methods were applied to each link. Finally, the 2035 ADT was calculated by applying a straight line extrapolation between the 2005 count and the post-processed 2035 ADT.

A growth factor was calculated for each link by dividing the 2035 ADT by the 2005 traffic count. This factor was then applied to the AM and PM peak hour count data to obtain 2035 AM and PM peak hour data. Turning movement forecasts for the 2035 AM, PM, and ADT were made using the NCHRP 255 iterative proportional method. Interchanges were treated as single point intersections where possible to determine the mainline, cross street, and ramp volumes at one time.

Finally, all 2035 traffic volumes on the mainline and between intersections were smoothed as appropriate for the AM, PM, and ADT periods. Technical Memorandums for the 30^{th} Highest Hour Adjustment Factor, Coordination of Traffic Projections for the Three HAM-75 Projects, and Coordination of Mainline Traffic Projections for the Three HAM-75 Projects as well as the Certified traffic plates are included in Appendix C.

6.1.4 Microsimulation Analyses

Both at the Federal and at the state level, traffic and operational analysis needs to be based on the Highway Capacity Manual operational analysis procedures. HCS was used to analyze the No Build Alternative and the recommended preferred alternative. HCS has limitations such as not being able to see queue lengths or imbalances in traffic volumes between lanes. VISSIM was used to ensure the recommended preferred alternative works as anticipated. Included in Appendix B are No-Build and Build VISSIM videos. These videos can be utilized by the reader to obtain a visual comparison of the alternatives.

6.2 Traffic Analyses Results

Capacity analyses are performed to estimate the maximum amount of traffic that can be accommodated by a roadway while maintaining prescribed operational qualities. Levels of service were determined for freeway segments, ramp junctions, weave segments, C-D roadways, and intersections for the No Build Alternative and the recommended preferred alternative. Tables with level of service information are presented in the following sections. Graphics of the level of service at each freeway segment, ramp junction, and intersection are included in Appendix D to show the effects of the new or revised interchanges on the Interstate System and the local road network. These graphics also show an overall comparison of operations between the No Build Alternative and the recommended preferred alternative.

6.2.1 Freeway Segments

The freeway segment level of service criteria as defined by the Transportation Research Board for freeway segment density is shown in Table 6-1. Table 6-2 through Table 6-5 include a reference column "Pg" that corresponds to page the HCS runs for freeway segments are included on, in Appendix D.

Table 6-1. Freeway Segment Level of Service

Level of Service (LOS)	Freeway Segment Density (pc/mi/ln)
A	0 – 11
B	> 11 – 18
C	> 18 – 26
D	> 26 – 35
E	> 35 – 45
F	> 45

6.2.1.1 No Build Alternative

The operating goal is to maintain LOS D or higher for all roadway segments. As a result, degradation from the No Build condition to the Build condition only occurs when the level of service for the Build condition is LOS E or LOS F and it has a lower level of service than the No Build condition. For this reason, only the number of locations which have LOS E or LOS F are discussed below. It should also be noted that the roadway system for the No Build and Build conditions are uniquely different, with the Build condition having C-D roadways, no left hand exits, no drop lanes, less weaves, and lane balance throughout the project. As a result, it may be difficult to make direct comparisons between the No Build and Build conditions at every location.

6.2.1.1.1 Kentucky

Eighteen freeway segments were analyzed along the No Build Alternative in Kentucky.

AM Peak
During the AM peak period, six of the freeway segments operated at LOS E, while two freeway segments operated at LOS F.

PM Peak
During the PM peak period, 11 of the freeway segments operated at LOS E, while three freeway segments operated at LOS F.

The freeway segment analysis for the No Build Alternative in Kentucky is presented in Table 6-2.

Table 6-2. No Build Alternative Freeway Analysis – Kentucky

Pg[1]	Ref	Facility	Location	LOS					
				AM Peak	Certified Traffic	Constrained Volume[2]	PM Peak	Certified Traffic	Constrained Volume[2]
2	F-1	I-71/I-75 SB	Between Brent Spence Bridge & KY 5th St. Diverge	D	6,520	6,048	F	8,870	7,905
2	F-2	I-71/I-75 SB	Between KY 5th St. Diverge & Pike St./ KY 12th St. Diverge	D	5,660	5,250	E	8,020	6,880
2	F-3	I-71/I-75 SB	Between Pike St./KY 12th St. Diverge & KY 5th St. Merge	D	5,390	5,000	D	7,430	6,370
2	F-4	I-71/I-75 SB	Between KY 5th St. Merge & KY 12th St. Merge	D	5,870	5,470	E	8,580	7,470
2	F-5	I-71/I-75 SB	Between KY 12th St. Merge & Kyles Lane Diverge	D	6,220	5,820	F	9,160	8,050
1	F-6	I-71/I-75 SB	Between Kyles Lane Diverge & Kyles Lane Merge	D	5,620	5,260	E	8,140	6,740
1	F-7	I-71/I-75 SB	Between Kyles Lane Merge & Dixie Hwy. Diverge	D	6,060	5,700	E	8,780	7,380
1	F-8	I-71/I-75 SB	Between Dixie Hwy. Diverge & Dixie Hwy. Merge	D	5,870	5,520	E	8,070	6,780

Table 6-2. No Build Alternative Freeway Analysis – Kentucky

Pg[1]	Ref	Facility	Location	LOS					
				AM Peak	Certified Traffic	Constrained Volume[2]	PM Peak	Certified Traffic	Constrained Volume[2]
1	F-9	I-71/I-75 SB	Between Dixie Hwy. Merge & Buttermilk Pike Diverge	D	6,200	5,850	E	8,650	7,360
1	F-10	I-71/I-75 NB	Between Buttermilk Pike Merge & Dixie Hwy. Diverge	F	5,760	5,710	F	6,570	5,730
1	F-11	I-71/I-75 NB	Between Dixie Hwy. Diverge & Dixie Hwy. Merge	E	5,490	5,440	E	6,210	5,420
1	F-12	I-71/I-75 NB	Between Dixie Hwy. Merge & Kyles Lane Diverge	D	6,430	6,380	D	6,600	5,810
1	F-13	I-71/I-75 NB	Between Kyles Lane Diverge & Kyles Lane Merge	E	5,930	5,680	E	5,790	5,100
1	F-14	I-71/I-75 NB	Between Kyles Lane Merge & KY 12th St. Diverge	E	7,250	5,760	E	6,410	5,720
2	F-15	I-71/I-75 NB	Between KY 12th St. Diverge & KY 5th St. Diverge	E	7,010	5,540	E	5,860	5,230
2	F-16	I-71/I-75 NB	Between KY 5th St. Diverge & Pike St. Merge	E	6,370	5,040	D	5,310	4,740
2	F-17	I-71/I-75 NB	Between Pike St. Merge & KY 4th St. Merge	F	7,490	5,810	E	5,710	5,140
2	F-18	I-71/I-75 NB	Between KY 4th St. Merge & Brent Spence Bridge	D	8,650	6,970	D	6,690	6,120

[1]Page Number refers to Appendix D HCS Results 2035 No Build.
[2]See section 6.1.2 for explanation on Constrained Volume. "-" means there was no constrained traffic for the analyzed segment.

6.2.1.1.2 Ohio

Sixty-nine freeway segments were analyzed along the No Build Alternative in Ohio.

AM Peak
During the AM peak period, six of the freeway segments operated at LOS E, while three freeway segments operated at LOS F.

PM Peak
During the PM peak period, five of the freeway segments operated at LOS E, while seven freeway segments operated at LOS F.

The freeway segment analysis for the No Build Alternative in Ohio is presented in Table 6-3.

Table 6-3. No Build Alternative Freeway Analysis - Ohio

Pg[1]	Ref	Facility	Location	LOS					
				AM Peak	Certified Traffic	Constrained Volume[2]	PM Peak	Certified Traffic	Constrained Volume[2]
8	F-1	I-75 SB	Between Hopple St. Merge & Western Hills Viaduct Diverge	F	9,630	-	D	6,530	-
8	F-2	I-75 SB	Between Western Hills Viaduct Diverge & Western Hills Viaduct Merge	E	9,370	7,674	D	6,030	-
8	F-3	I-75 SB	Between Western Ave. Diverge & Western Ave./Ezzard Charles Dr. Diverge	E	9,430	7,857	D	5,960	-
7	F-4	I-75 SB	Between Western Ave./Ezzard Charles Dr. Diverge & Freeman Ave. Diverge	E	8,810	7,340	D	5,720	-
7	F-5	I-75 SB	Between Freeman Ave. Diverge & Western Ave. Merge	D	8,140	6,782	C	5,260	-
5	F-6	I-75 SB	Between OH 7th St. Diverge & I-71 NB Diverge	D	7,080	5,962	D	5,550	-

Table 6-3. No Build Alternative Freeway Analysis - Ohio

Pg[1]	Ref	Facility	Location	LOS					
				AM Peak	Certified Traffic	Constrained Volume[2]	PM Peak	Certified Traffic	Constrained Volume[2]
5	F-7	I-75 SB	Between I-71 NB Diverge & OH 9th St. Merge	C	3,000	2,528	D	2,760	-
5	F-8	I-75 SB	Between OH 9th St. Merge & OH 6th St. Merge	D	3,160	2,688	E	3,700	-
4	F-9	I-75 SB	Between OH 6th St. Merge & I-71 SB Merge	D	3,840	3,368	F	4,530	3,967
3	F-10	I-71 SB	Between Reading Rd./Dorchester Ave. Merge & I-471 Diverge	E	5,350	-	F	6,330	-
3	F-11	I-71 SB	Between I-471 Diverge & OH 3rd St. Diverge	D	4,700	-	D	4,820	4,568
3	F-12	I-71 SB	Between OH 3rd St. Diverge & US 50 Merge	D	3,030	-	F	4,290	4,066
3	F-13	I-71 SB	Ramp to OH 3rd St.	D	1,670	-	A	530	502
3	F-14	US 50 WB	Between OH 3rd St. Diverge & I-71 SB Merge	C	2,240	-	B	1,900	-
4	F-15	I-71 SB	Between US 50 Merge & I-75 NB Diverge	C	5,270	-	D	6,190	5,881
4	F-16	I-71 SB	Between I-75 NB Diverge & OH 3rd St. Merge	C	2,420	-	D	3,140	2,983
4	F-17	I-71 SB	Between OH 3rd St. Merge & I-75 SB Merge	D	2,680	-	F	4,340	3,966
4	F-18	I-71/I-75 SB	Between I-75 SB Merge & Brent Spence Bridge	D	6,520	6,048	F	8,870	7,905
5	F-19	I-71 NB Ramp	Between I-75 SB Diverge & OH 5th St. Diverge	D	4,080	3,434	D	2,790	-

Table 6-3. No Build Alternative Freeway Analysis - Ohio

Pg[1]	Ref	Facility	Location	LOS					
				AM Peak	Certified Traffic	Constrained Volume[2]	PM Peak	Certified Traffic	Constrained Volume[2]
5	F-20	I-71 NB Ramp	Between OH 5th St. Diverge & OH 2nd St. Diverge	D	3,370	2,836	C	2,540	-
4	F-21	I-71 NB Ramp	Between OH 2nd St. Diverge & OH 6th St. Merge	D	1,860	1,565	D	1,730	-
4	F-22	I-71 NB Ramp	Between OH 2nd St. Diverge & OH 6th St. Merge	C	1,510	1,271	B	810	-
4	F-23	OH 6th St. EB	Between I-71/I-75 SB Merge & I-71 NB Merge	D	1,750	-	C	1,190	-
4	F-24	I-71 NB Ramp	Between OH 6th St. Merge & I-71 NB Merge	D	3,610	3,315	D	2,920	-
5	F-25	OH 6th St. EB	Between Linn St. Merge & OH 5th St. Diverge	B	3,330	-	A	2,290	-
5	F-26	OH 6th St. EB	Ramp to OH 5th St.	A	560	-	A	150	-
5	F-27	OH 6th St. EB	Between OH 5th St. Diverge & I-71/I-75 SB Merge	D	2,770	-	C	2,140	-
5	F-28	OH 6th St. EB	Between I-71 NB Merge & I-71/I-75 SB Merge	C	1,020	-	C	950	-
4	F-29	OH 6th St. EB	Between OH 2nd St. Diverge & I-71/I-75 SB Merge	B	680	-	B	830	-
4	F-30	OH 6th St. EB	Between I-71/I-75 SB Merge & OH 2nd St. Diverge	A	340	-	A	120	-
4	F-31	I-75 SB	I-75 SB Ramp/OH 6th St. Ramp to OH 2nd St.	B	1,850	1,611	A	930	-
4	F-32	OH 2nd St. EB	Between I-75 SB Diverge & I-71 NB Diverge	B	2,070	1,831	A	1,340	-

Table 6-3. No Build Alternative Freeway Analysis - Ohio

Pg[1]	Ref	Facility	Location	LOS					
				AM Peak	Certified Traffic	Constrained Volume[2]	PM Peak	Certified Traffic	Constrained Volume[2]
4	F-33	I-71/I-75 NB	Between Brent Spence Bridge & I-71/I-75 NB Diverge	D	8,650	6,970	D	6,690	6,120
4	F-34	I-71 NB	Between I-75 NB Diverge & OH 2nd St. Diverge	E	4,800	3,868	C	2,330	2,131
4	F-35	I-71 NB	Between OH 2nd St. Diverge & I-75 SB Merge	D	3,600	2,901	B	1,900	1,738
4	F-36	I-71 NB	Between I-75 SB Diverge & US 50 Diverge	D	7,210	6,216	C	4,820	4,658
4	F-37	OH 2nd St. EB	Between I-71 NB Diverge & Elm St.	A	3,270	2,798	A	1,770	1,733
3	F-38	I-71 NB	Between US 50 Diverge & OH 2nd St. Merge	F	5,120	4,414	C	2,390	2,310
3	F-39	US 50 EB	Between I-71 NB & OH 2nd St. Merge	B	2,090	1,802	C	2,430	2,348
3	F-40	I-71 NB	Between OH 2nd St. Merge & OH 5th St. Merge	C	5,210	4,033	B	2,820	2,740
3	F-41	I-71 NB	Between OH 5th St. Merge & I-471 Merge	D	5,430	4,253	C	3,440	3,360
3	F-42	I-71 NB	Between I-471 Merge & Gilbert Ave. Merge	F	7,400	6,004	D	4,560	4,480
3	F-43	I-71 NB	Between Gilbert Ave. Merge & Reading Rd. Diverge	D	7,550	6,151	D	5,700	5,620
3	F-44	I-471 SB	Between Liberty St. Merge & Columbia Pkwy. Merge	A	970	-	D	2,920	-
3	F-45	I-471 NB	Between OH 6th St. Diverge & Liberty St. Diverge	D	3,430	-	B	1,370	-

Table 6-3. No Build Alternative Freeway Analysis - Ohio

Pg[1]	Ref	Facility	Location	LOS					
				AM Peak	Certified Traffic	Constrained Volume[2]	PM Peak	Certified Traffic	Constrained Volume[2]
4	F-46	I-75 NB	Between I-71 NB Diverge & OH 5th St. Diverge	C	3,850	3,102	C	4,360	3,989
4	F-47	I-75 NB	Between OH 5th St. Diverge & OH 6th St. Diverge	C	3,090	2,490	E	3,990	3,650
4	F-48	I-75 NB	Ramp to OH 5th St.	B	760	612	A	370	339
5	F-49	I-75 NB	Between OH 6th St. Diverge & I-75 NB Merge	C	2,360	1,902	D	3,290	3,010
5	F-50	I-75 NB	Ramp to OH 6th St.	B	730	588	B	700	640
4	F-51	I-71 SB	Between I-71 SB Diverge & OH 6th St. Diverge	D	2,850	-	D	3,050	2,898
4	F-52	I-71 SB	Ramp to OH 6th St.	C	940	-	D	1,450	1,378
5	F-53	I-71 SB	I-71 SB/I-75 NB Ramp to OH 6th St.	B	1,670	1,528	C	2,150	2,018
5	F-54	OH 6th St. WB	Between I-71 SB/I-75 NB Merge & Gest St. Diverge	A	1,860	1,718	B	3,110	2,978
4	F-55	I-71 SB	Between OH 6th St. Diverge & OH 4th St. Merge	E	1,910	-	D	1,600	1,520
5	F-56	I-71 SB	Between OH 4th St. Merge & OH 6th St. Merge	C	2,200	-	D	3,200	3,120
5	F-57	I-71 SB	Between OH 6th St. Merge & Winchell Ave. Diverge	B	2,390	-	B	3,720	3,640
6	F-58	I-71 SB	Between Winchell Ave. Diverge & I-75 NB Merge	B	2,220	-	C	3,400	3,327
7	F-59	I-75 NB	Between I-71 SB Merge & OH 9th St. Merge	C	4,580	4,122	D	6,690	6,337

Table 6-3. No Build Alternative Freeway Analysis - Ohio

Pg[1]	Ref	Facility	Location	LOS					
				AM Peak	Certified Traffic	Constrained Volume[2]	PM Peak	Certified Traffic	Constrained Volume[2]
7	F-60	I-75 NB	Between OH 9th St. Merge & Freeman Ave. Merge	C	4,730	4,272	E	7,520	7,167
7	F-61	I-75 NB	Between Freeman Ave. Merge & Winchell Ave./Ezzard Charles Dr. Merge	C	5,220	4,762	E	8,080	7,727
8	F-62	I-75 NB	Between Winchell Ave./Ezzard Charles Dr. Merge & Western Hills Viaduct Diverge	C	5,350	4,892	F	8,480	7,893
8	F-63	I-75 NB	Bank St./Western Hills Viaduct Entrance Ramp	C	1,010	-	B	910	-
8	F-64	I-75 NB	Between Western Hills Viaduct Diverge & Western Hills Viaduct Merge	C	5,030	4,599	E	7,950	7,400
8	F-65	I-75 NB	Between Western Hills Viaduct Merge & Hopple St. Diverge	D	6,040	5,609	F	8,860	7,888
9	F-66	I-75 SB	Between I-74 Merge & Hopple St. Diverge	F	10,040	9,452	D	7,210	6,863
9	F-67	I-75 NB	Between Hopple St. Merge & Bates Ave. Merge	C	6,280	5,340	E	8,530	7,591
9	F-67A	I-75 NB	Between Hopple St. Diverge & Hopple St. Merge	C	6,580	5,081	E	8,890	7,329
9	F-68	I-75 SB	Between Hopple St. Diverge & Hopple St. Merge	F	9,080	8,636	D	6,280	6,079

[1]Page Number refers to Appendix D HCS Results 2035 No Build.
[2]See section 6.1.2 for explanation on Constrained Volume. "-" means there was no constrained traffic for the analyzed segment.

6.2.1.2 Recommended Preferred Alternative

6.2.1.2.1 Kentucky

Twenty-one freeway segments were analyzed along the recommended preferred alternative in Kentucky.

AM Peak
During the AM peak period, three freeway segments operated at LOS E, while two operated at LOS F.

PM Peak
During the PM peak period, five of the freeway segments operated at LOS E, while four segments operated at LOS F.

The freeway segment analysis for the recommended preferred alternative in Kentucky is presented in Table 6-4.

At the southern end of the project, I-71/I-75 currently has three mainline lanes in the northbound direction and four in the southbound direction. Calculations show that in the design year (2035) I-71/I-75 in the No Build Alternative will have numerous locations through the Buttermilk Pike, Dixie Highway, and Kyles Lane interchanges where the levels of service will be LOS E or LOS F. In the recommended preferred alternative, I-71/I-75 will be widened to six mainline lanes in each direction just north of the Kyles Lane interchange. For southbound I-71/I-75, the expanded number of lanes must be reduced to connect to the existing number of lanes at the southern project limit. Since the additional lanes in the recommended preferred alternative can carry more traffic than the No Build Alternative, the level of service will fall below LOS D in the area surrounding the Dixie Highway and Kyles Lane interchanges. I-71/I-75 operates at LOS F south of the Dixie Highway interchange in the northbound direction for both the recommended preferred alternative and the No Build Alternative. In the southbound direction, I-71/I-75 operates at LOS F between the Kyles Lane and Dixie Highway interchanges in the recommended preferred alternative. For this same freeway segment, the No Build Alternative operates at LOS E. The No Build Alternative operates at a better level of service at this location because less traffic is able to reach this location due to constrained traffic conditions in the northern freeway segments. LOS D or better in this area can be obtained if KYTC decides to extend the additional lanes included in the recommended preferred alternative to the south.

Once the project's roadway is expanded from the existing three lanes at the southern limits of the project to the full complement of six lanes around Kyles Lane in Kentucky, only two other freeway segments in Kentucky will operate below LOS D with each operating at LOS E. By contrast, the level of service at these same two locations would *operate* at LOS F in the No Build Alternative.

Table 6-4. Recommended Preferred Alternative Freeway Segment Analysis - Kentucky

Pg[1]	Ref	Facility	Location	LOS					
				AM Peak	Certified Traffic	Constrained Volume[2]	PM Peak	Certified Traffic	Constrained Volume[2]
3	F-1	I-75 SB	Between Brent Spence Bridge & SB C-D Roadway Merge	D	3,920	-	C	2,730	-
3	F-2	I-71 SB	Between Brent Spence Bridge & I-71/I-75 Merge	C	2,310	-	D	3,170	2,920
3	F-3	I-75 SB	Between C-D Roadway SB Merge & I-71/I-75 Merge	C	4,250	-	C	5,760	5,740
3	F-4	I-71/I-75 SB	7-lane section between I-71/I-75 Merge & KY 12th St. Merge	C	6,560	-	D	8,930	8,660
3	F-5	I-71/I-75 SB	6-lane section between I-71/I-75 Merge & KY 12th St. Merge	C	6,560	-	D	8,930	8,660
3	F-6	I-71/I-75 SB	Between KY 12th St. Merge & Kyles-Dixie C-D Roadway Diverge	D	7,340	-	E	10,390	10,120
2	F-7	I-71/I-75 SB	6-lane section between Kyles-Dixie C-D Roadway Diverge & Kyles-Dixie C-D Roadway Merge	C	6,460	-	D	8,570	8,350
2	F-8	I-71/I-75 SB	5-lane section between Kyles-Dixie C-D Roadway Diverge & Kyles-Dixie C-D Roadway Merge	D	6,460	-	E	8,570	8,350
2	F-9	I-71/I-75 SB	4-lane section between Kyles-Dixie C-D Roadway Diverge & Kyles-Dixie C-D Roadway Merge	E	6,460	-	F	8,570	7,540
2	F-10	I-71/I-75 SB	Between Kyles-Dixie C-D Roadway Merge & Dixie Hwy. Merge	D	6,810	-	E	9,130	8,100
2	F-11	I-71/I-75 SB	Between Dixie Hwy. Merge & Buttermilk Pike Diverge	D	7,150	-	E	9,760	8,730
1	F-12	I-71/I-75 SB	Between Buttermilk Pike Diverge & Buttermilk Pike Merge	E	6,440	-	F	8,540	7,640
1	F-13	I-71/I-75 NB	Between Buttermilk Pike Merge & Kyles-Dixie C-D Roadway Diverge	F	7,160	-	F	8,280	-
2	F-14	I-71/I-75 NB	3-lane section between Kyles-Dixie C-D Roadway Diverge & Kyles-Dixie C-D Roadway Merge	F	6,440	-	F	7,180	-
2	F-15	I-71/I-75 NB	4-lane section between Kyles-Dixie C-D Roadway Diverge & Kyles-Dixie C-D Roadway Merge	D	6,440	-	E	7,180	-
2	F-16	I-71/I-75 NB	Between Kyles-Dixie C-D Roadway Merge & Kyles Lane Merge	D	7,440	-	D	7,560	-
2	F-17	I-71/I-75 NB	Between Kyles Lane Merge & C-D Roadway	D	8,910	-	D	8,270	-

Table 6-4. Recommended Preferred Alternative Freeway Segment Analysis - Kentucky

Pg[1]	Ref	Facility	Location	LOS					
				AM Peak	Certified Traffic	Constrained Volume[2]	PM Peak	Certified Traffic	Constrained Volume[2]
			NB Diverge						
3	F-18	I-71/I-75 NB	Between C-D Roadway NB Diverge & I-71 NB Diverge	D	5,700	-	D	6,240	-
3	F-19	I-71 NB	Between I-75 NB Diverge & Pike St. Merge	D	3,250	-	C	2,240	-
3	F-20	I-75 NB	Between I-71 NB Diverge & Brent Spence Bridge	B	2,450	-	C	4,000	-
3	F-21	I-71 NB	Between Pike St. Merge & Brent Spence Bridge	E	3,690	-	C	2,380	-

[1]Page Number refers to Appendix D HCS Results 2035 Alternative I.
[2]See section 6.1.2 for explanation on Constrained Volume. "-" means there was no constrained traffic for the analyzed segment.

6.2.1.2.2 Ohio

Fifty-five freeway segments were analyzed along the recommended preferred alternative in Ohio.

AM Peak
During the AM peak period, six of the freeway segments operated at LOS E, while two segments operated at LOS F.

PM Peak
During the PM peak period, one of the freeway segments operated at LOS E, while two segments operated at LOS F.

The freeway segment analysis for the recommended preferred alternative in Ohio is presented in Table 6-5.

At the northern end of the project, I-75 northbound north of the Western Hills Viaduct Interchange will be LOS E in the PM peak period. The LOS E obtained at this location is an extremely good LOS E (almost LOS D). Unlike the project limits of many freeway projects where the freeway adjacent to the project limits is old and in need of additional lanes, the Mill Creek Expressway project is concurrently under design and construction to the north. Additional lanes were not added at this location to raise the level of service to LOS D because the LOS E was contained to one freeway segment and did not extend into other freeway segments upstream or downstream on I-75. The LOS E is very close to being LOS D; and it would be very difficult and costly to add an additional lane for this isolated location and keep lane balance on I-75. When this location in the recommended preferred alternative is compared to the same location in the No Build Alternative, the level of service for the No Build Alternative north of the Western Hills Viaduct Interchange would be LOS F.

At the eastern end of the project, a degradation of the level of service will occur on I-71 northbound at the eastern limits of the project where US 50 splits from I-71 northbound on Fort Washington Way (FWW) through downtown Cincinnati. While both the recommended preferred alternative and the No Build Alternative will have a LOS F at this location in the design year, approximately 12 percent more vehicles will reach this location with the recommended preferred alternative, making this a substantially reduced LOS F. Congestion at this location could potentially cause long queues to develop which could obstruct the mainline of I-71 northbound as well as the northbound C-D roadway system, which provides access to and from the cities of Covington and Cincinnati at some time in the design life of this project. Possible solutions to reduce congestion at this location have been identified, but would require substantial additional cost and are beyond the scope of this project. ODOT and FHWA (Ohio) are concerned with increases in the cost of the Brent Spence Bridge Replacement/Rehabilitation Project and have been cautioned about "scope creep." A potential solution could involve the modification to the Lytle Tunnel, at the eastern end of the FWW. The Lytle Tunnel has a city park and buildings on top of it which would likely be impacted, and this solution would also likely require the removal of an existing entrance ramp from OH 2nd Street to I-71 northbound, and such a solution could potentially violate the terms of the Major Investment Study (MIS) that was conducted for I-71, *I-71 Corridor Transportation Study* (1998).

The *I-71 Corridor Transportation Study* (1998) required that additional capacity within the I-71 corridor would be created by a light rail system rather than by adding lanes to I-71. Therefore, no additional through lanes could be added to the I-71 corridor within the MIS's project limits, which includes the FWW and I-71 continuing further north.

Due to these reasons, ODOT and FHWA (Ohio) at a joint meeting on August 12th, 2010 recommended that the degradation in the level of service which is anticipated to occur on I-71 northbound where US 50 splits from I-71 northbound on FWW will not be addressed as part of the Brent Spence Bridge Replacement/Rehabilitation Project. Both ODOT and FHWA (Ohio) agreed to maintain the existing conditions at this location and will determine at a later date if a separate project will need proposed to address the congestion in this area.

The LOS F for F-24, F-26, F-47, and F-51 are all on I-71 and outside the project limits of this project. These locations were included for the purpose of making level of service comparisons between the No Build Alternative and the recommended preferred alternative at the next freeway segments and interchanges adjacent to the project limits. These segments are within the project limits of the *I-71 Corridor Transportation Study*.

Within the project limits only five of the freeway segments in Ohio will operate below LOS D, with all five of these freeway segments will operate at LOS E. The five segments are I-75 southbound between the Western Hills Viaduct diverge and the Western Hills Viaduct merge (F-2), I-75 southbound between the C-D roadway southbound diverge and the I-71 northbound diverge (F-5), I-75 northbound between the US 50 westbound diverge and the OH 4th Street merge (F-34), and I-71 northbound between the Brent Spence Bridge the I-75 southbound merge (F-44 & F-45). By comparison, the level of service for all five of these freeway segments in the No Build Alternative would also be at LOS E. Additional lanes were considered at these locations to raise the level of service to LOS D, but the three segments which affect I-71 northbound would have required major reconstruction in the Fort Washington Way, which was constructed approximately 10 years ago. Given the cost, lack of right of way and the context of the Fort Washington

Way area, this was determined not to be possible. The other three locations would have made it extremely difficult to maintain lane balance due to the number of lanes on the roadway into which they would be interconnected.

Table 6-5. Recommended Preferred Alternative Freeway Segment Analysis - Ohio

Pg[1]	Ref	Facility	Location	LOS					
				AM Peak	Certified Traffic	Constrained Volume[2]	PM Peak	Certified Traffic	Constrained Volume[2]
9	F-1	I-75 SB	Between Hopple St. Merge & Western Hills Viaduct Diverge	D	9,750	-	C	7,690	-
9	F-2	I-75 SB	Between Western Hills Viaduct Diverge & Western Hills Viaduct Merge	E	8,750	-	D	6,720	-
9	F-3	I-75 SB	Ramp to Western Hills Viaduct/Findlay St.	C	1,000	-	C	970	-
9	F-4	I-75 SB	Between Western Hills Viaduct Merge & C-D Roadway SB Diverge	D	9,550	-	C	7,120	-
8	F-5	I-75 SB	Between C-D Roadway SB Diverge & I-71 NB Diverge	E	5,240	-	C	3,950	-
5	F-6	I-75 SB	Between I-71 NB Diverge & Brent Spence Bridge	D	3,920	-	C	2,730	-
6	F-7	OH 9th St. WB	Between Central Ave. & Ramp to Winchell Ave.	A	400	-	A	1,540	-
6	F-8	OH 9th St. WB	Between Winchell Ave. Ramp & C-D Roadway SB Merge	A	330	-	A	1,190	-
6	F-9	OH 9th St. WB	Ramp to Winchell Ave.	A	70	-	A	350	-
6	F-10	OH 9th St. WB	Between C-D Roadway SB Merge & Linn St.	A	240	-	A	690	-
6	F-11	OH 9th St. WB	Ramp to C-D Roadway SB	A	90	-	A	500	-
6	F-12	OH 7th St. EB	Between Gest St. Merge & C-D Roadway SB Diverge	A	850	-	A	570	-
6	F-13	OH 7th St. EB	Between C-D Roadway SB Diverge & Central Ave.	B	2,220	-	A	750	-
6	F-14	OH 6th St. WB	Between Ramp to Winchell Ave. & C-D Roadway NB Diverge	A	130	-	A	800	-
6	F-15	OH 7th St. EB	Between C-D Roadway NB Diverge & I-71 SB Diverge	A	980	-	A	1,630	-
6	F-16	OH 7th St. EB	Between I-71 SB Diverge & Gest St. Diverge	A	1,910	-	B	3,090	2,975
6	F-17	OH 6th St. EB	Between Linn St. Merge & C-D Roadway SB Merge	B	3,210	-	A	2,250	-
6	F-18	OH 6th St. EB	Between C-D Roadway SB Diverge & I-71 NB Diverge	C	2,270	-	B	1,340	-
6	F-19	OH 6th St. EB	Between I-71 NB Diverge & OH 5th St. Diverge	A	940	-	A	910	-
6	F-20	OH 6th St. EB	Ramp to OH 5th St.	A	270	-	A	90	-
6	F-21	OH 6th St. EB	Ramp to C-D Roadway SB	B	670	-	B	820	-
6	F-22	OH 6th St. EB	Ramp to OH 2nd St.	B	580	-	A	200	-
4	F-24	I-71 SB	Between Reading Rd./Dorchester Ave. Merge & I-471 Diverge	D	5,230	-	F	6,490	-
4	F-25	I-71 SB	Between I-471 Diverge & OH 3rd St. Diverge	D	4,580	-	D	4,960	4,586
4	F-26	I-71 SB	Between OH 3rd St. Diverge & US 50 Merge	D	3,120	-	F	4,490	4,151

Table 6-5. Recommended Preferred Alternative Freeway Segment Analysis - Ohio

Pg[1]	Ref	Facility	Location	LOS AM Peak	Certified Traffic	Constrained Volume[2]	LOS PM Peak	Certified Traffic	Constrained Volume[2]
4	F-27	I-71 SB	Ramp to OH 3rd St.	D	1,460	-	A	470	435
4	F-28	US 50 WB	Between OH 3rd St. Diverge & I-71 SB Merge	C	2,320	-	C	1,970	-
4	F-29	I-71 SB	Between US 50 Merge & US 50 Diverge	D	5,440	-	D	6,460	5,951
5	F-30	I-71 SB	Between US 50 Diverge & Brent Spence Bridge	C	2,310	-	D	3,170	2,920
5	F-31	I-75 NB	Between Brent Spence Bridge & OH 3rd St. Merge	B	2,450	-	C	4,000	-
6	F-32	I-75 NB	Between OH 3rd St. Merge & NB C-D Roadway Merge	C	2,780	-	D	4,490	-
5	F-33	I-75 NB	Between I-71 SB Diverge & US 50 Diverge	D	2,940	-	D	2,970	2,736
5	F-34	I-75 NB	Between US 50 Diverge & OH 4th St. Merge	E	2,010	-	D	1,510	1,391
5	F-35	I-75 NB	Ramp to US 50 WB	B	930	-	C	1,460	1,345
8	F-36	I-75 NB	Between C-D Roadway NB Merge & Freeman Ave. Merge	C	5,490	-	D	7,740	7,629
8	F-37	I-75 NB	Between Freeman Ave. Merge & Western Hills Viaduct Diverge	C	6,160	-	D	8,490	8,379
9	F-38	I-75 NB	Between Western Hills Viaduct Diverge & Western Hills Viaduct Merge	C	5,840	-	D	7,960	7,856
9	F-39	I-75 NB	Between Western Hills Viaduct Merge & Hopple St. Diverge	D	6,910	-	E	8,870	8,766
5	F-40	OH 2nd St. EB	Between C-D Roadway SB Merge & C-D Roadway NB Merge	B	1,970	-	A	1,550	-
5	F-41	OH 2nd St. EB	Between C-D Roadway NB Merge & Elm St.	B	3,170	-	A	1,980	-
6	F-42	US 50 EB	Between OH 2nd St. Diverge & I-75 SB Merge	D	1,690	-	C	1,140	-
5	F-43	I-75 SB	Between I-75 SB Merge & I-71 NB Merge	D	3,010	-	C	2,360	-
5	F-44	I-71 NB	Between Brent Spence Bridge & C-D Roadway NB Merge	E	3,690	-	C	2,380	-
5	F-45	I-71 NB	Between C-D Roadway NB Merge & I-75 SB Merge	E	4,470	3,943	C	2,660	-
5	F-46	I-71 NB	Between I-75 SB Merge & US 50 Diverge	E	7,480	6,953	C	5,020	-
4	F-47	I-71 NB	Between US 50 Diverge & OH 2nd St. Merge	F	5,320	4,945	C	2,510	-
4	F-48	US 50 EB	Between I_71 NB Diverge & OH 2nd St. Merge	C	2,160	2,008	C	2,510	-
4	F-49	I-71 NB	Between OH 2nd St. Merge & OH 5th St. Merge	C	5,380	4,041	B	2,800	-
4	F-50	I-71 NB	Between OH 5th St. Merge & I-471 NB Merge	D	5,570	4,231	C	3,330	-
4	F-51	I-71 NB	Between I-471 Merge & Gilbert Ave. Merge	F	7,530	6,005	D	4,440	-
4	F-52	I-71 NB	Between Gilbert Ave. Merge & Reading Rd. Diverge	D	7,690	6,161	D	5,680	-

Table 6-5. Recommended Preferred Alternative Freeway Segment Analysis - Ohio

Pg[1]	Ref	Facility	Location	LOS					
				AM Peak	Certified Traffic	Constrained Volume[2]	PM Peak	Certified Traffic	Constrained Volume[2]
4	F-53	I-471 NB	Between OH 6th St. Diverge & Liberty St. Diverge	D	3,280	-	B	1,340	-
4	F-54	I-471 SB	Between Liberty St. Merge & Columbia Pkwy. Merge	A	1,000	-	D	3,050	-
10	F-56	I-75 SB	Between Hopple St. Merge & Hopple St. Merge	E	8,950	-	D	7,450	-
10	F-57	I-75 NB	Between Hopple St. Diverge & I-75 Diverge	C	6,440	-	D	9,300	8,410

[1]Page Number refers to Appendix D HCS Results 2035 Alternative I.
[2]See section 6.1.2 for explanation on Constrained Volume. "-" means there was no constrained traffic for the analyzed segment.

6.2.2 Weave Segments

The weaving segment level of service criteria as defined by the Transportation Research Board for weaving segments density is shown in Table 6-6. Table 6-7 through Table 6-9, which identify the level of service for Kentucky and Ohio, include a reference column "Pg" that corresponds to the page on which the HCS runs for weave segments are located in Appendix D.

Table 6-6. Weaving Segment Level of Service

Level of Service (LOS)	Weaving Segment Density (pc/mi/ln)
A	≥ 10
B	> 10 – 20
C	> 20 – 28
D	> 28 – 35
E	> 35 – 43
F	> 43

6.2.2.1 No Build Alternative

6.2.2.1.1 Kentucky

Three weave segments were analyzed along the No Build Alternative in Kentucky.

AM Peak
During the AM peak period, one of the weave segments operated at LOS E.

PM Peak
During the PM peak period, two of the three weave segments operated at LOS E, while one weave segment operated at LOS F.

The weave segment analysis for the No Build Alternative in Kentucky is presented in Table 6-7.

Table 6-7. No Build Alternative Weave Segment Analysis - Kentucky

Pg[1]	Ref	Facility	Location	LOS					
				AM Peak	Certified Traffic	Constrained Volume[2]	PM Peak	Certified Traffic	Constrained Volume[2]
2	W-1	Bullock St.	Between I-71/I-75 SB Merge & I-71/I-75 SB Diverge	B	940	920	F	2,030	1,950
1	W-2	I-71/I-75 SB	Between Kyles Lane Merge & Dixie Hwy. Diverge	C	6,060	5,700	E	8,780	7,380
1	W-3	I-71/I-75 NB	Between Dixie Hwy. Merge & Kyles Lane Diverge	E	6,430	6,380	E	6,600	5,810

[1]Page Number refers to Appendix D HCS Results 2035 No Build.
[2]See section 6.1.2 for explanation on Constrained Volume. "-" means there was no constrained traffic for the analyzed segment.

6.2.2.1.2 Ohio

Four weave segments were analyzed along the No Build Alternative in Ohio.

AM Peak
During the AM peak period, two of the weave segments operated at LOS E.

PM Peak
During the PM peak period, every weave segment operated at LOS D or better.

The weave segment analysis for the No Build Alternative in Ohio is presented in Table 6-8.

Table 6-8. No Build Alternative Weave Segment Analysis - Ohio

Pg[1]	Ref	Facility	Location	LOS					
				AM Peak	Certified Traffic	Constrained Volume[2]	PM Peak	Certified Traffic	Constrained Volume[2]
8	W-1	I-75 SB	Between Western Hills Viaduct Merge & Western Ave. Diverge	E	10,170	8,474	D	6,430	-
7	W-2	I-75 SB	Between Western Ave. Merge & OH 7th St. Diverge	E	8,410	7,052	C	5,730	-
6	W-3	US 50 WB	Between I-75 NB Merge & Linn St. Diverge	A	1,310	1,210	B	2,730	2,614

Table 6-8. No Build Alternative Weave Segment Analysis - Ohio

Pg[1]	Ref	Facility	Location	LOS					
				AM Peak	Certified Traffic	Constrained Volume[2]	PM Peak	Certified Traffic	Constrained Volume[2]
5	W-4	OH 5th St. EB	Between US 50 EB & Central Ave. NB	B	1,270	1,158	A	400	-

[1]Page Number refers to Appendix D HCS Results 2035 No Build.
[2]See section 6.1.2 for explanation on Constrained Volume. "-" means there was no constrained traffic for the analyzed segment.

6.2.2.2 Recommended Preferred Alternative

6.2.2.2.1 Kentucky

There are no weaving sections in the recommended preferred alternative in Kentucky.

6.2.2.2.2 Ohio

Three weave segments were analyzed along the recommended preferred alternative in Ohio.

AM Peak
During the AM peak period, every weave segment operated at LOS C or better.

PM Peak
During the AM peak period, every weave segment operated at LOS C or better.

The weave segment analysis for the recommended preferred alternative in Ohio is presented in Table 6-9.

Table 6-9. Recommended Preferred Alternative Weave Segment Analysis - Ohio

Pg[1]	Ref	Facility	Location	LOS					
				AM Peak	Certified Traffic	Constrained Volume[2]	PM Peak	Certified Traffic	Constrained Volume[2]
6	W-1	C-D Roadway NB	Between I-71 SB Merge & Winchell Ave. Diverge	C	3,090	-	C	3,490	3,371
7	W-2	US 50 WB	Between I-75 NB Merge & Linn St. Diverge	B	1,390	-	B	2,660	2,561
6	W-3	OH 5th St. EB	Between US 50 EB & Central Ave. NB	A	940	-	A	260	-

[1]Page Number refers to Appendix D HCS Results 2035 Alternative I.
[2]See section 6.1.2 for explanation on Constrained Volume. "-" means there was no constrained traffic for the analyzed segment.

6.2.3 Ramp Junctions

Levels of service for ramp merge and diverge areas along the No Build Alternative and recommended preferred alternative were determined using one of the two methods defined in Section 6.1.2. The ramp junction level of service criteria as defined by the Transportation Research Board for ramp junction density is shown in Table 6-10. Table 6-11 through Table 6-14 include a reference column that corresponds to the HCS runs for ramp junctions, which are included in Appendix D.

Table 6-10. Ramp Junction Level of Service

Level of Service (LOS)	Ramp Junction Density (pc/mi/ln)
A	≥ 10
B	> 10 – 20
C	> 20 – 28
D	> 28 – 35
E	> 35
F	Demand Exceeds Capacity

6.2.3.1 No Build Alternative

6.2.3.1.1 Kentucky

Sixteen ramp junctions were analyzed along the No Build Alternative in Kentucky. Of these, eight were merges and eight were diverges.

AM Peak – Merges
During the AM peak period, of the eight ramp junction merges analyzed, two operated at LOS F.

AM Peak – Diverges
During the AM peak period, of the eight ramp junction diverges analyzed, one operated at LOS E, while two operated at LOS F.
PM Peak – Merges
During the PM peak period, of the eight ramp junction merges analyzed, one operated at LOS E, while one operated at LOS F.
PM Peak – Diverges
During the PM peak period, of the eight ramp junction diverges analyzed, five operated at LOS E, while one operated at LOS F.

The ramp junction analysis for the No Build Alternative in Kentucky is presented in Table 6-11.

Table 6-11. No Build Alternative Ramp Junction Analysis - Kentucky

Pg[1]	Ref	Facility	Location	LOS					
				AM Peak	Certified Traffic	Constrained Volume[2]	PM Peak	Certified Traffic	Constrained Volume[2]
2	R-1	I-71/I-75 SB	KY 5th St. Exit Ramp	D	860	800	F	850	730
2	R-2	I-71/I-75 SB	Pike St. Exit Ramp	C	270	250	E	590	510
2	R-3	I-71/I-75 SB	KY 5th St. Entrance Ramp	C	480	470	E	1,150	1,100
2	R-4	I-71/I-75 SB	KY 12th St. Entrance Ramp	C	350	-	F	580	-

Table 6-11. No Build Alternative Ramp Junction Analysis - Kentucky

Pg[1]	Ref	Facility	Location	LOS					
				AM Peak	Certified Traffic	Constrained Volume[2]	PM Peak	Certified Traffic	Constrained Volume[2]
1	R-5	I-71/I-75 SB	Kyles Lane Exit Ramp	D	600	560	E	1,020	840
1	R-6	I-71/I-75 SB	Kyles Lane Entrance Ramp	ADD A	440	-	ADD A	640	-
1	R-7	I-71/I-75 SB	Dixie Hwy Exit Ramp	DROP A	190	180	DROP A	710	600
1	R-8	I-71/I-75 SB	Dixie Hwy Entrance Ramp	C	330	-	D	580	-
1	R-9	I-71/I-75 NB	Dixie Hwy Exit Ramp	F	270	-	E	360	310
1	R-10	I-71/I-75 NB	Dixie Hwy Entrance Ramp	ADD C	940	-	ADD A	390	-
1	R-11	I-71/I-75 NB	Kyles Lane Exit Ramp	DROP A	500	-	DROP B	810	710
1	R-12	I-71/I-75 NB	Kyles Lane Entrance Ramp	F	1,320	-	D	620	-
2	R-13	I-71/I-75 NB	KY 12th St. Exit Ramp	F	240	220	E	550	490
2	R-14	I-71/I-75 NB	KY 5th St. Exit Ramp	E	640	500	E	550	490
2	R-15	I-71/I-75 NB	Pike St. Entrance Ramp	F	1,120	-	D	400	-
2	R-16	I-71/I-75 NB	KY 4th St. Entrance Ramp	ADD C	1,160	-	ADD C	980	-

[1]Page Number refers to Appendix D HCS Results 2035 No Build.
[2]See section 6.1.2 for explanation on Constrained Volume. "-" means there was no constrained traffic for the analyzed segment.

6.2.3.1.2 Ohio

Nineteen ramp junctions were analyzed along the No Build Alternative in Ohio. Of these, 11 were merges and eight were diverges.

AM Peak – Merges
During the AM peak period, of the 11 merges analyzed, one operated at LOS F.

Am Peak – Diverges
During the AM peak period, of the eight diverges analyzed, one operated at LOS E.

PM Peak – Merges
During the PM peak period, of the 11 merges analyzed, four operated at LOS F.

PM Peak – Diverges
During the PM peak period, of the eight diverges analyzed, two operated at LOS F.

The ramp junction analysis for the No Build Alternative in Ohio is presented in Table 6-12.

Table 6-12. No Build Alternative Ramp Junction Analysis - Ohio

Pg[1]	Ref	Facility	Location	LOS					
				AM Peak	Certified Traffic	Constrained Volume[2]	PM Peak	Certified Traffic	Constrained Volume[2]
8	R-1	I-75 SB	Western Hills Viaduct Exit Ramp	D	260	213	D	500	-
7	R-2	I-75 SB	Western Ave./Ezzard Charles Dr. Exit Ramp	D	620	517	C	240	-
7	R-3	I-75 SB	Freeman Ave. Exit Ramp	D	670	558	C	460	-
5	R-4	I-75 SB	OH 8th St. Entrance Ramp	C	160	-	D	940	-
4	R-5	I-75 SB	OH 6th St. Entrance Ramp	D	680	-	F	830	-
3	R-6	I-71 SB	I-471 Exit Ramp	D	650	-	F	1,510	1,432
4	R-7	I-71 SB	OH 3rd St. Entrance Ramp	C	260	-	F	1,200	-
5	R-8	I-75 SB	OH 5th St. Exit Ramp	D	710	598	C	250	-
5	R-9	US-50 EB	I-75 SB Entrance Ramp	B	680	-	A	830	-
4	R-10	I-71 NB	OH 2nd St. Exit Ramp	E	1,200	967	B	430	393
3	R-11	I-71 NB	OH 5th St. Entrance Ramp	C	220	-	B	620	-
3	R-12	I-71 NB	I-471 Entrance Ramp	F	1,970	-	C	1,120	-
4	R-13	I-75 NB	OH 6th St. Exit Ramp	C	730	588	D	700	640
7	R-14	I-75 NB	OH 9th St. Entrance Ramp	B	150	-	C	830	-
7	R-15	I-75 NB	Freeman Ave. Entrance Ramp	B	490	-	D	560	-
7	R-16	I-75 NB	Winchell Ave./Ezzard Charles Dr. Entrance Ramp	B	130	-	F	400	-
8	R-17	I-75 NB	Western Hills Viaduct Entrance Ramp	A	760	-	B	370	-

Table 6-12. No Build Alternative Ramp Junction Analysis - Ohio

Pg[1]	Ref	Facility	Location	LOS					
				AM Peak	Certified Traffic	Constrained Volume[2]	PM Peak	Certified Traffic	Constrained Volume[2]
8	R-18	I-75 NB	Western Hills Viaduct Exit Ramp	C	320	293	F	530	493
8	R-19	I-75 NB	Western Hills Viaduct Entrance Ramp	C	1,010	-	F	910	-
9	R-20	I-75 SB	Hopple St. Exit Ramp	F	960	816	D	930	784
9	R-21	I-75 NB	Hopple St. Entrance Ramp	C	320	259	D	270	262
9	R-22	I-75 NB	Hopple St. Exit Ramp	D	620	528	E	630	559
9	R-23	I-75 SB	Hopple St. Entrance Ramp	F	810	749	D	390	243

[1]Page Number refers to Appendix D HCS Results 2035 No Build.
[2]See section 6.1.2 for explanation on Constrained Volume. "-" means there was no constrained traffic for the analyzed segment.

6.2.3.2 Recommended Preferred Alternative

6.2.3.2.1 Kentucky

Twenty-three ramp junctions were analyzed along the recommended preferred alternative in Kentucky. Of these, 11 were merges and 12 were diverges.

AM Peak - Merges
During the AM peak period, of the 11 merges analyzed, every merge operated at LOS D or better.

AM Peak - Diverges
During the AM peak period, of the twelve diverges analyzed, one operated at LOS F.

PM Peak - Merges
During the PM peak period, of the 11 merges analyzed, every merge operated at LOS D or better.

PM Peak - Diverges
During the PM peak period, of the 12 diverges analyzed, one operated at LOS E, while one operated at LOS F.

The ramp junction analysis for the recommended preferred alternative in Kentucky is presented in Table 6-13.

All of the ramp junctions in Kentucky for the recommended preferred alternative will have a LOS D or better in the design year except for the I-71/I-75 southbound exit to Kyles Lane (LOS E) and the I-71/I-75 northbound exit to Dixie Highway (LOS F). Both of these locations have matching levels of service in the No Build Alternative. The LOS E at the I-71/I-75 southbound exit to Kyles Lane is an extremely good LOS E (almost LOS D). If an additional lane is added to I-71/I-75 northbound immediately south of the Dixie Highway Interchange, the level of service at the exit to Dixie Highway will rise to LOS D.

Table 6-13. Recommended Preferred Alternative Ramp Junction Analysis - Kentucky

Pg[1]	Ref	Facility	Location	LOS					
				AM Peak	Certified Traffic	Constrained Volume[2]	PM Peak	Certified Traffic	Constrained Volume[2]
3	R-1	C-D Roadway SB	KY 5th St. Exit Ramp	A	800	-	D	850	-
3	R-2	C-D Roadway SB	KY 9th St. Exit Ramp	A	280	-	B	780	-
3	R-3	I-75 SB	C-D Roadway SB Entrance Ramp	ADD A	330	-	ADD D	3,030	3,010
3	R-4	I-71/I-75 SB	KY 12th St. Entrance Ramp	B	780	-	D	1,460	-
2	R-5	I-71/I-75 SB	Kyles-Dixie C-D Roadway Exit Ramp	C	880	-	E	1,820	1,770
2	R-6	Kyles-Dixie C-D Roadway SB	Kyles Lane Exit Ramp	B	690	-	D	1,140	1,110
2	R-7	Kyles-Dixie C-D Roadway SB	Kyles Lane Entrance Ramp	A	350	-	B	560	-
2	R-8	Kyles-Dixie C-D Roadway SB	Dixie Hwy Exit Ramp	A	190	-	C	680	660
2	R-9	I-71/I-75 SB	Kyles-Dixie C-D Roadway Entrance Ramp	ADD A	350	-	ADD B	560	-
2	R-10	I-71/I-75 SB	Dixie Hwy Entrance Ramp	B	340	-	C	630	-

Table 6-13. Recommended Preferred Alternative Ramp Junction Analysis - Kentucky

Pg[1]	Ref	Facility	Location	LOS					
				AM Peak	Certified Traffic	Constrained Volume[2]	PM Peak	Certified Traffic	Constrained Volume[2]
1	R-11	I-71/I-75 SB	Buttermilk Pike Exit Ramp	DROP A	710	-	DROP B	1,220	1,090
2	R-12	I-71/I-75 NB	Kyles-Dixie C-D Roadway Exit Ramp	F	720	-	F	1,100	-
2	R-13	Kyles-Dixie C-D Roadway NB	Dixie Hwy Exit Ramp	B	280	-	C	380	-
2	R-14	Kyles-Dixie C-D Roadway NB	Dixie Hwy Entrance Ramp	B	1,000	-	B	380	-
2	R-15	I-71/I-75 NB	Kyles-Dixie C-D Roadway Entrance Ramp	ADD C	1,000	-	ADD A	380	-
2	R-16	Kyles-Dixie C-D Roadway NB	Kyles Lane Exit Ramp	D	440	-	C	720	-
2	R-17	I-71/I-75 NB	Kyles Lane Entrance Ramp	ADD D	1,470	-	ADD B	710	-
3	R-18	I-71/I-75 NB	Exit Ramp to NB Local C-D Roadway	DROP D	3,210	-	DROP C	2,030	-
3	R-19	C-D Roadway NB	KY 12th St. Exit Ramp	C	1,140	-	B	1,200	-
3	R-20	Pike St. Off-Ramp	Split to NB Local C-D and NB I-71	DROP B	1,430	-	DROP A	550	-
3	R-21	I-71/I-75 NB	Pike St. Entrance Ramp	D	440	-	B	140	-
3	R-22	C-D Roadway NB	Pike St. Entrance Ramp	C	990	-	A	410	-
3	R-23	C-D Roadway NB	4th St. Entrance Ramp	ADD C	1,160	-	ADD C	1,050	-

[1]Page Number refers to Appendix D HCS Results 2035 Alternative I.
[2]See section 6.1.2 for explanation on Constrained Volume. "-" means there was no constrained traffic for the analyzed segment.

6.2.3.2.2 Ohio

Twenty ramp junctions were analyzed along the recommended preferred alternative in Ohio. Of these, eight were merges and ten were diverges.

AM Peak – Merges
During the AM peak period, of the eight merges analyzed, two operated at LOS F.

AM Peak – Diverges
During the AM peak period, of the ten diverges analyzed, every diverge operated at LOS D or better.

PM Peak – Merges
During the PM peak period, of the eight merges analyzed, every merge operated at LOS D or better.

PM Peak – Diverges
During the PM peak period, of the ten diverges analyzed, one operated at LOS F.

The ramp junction analysis for the recommended preferred alternative in Ohio is presented in Table 6-14.

Within the project limits, only one ramp junction (R-16) will operate below LOS D, operating at LOS F. The C-D roadway ramp to I-71 northbound at the western end of Fort Washington Way (FWW) does not exist in the No Build Alternative; however, its comparable movement, the Pike Street entrance ramp in Kentucky, would operate at LOS F. The C-D roadway northbound entrance ramp to I-71 and FWW was addressed at the joint meeting with ODOT and FHWA (Ohio) as discussed in Section 6.2.1.2.2. The C-D roadway northbound entrance ramp to I-71 would have a better density (37.9 pc/mi/ln) than the comparable Pike Street entrance ramp to I-71 (38.6 pc/mi/ln), therefore degradation would not occur. If KYTC does not build a fourth lane and three lanes continue to exist for I-71/I-75 northbound in Kentucky, south of the Dixie Highway Interchange, the I-71/I-75 northbound traffic will be constrained. The reduced traffic volumes at the merge for the C-D roadway ramp to I-71 northbound would result in this ramp junction operating at LOS D. If Kentucky adds a fourth lane, the level of service would be LOS F due to additional traffic volumes. At the joint meeting, it was agreed that if Kentucky adds a fourth lane, congestion would be evaluated at a later date taking into account the perspective of FWW as discussed in Section 6.2.1.2.2.

There are two ramp junctions (R-7 and R-18), that have a level of service of LOS F in both the No Build Alternative and the recommended preferred alternative. Both of these ramp junctions are located outside of the project limits. The diverge (R-7) and merge (R-18) are not being degraded as part of this project.

Table 6-14. Recommended Preferred Alternative Ramp Junction Analysis - Ohio

Pg[1]	Ref	Facility	Location	LOS					
				AM Peak	Certified Traffic	Constrained Volume[2]	PM Peak	Certified Traffic	Constrained Volume[2]
9	R-1	I-75 SB	Findlay St. Exit Ramp	B	740	-	B	470	-
8	R-2	I-75 SB	Freeman Ave. Exit Ramp	D	810	-	C	610	-
6	R-3	I-75 SB	I-71 NB Exit Ramp	D	1,320	-	C	1,220	-
8	R-4	C-D Roadway SB	Western Ave. Entrance Ramp	B	160	-	A	350	-
5	R-5	C-D Roadway SB	US 50 Entrance Ramp	A	670	-	C	820	-
6	R-6	C-D Roadway SB	OH 3rd St. Exit Ramp	C	200	-	B	260	-
4	R-7	I-71 SB	I-471 SB Exit Ramp	D	650	-	F	1,530	1,415
5	R-8	I-71 SB	C-D Roadway SB Exit Ramp	C	190	-	C	320	295
5	R-9	C-D Roadway SB	3rd St. Entrance Ramp	A	280	-	B	1,450	-
5	R-10	I-75 NB	3rd St. Entrance Ramp	B	330	-	C	490	-
5	R-11	C-D Roadway NB	5th St. Exit Ramp	B	580	-	B	280	-
8	R-12	I-75 NB	Freeman Ave. Entrance Ramp	B	670	-	C	750	-
9	R-13	I-75 NB	Western Hills Viaduct Exit Ramp	C	320	-	D	530	523
9	R-14	I-75 NB	Western Hills Viaduct Entrance Ramp	C	1,070	-	C	910	-
5	R-15	C-D Roadway NB	OH 2nd St. Exit Ramp	C	1,200	-	A	430	-
5	R-16	I-71 NB	C-D Roadway NB Entrance Ramp	F	780	-	C	280	-
4	R-17	I-71 NB	OH 5th St. Entrance Ramp	C	190	-	B	530	-
4	R-18	I-71 NB	I-471 NB Entrance Ramp	F	1,960	-	C	1,110	-
10	R-20	I-75 SB	Hopple St. Entrance Ramp	D	230	-	C	240	-
10	R-21	I-75 NB	Hopple St. Exit Ramp	C	470	-	D	550	356

[1]Page Number refers to Appendix D HCS Results 2035 Alternative I.
[2]See section 6.1.2 for explanation on Constrained Volume. "-" means there was no constrained traffic for the analyzed segment.

6.2.4 Collector Distributor (C-D) Roadways

The existing conditions within the study area do not include C-D roadways. Therefore the C-D roadways could not be analyzed as part of the No Build Alternative and were only analyzed as part of the recommended preferred alternative. Table 6-15 and Table 6-16 include a reference column that corresponds to the HCS runs for C-D roadways, which are included in Appendix D.

6.2.4.1 Recommended Preferred Alternative

6.2.4.1.1 Kentucky

Nine C-D roadway segments were analyzed along the recommended preferred alternative in Kentucky. Of these, four were southbound and five were northbound.

AM Peak
During the AM peak period, every C-D roadway segment operated at LOS D or better.

PM Peak
During the PM peak period, every C-D roadway segment operated at LOS D or better.

The C-D roadway analysis for the recommended preferred alternative in Kentucky is presented in Table 6-15.

Table 6-15. Recommended Preferred Alternative C-D Roadway Analysis - Kentucky

Pg[1]	Ref	Facility	Location	LOS					
				AM Peak	Certified Traffic	Constrained Volume[2]	PM Peak	Certified Traffic	Constrained Volume[2]
3	CD-1	C-D Roadway SB	Between Brent Spence Bridge & KY 5th St. Diverge	A	1,410	-	D	4,660	4,635
3	CD-2	C-D Roadway SB	Between KY 5th St. Diverge & KY 9th St. Diverge	A	610	-	D	3,810	3,790

Table 6-15. Recommended Preferred Alternative C-D Roadway Analysis - Kentucky

Pg[1]	Ref	Facility	Location	LOS					
				AM Peak	Certified Traffic	Constrained Volume[2]	PM Peak	Certified Traffic	Constrained Volume[2]
2	CD-3	Kyles-Dixie C-D Roadway SB	Between Kyles Lane Diverge & Kyles Lane Merge	A	190	-	B	680	660
2	CD-4	Kyles-Dixie C-D Roadway SB	Between Kyles Lane Merge & Dixie Hwy. Diverge	B	540	-	C	1,240	1,220
2	CD-5	Kyles-Dixie C-D Roadway NB	Between Dixie Hwy. Diverge & Dixie Hwy. Merge	A	440	-	B	720	-
2	CD-6	Kyles-Dixie C-D Roadway NB	Between Dixie Hwy. Merge & Kyles Lane Diverge	D	1,440	-	C	1,100	-
3	CD-7	C-D Roadway NB	Between KY 12th St. Diverge & Pike St. Merge	C	2,070	-	A	830	-
3	CD-8	C-D Roadway NB	Between Pike St. Merge & KY 4th St. Merge	D	3,060	-	B	1,240	-
3	CD-9	C-D Roadway NB	Between KY 4th St. Merge & Brent Spence Bridge	D	4,220	-	B	2,290	-

[1]Page Number refers to Appendix D HCS Results 2035 Alternative I.
[2]See section 6.1.2 for explanation on Constrained Volume. "-" means there was no constrained traffic for the analyzed segment.

6.2.4.1.2 Ohio

Twenty C-D roadway segments were analyzed along the recommended preferred alternative in Ohio. Of these, eleven were southbound and nine were northbound.

AM Peak
During the AM peak period, one C-D roadway segment operated at LOS E.

PM Peak
During the PM peak period, every C-D roadway segment operated at LOS D or better.

The C-D roadway analysis for the recommended preferred alternative in Ohio is presented in Table 6-16.

Within the project limits, only one of the C-D roadway segments will operate below LOS D, operating at LOS E. This C-D roadway segment does not exist in the No Build Alternative; however, its comparable movement in the No Build Alternative, I-71 northbound between the Ohio River and the OH 2nd Street exit ramp, would also operate at LOS E.

Table 6-16. Recommended Preferred Alternative C-D Roadway Analysis - Ohio

Pg[1]	Ref	Facility	Location	LOS					
				AM Peak	Certified Traffic	Constrained Volume[2]	PM Peak	Certified Traffic	Constrained Volume[2]
8	CD-1	C-D Roadway SB	Between I-75 SB Diverge & Western Ave. Merge	B	3,500	-	B	2,560	-
8	CD-2	C-D Roadway SB	Between Western Ave. Merge & OH 7th St. Diverge	B	3,660	-	B	2,910	-
6	CD-3	C-D Roadway SB	Between OH 7th St. Diverge & OH 5th St./ OH 2nd St. Diverge	B	2,290	-	B	2,730	-
6	CD-4	C-D Roadway SB	Ramp to OH 7th St.	D	1,370	-	A	180	-
6	CD-5	C-D Roadway SB	Between OH 5th St./OH 2nd St. Diverge & 9th St. Merge	A	180	-	D	1,570	-
6	CD-6	C-D Roadway SB	Between OH 5th St. Diverge & OH 6th St. Merge	D	1,440	-	C	990	-
6	CD-7	C-D Roadway SB	Ramp to OH 5th St.	B	670	-	A	170	-
6	CD-8	C-D Roadway SB	Between OH 9th St. Merge & 3rd St. Merge	A	270	-	C	2,070	-
5	CD-9	C-D Roadway SB	Between OH 3rd St. & 6th St. Ramps	A	740	-	C	3,840	3,815
5	CD-10	C-D Roadway SB	Between OH 6th St. Ramp & Ohio River	A	1,410	-	D	4,660	4,635
5	CD-11	C-D Roadway SB	Ramp to OH 2nd St.	B	1,820	-	A	930	-
5	CD-12	C-D Roadway NB	Between Brent Spence Bridge & I-71 NB/OH 2nd St. Diverge	D	4,220	-	B	2,290	-
5	CD-13	C-D Roadway NB	Between I-71 NB/OH 2nd St. Diverge & OH 5th St. Diverge	C	2,240	-	B	1,580	-

Table 6-16. Recommended Preferred Alternative C-D Roadway Analysis - Ohio

Pg[1]	Ref	Facility	Location	LOS					
				AM Peak	Certified Traffic	Constrained Volume[2]	PM Peak	Certified Traffic	Constrained Volume[2]
5	CD-14	C-D Roadway NB	Between C-D Roadway NB Diverge & OH 2nd St. Diverge	E	1,980	-	B	710	-
5	CD-15	C-D Roadway NB	Between OH 5th St. Diverge & US 50 Diverge	B	1,660	-	B	1,300	-
6	CD-16	C-D Roadway NB	Between US 50 Diverge & I-71 SB Merge	B	810	-	A	470	-
6	CD-17	C-D Roadway NB	Ramp to US 50 WB	B	850	-	B	830	-
5	CD-18	C-D Roadway NB	Ramp from OH 4th St.	A	270	-	D	1,510	-
6	CD-19	C-D Roadway NB	Between OH 4th St. Merge & C-D Roadway NB Merge	C	2,280	-	D	3,020	2,901
8	CD-20	C-D Roadway NB	Between Winchell Ave. Diverge & I-75 NB Merge	C	2,710	-	D	3,250	3,139

[1]Page Number refers to Appendix D HCS Results 2035 Alternative I.
[2]See section 6.1.2 for explanation on Constrained Volume. "-" means there was no constrained traffic for the analyzed segment.

6.2.5 Intersections

The average vehicle delay calculation at each intersection is assigned a level of service ranging from LOS A, the best, to LOS F, the worst or failure. LOS C is considered acceptable, and in urban areas LOS D is generally considered acceptable. The intersection level of service criteria as defined by the Transportation Research Board for signalized and unsignalized intersections is shown in Table 6-17.

The intersection analysis includes the intersections within the study area which are formed by freeway ramps and their crossroads, as well as the intersections on the crossroads adjacent to those at the freeway ramps. These adjacent intersections are referred to as "check in" intersections and are included in this analysis to insure that the project does not negatively impact the level of service for intersections beyond the project's limits. Additionally, other adjacent intersections were analyzed if they would be affected by the recommended preferred alternative. The analysis was conducted for both the No Build Alternative as well as the recommended preferred alternative; however, due to the additional intersections created by the C-D roadways, the recommended preferred alternative analyzes additional intersections when compared to the No Build Alternative analysis.

Table 6-17. Intersection Level of Service Criteria

Level of Service (LOS)	Signalized Intersection: Control Delay per Vehicle (seconds)	Two-Way Stop-Controlled (Unsignalized) Intersection: Average Control Delay per Vehicle (seconds)
A	Less than 10	Less than 10
B	> 10 – 20	> 10 – 15
C	> 20 – 35	> 15 – 25
D	> 35 – 55	> 25 – 35
E	> 55 – 80	> 35 – 50
F	> 80	> 50

6.2.5.1 No Build Alternative

6.2.5.1.1 Kentucky

A total of 18 intersections were analyzed in Kentucky for the No Build Alternative. Five intersections were analyzed as unsignalized for the No Build Alternative: I-1 (W. KY 4th Street and Crescent Avenue), I-6 (West KY 5th Street and Crescent Avenue), I-8 (West KY 5th Street and Bakewell Street), I-12 (West KY 12th Street and Bullock Street), and I-13 (West KY 12th Street and Jillians Way).

AM Peak
Of the unsignalized intersections during the AM peak period in the No Build Alternative, one operated at LOS E and one operated at LOS F. Of the signalized intersections, during the AM peak period in the No Build Alternative, three operated at LOS F.

PM Peak
Of the unsignalized intersections during the AM peak period in the No Build Alternative, two operated at LOS F. At the signalized intersections during the PM peak period, one of the intersections operated at LOS E and two of the intersections operated at LOS F.

Intersection analyses for the No Build Alternative in Kentucky are presented in Table 6-18. Of the 18 intersections analyzed for the No Build Alternative in Kentucky, five will operate below LOS D during both the AM and PM peak periods, but three of these intersections are "check in" locations, or non-project locations, which are intersections adjacent to those analyzed as part of this project. These "check in" locations are included to show that while the project may improve the level of service at intersections within the project's limits, the project also does not negatively impact the intersections beyond the project's limits.

Table 6-18. No Build Alternative Intersection Analyses - Kentucky

Pg[1]	Ref	Intersection	LOS	
			No Build Alternative	
			AM Peak	PM Peak
2	I-1	W. 4th Street and Crescent Avenue	C	F
2	I-2	W. 4th Street and Philadelphia Street	D	E
2	I-3	W. 4th Street and Bakewell Street	B	B
2	I-4	W. 4th Street and Clay Wade Bailey Bridge	B	C
2	I-6	W. 5th Street and Crescent Avenue	B	C
2	I-7	W. 5th Street and Philadelphia Street	B	B
2	I-8	W. 5th Street and Bakewell Street	E	C
2	I-9	W. 5th Street and Main Street	B	B
2	I-10	Pike Street and Bullock Street	C	C
2	I-11	Pike Street and Jillians Way	D	B
2	I-12	W. 12th Street and Bullock Street	C	C
2	I-13	W. 12th Street and Jillians Way	F	F
1	I-14	Kyles Lane and Dixie Highway	F	F
1	I-15	Kyles Lane and I-75 SB Ramps	C	D
1	I-16	Kyles Lane and I-75 NB Ramps	F	C
1	I-17	W. Kyles Lane and Highlands Avenue	F	F
1	I-18	Dixie Highway and I-75 SB Ramps	B	C
1	I-19	Dixie Highway and I-75 NB Ramps	C	B

[1]Page Number refers to Appendix D HCS Results 2035 No Build.

X	LOS OK, Movement v/c > 1.00
X	LOS E or F
X	Non-Project Intersection

6.2.5.1.2 Ohio

In Ohio, 43 intersections were analyzed in the No Build Alternative. Three of the intersections were analyzed as unsignalized intersections for the No Build Alternative: I-4 (Bank Street and Linn Street), I-21 (Court Street and Linn Street), and I-28 (OH 6th Street and Linn Street).

Within the signalized module of HCS there is a provision for analyzing signalized intersections within the Central Business District (CBD). The CBD is typically characterized by a grid street system which may feature on-street parking, bus stops, sidewalks extending from buildings to the curb, a significant interaction between pedestrians and motorized vehicles, and mixed building uses which may feature shopping, restaurants, professional services, entertainment, etc. For purposes of using this feature for the intersections being analyzed, the CBD was assumed to exist in Ohio from the Ohio River north to and including Court Street, and for those intersections analyzed within this Access Point Request Document east of I-75.

The intersections of Ezzard Charles westbound and Western Avenue, Ezzard Charles westbound and Winchell Avenue, Ezzard Charles eastbound and Western Avenue as well as Ezzard Charles eastbound and Winchell Avenue will not have an even lane distribution for all of the approaches due to the close proximity of the intersections. The "highest single lane volume in lane group" feature in HCS was used to provide the lane utilization due to the logical volume loading of the lanes with respect to the adjacent intersections.

The intersection of Gest Street and Western Avenue is very close to the intersection of Gest Street and Freeman Avenue. Due to the close proximity to each other, Synchro is being used to supplement the HCS analyses for these two intersections. This allows for both intersections to be run off of the same controller. The optimized cycle length from Synchro was carried through to the HCS analyses. Synchro level of service results for these two intersections are included in Table 6-19 directly below the equivalent HCS results.

The intersection of OH 7th Street and Central Avenue has a pocket lane on the right side of the west approach that allows through movements on OH 7th Street, as evidenced by the combination through-right turn pavement marking arrow. However, since the through lane on the east side of the intersection is approximately 100 feet long, the capacity analyses assume this lane is a pocket right turn lane due to practicality purposes.

The intersection of OH 6th Street and Central Avenue will not have an even lane distribution for the three through lanes on the east approach of OH 6th Street; with two lanes dedicated as through lanes to continue on OH 6th Street and one lane dedicated to the entrance ramp for the northbound C-D roadway. The "highest single lane volume in lane group" feature in HCS was used to provide the lane utilization due to the logical volume loading of the lanes with the entrance ramp located immediately west of the intersection.

Three roadways converge to form the west approach of the OH 5th Street and Central Avenue intersection. The proposed design has a single ramp lane from the southbound C-D roadway entering on the left, a single ramp lane from US 50 eastbound entering adjacent to it on the right, and dual ramp lanes from the northbound C-D roadway entering on the extreme right. Shortly after the ramp lane from the southbound C-D roadway enters, an exclusive left turn lane is formed. The proposed design will have a raised median separating the movements between the US 50 ramp lane and the northbound C-D roadway ramp lanes. As a result, no weaving will be permitted between these two roadways. Weaving may exist for motorists entering form US 50 who desire to weave across the ramp lane from the southbound C-D roadway to the left turn lane for Central Avenue. Due to not having weaving volumes available, all of the left turns onto Central Avenue from the west approach of OH 5th Street were assumed to enter from US 50 eastbound. This concept was utilized to insure that the worst case scenario was analyzed. The weave analyses can be found in Table 6-8 and
Table 6-9.

The intersection of OH 3rd Street and Elm Street will not have an even lane distribution for the four through lanes on the east approach of OH 3rd Street; with two lanes dedicated to the entrance ramp for I-71 southbound in the No Build (entrance ramp for C-D roadway southbound for the recommended preferred alternative) and two lanes dedicated as through lanes to continue on 3rd Street. Elm Street has four lanes on the south approach; with the leftmost lane dropping to the entrance ramp for I-71 southbound in the No Build (entrance ramp for C-D roadway southbound for the recommended preferred alternative), the adjacent lane having the option to turn left onto OH 3rd Street or continue northbound on Elm Street; and the additional two lanes as through lanes on Elm Street. In order to calculate the lane utilization, an assumption was made that half of the northbound traffic on Elm Street that desired to turn left was going to the entrance ramp. The two westbound lanes dedicated to the entrance ramp will not have the same volume distribution as the two westbound lanes dedicated as through lanes that continue on OH 3rd Street. The "highest single lane volume in lane group" feature in HCS was used to provide the lane utilization due to the logical volume loading of the lanes with the entrance ramp located immediately west of the intersection.

AM Peak
None of the intersections in the No Build Alternative operated below LOS D.

PM Peak
None of the unsignalized intersections in the No Build Alternative operated below LOS D. At the signalized intersections during the PM peak period, one of the intersections operated at LOS E.

In the No Build Alternative, of the 41 intersection analyzed, six would operate at LOS D or lower. Additionally, three of the intersections will have a volume to capacity (v/c) ratio of greater than 0.92 The intersection of OH 9th Street and Central Avenue will have a v/c ratio of 0.96 for the westbound through/right movement in the PM peak hour. The intersection of OH 4th Street and Central Avenue will have a v/c ratio of 1.00 for the northbound left turn movement and a v/c ratio of 0.96 for the westbound through/left movement in the PM peak hour. The intersection of OH 3rd Street and Central Avenue will have a v/c ratio of 1.00 for the westbound through/right movement and a v/c ratio of 0.97 for the northbound left turn movement in the PM peak hour. This provides the level of service for the AM and PM peak hours for the No Build Alternative in Ohio. Those intersections highlighted in blue are existing intersections outside of the project limits and are "check in" intersections. All of the intersections will operate at LOS D or higher in the No Build Alternative, except the intersection at OH 3rd Street and Central Avenue. This intersection will operate at LOS E during the PM peak hour.

Table 6-19. No Build Alternative Intersection Analyses - Ohio

Pg[1]	Ref	Intersection	LOS	
			No Build Alternative	
			AM Peak	PM Peak
8	1	Bank Street & Dalton Avenue	B	B
8	2	Bank Street & Winchell Avenue	B	B
8	3	Central Parkway & Linn Street	B	B
8	4	Bank Street & Linn Street	B	B
8	5	Dalton Avenue & Findlay Street	B	B
8	6	Findlay Street & Western Avenue	B	B
8	7	Findlay Street & Winchell Avenue	B	B
8	8	Dalton Avenue & Liberty Street	B	B
8	9	Western Avenue & Liberty Street	C	B
8	10	Liberty Street & Winchell Avenue	B	B
8	11	Liberty Avenue & Linn Street	B	B
7	12	Ezzard Charles Drive (WB) & Western Avenue	B	B
7	13	Ezzard Charles Drive (WB) & Winchell Avenue	B	B
7	14	Ezzard Charles Drive (EB) & Western Avenue	B	B
7	15	Ezzard Charles Drive (EB) & Winchell Avenue	B	B
7	16	Ezzard Charles Drive & Linn Street	B	B
7	17	Gest Street & Dalton Avenue	B	B
7	18	Gest Street & Western Avenue	B	B
-	*18**	*Gest Street & Western Avenue*	*A*	*A*
7	19	Gest Street & Freeman Avenue	D	D
-	*19**	*Gest Street & Freeman Avenue*	*D*	*D*
6	20	Linn Street & Gest Street	B	B
7	21	Court Street & Linn Street	C	C
6	23	8th Street & Dalton Avenue	B	B
6	24	8th Street & Freeman Avenue	B	B
6	25	8th Street & Linn Street	B	C
8	26	Western Hills Viaduct & Spring Grove	B	B
6	27	Dalton Avenue & Linn Street	B	B
6	28	6th Street & Linn Street	A	B
6	29	Court Street & Central Avenue	B	B
6	30	9th Street & Central Avenue	B	D
6	31	7th Street & Central Avenue	B	B
6	32	6th Street & Central Avenue	B	C
6	33	5th Street & Central Avenue	C	B
4	34	4th Street & Central Avenue	B	D
4	35	3rd Street & Central Avenue	D	E
4	36	4th Street & Plum Street	B	B
4	37	3rd Street & Plum Street	B	B
4	38	4th Street & Elm Street	B	B
4	39	3rd Street & Elm Street	B	B
4	40	2nd Street & Elm Street	B	B
4	41	3rd Street & Clay Wade Bailey Bridge	C	D
8	43	Central Parkway & McMillan Street	C	D

[1]Page Number refers to Appendix D HCS Results 2035 No Build
*Synchro Results for I-18 and I-19

X (yellow)	LOS OK, Movement v/c > 0.92
X (red)	LOS E or F
X (blue)	Non-Project Intersection

6.2.5.2 Recommended Preferred Alternative

6.2.5.2.1 Kentucky

A total of 21 intersections were analyzed in Kentucky for the recommended preferred alternative. Three intersections were analyzed as unsignalized for the recommended preferred alternative: I-1 (West KY 4th

Street and Crescent Avenue), I-6 (West KY 5th Street and Crescent Avenue), I-8 (West KY 5th Street and Bakewell Street).

AM Peak
Of the unsignalized intersections during the AM peak period in the recommended preferred alternative, one operated at LOS F. Of the signalized intersections during the AM peak period in the recommended preferred alternative, two operated at LOS F.

PM Peak
None of the unsignalized intersections in the recommended preferred alternative operated below LOS D. At the signalized intersections during the PM peak period, two of the intersections operated at LOS F.

Intersection analyses for the recommended preferred alternative in Kentucky are presented in Table 6-20. None of the intersections constructed for the recommended preferred alternative will operate below LOS D. Those intersections identified in Table 6-20 as having a level of service below LOS D are "check in" locations, which are intersections adjacent to those intersections that would be constructed/reconstructed as part of this project. These "check in" locations are included to show that while the project may improve the level of service at intersections within the project's limits, the project also does not negatively impact the intersections beyond the project's limits.

It is indicated that the level of service at intersections I-4 and I-9 LOS during the PM Peak will be degraded from the no-build condition. After the project is completed and traffic is following the new pattern, KYTC will evaluate these locations.

Table 6-20. Recommended Preferred Alternative Intersection Analyses - Kentucky

Pg[1]	Ref	Intersection	LOS	
			Recommended Preferred Alternative	
			AM Peak	PM Peak
3	I-1	W. 4th Street and Crescent Avenue	C	C
3	I-2	W. 4th Street and Philadelphia Street	C	B
3	I-3	W. 4th Street and Bakewell Street	B	B
3	I-4	W. 4th Street and Clay Wade Bailey Bridge	B	D
3	I-6	W. 5th Street and Crescent Avenue	B	C
3	I-7	W. 5th Street and Philadelphia Street	B	B
3	I-8	W. 5th Street and Bakewell Street	F	D
3	I-9	W. 5th Street and Main Street	B	D
3	I-10	Pike Street and Bullock Street	C	C
3	I-11	Pike Street and Jillians Way	B	B
3	I-12	W. 12th Street and Bullock Street	B	B
3	I-13	W. 12th Street and Jillians Way	C	B
2	I-14	Kyles Lane and Dixie Highway	F	F
2	I-15	Kyles Lane and I-75 SB Ramps	B	C
2	I-16	Kyles Lane and I-75 NB Ramps	C	C
2	I-17	W. Kyles Lane and Highlands Avenue	F	F
2	I-18	Dixie Highway and I-75 SB Ramps	B	C
2	I-19	Dixie Highway and I-75 NB Ramps	C	B
3	I-A	9th Street and Jillians Way	B	B
3	I-B	9th Street and Bullock Street	B	B
3	I-C	W. 5th Street and Jillians Way	B	B

[1]Page Number refers to Appendix D HCS Results 2035 Alternative I.

X	LOS OK, Movement v/c > 1.00
X	LOS E or F
X	Non-Project Intersection

6.2.5.2.2 *Ohio*

In Ohio, 42 intersections were analyzed in the recommended preferred alternative. Three of the intersections were analyzed as unsignalized intersections: I-4 (Bank Street and Linn Street), I-21 (Court Street and Linn Street), and I-28 (OH 6th Street and Linn Street).

Within the signalized module of HCS there is a provision for analyzing signalized intersections within the Central Business District (CBD). The CBD is typically characterized by a grid street system which may feature on-street parking, bus stops, sidewalks extending from buildings to the curb, a significant interaction between pedestrians and motorized vehicles and mixed building uses which may feature shopping, restaurants, professional services, entertainment, etc. For purposes of using this feature for the intersections being analyzed, the CBD was assumed to exist in Ohio from the Ohio River north to and including Court Street, and for those intersections analyzed within this Access Point Request Document east of I-75.

The intersections of Ezzard Charles westbound and Western Avenue, Ezzard Charles westbound and Winchell Avenue, Ezzard Charles eastbound and Western Avenue as well as Ezzard Charles eastbound and Winchell Avenue will not have an even lane distribution for all of the approaches due to the close proximity of the intersections. The "highest single lane volume in lane group" feature in HCS was used to provide the lane utilization due to the logical volume loading of the lanes with respect to the adjacent intersections.

The intersection of Gest Street and Western Avenue is very close to the intersection of Gest Street and Freeman Avenue. Due to the close proximity to each other, Synchro is being used to supplement the HCS analyses for these two intersections. This allows for both intersections to be run off of the same controller. The optimized cycle length from Synchro was carried through to the HCS analyses. Synchro level of service results for these two intersections is included in Table 6-21 directly below the equivalent HCS results.

The intersection of OH 7th Street and Central Avenue has a pocket lane on the right side of the west approach that allows through movements on OH 7th Street, as evidenced by the combination through-right turn pavement marking arrow. However, since the through lane on the east side of the intersection is approximately 100 feet long, the capacity analyses assume this lane is a pocket right turn lane due to practicality purposes.

The intersection of 6th Street and Central Avenue will not have an even lane distribution for the three through lanes on the east approach of OH 6th Street; with two lanes dedicated as through lanes to continue on 6th Street and one lane dedicated to the entrance ramp for the northbound C-D roadway. The "highest single lane volume in lane group" feature in HCS was used to provide the lane utilization due to the logical volume loading of the lanes with the entrance ramp located immediately west of the intersection.

Three roadways converge to form the west approach of the OH 5th Street and Central Avenue intersection. The proposed design has a single ramp lane from the southbound C-D roadway entering on the left, a single ramp lane from US 50 eastbound entering adjacent to it on the right, and dual ramp lanes from the northbound C-D roadway entering on the extreme right. Shortly after the ramp lane from the southbound C-D roadway enters, an exclusive left turn lane is formed. The proposed design will have a raised median separating the movements between the US 50 ramp lane and the northbound C-D roadway ramp lanes. As a result, no weaving will be permitted between these two roadways. Weaving may exist for motorists entering form US 50 who desire to weave across the ramp lane from the southbound C-D roadway to the left turn lane for Central Avenue. Due to not having weaving volumes available, all of the left turns onto Central Avenue from the west approach of 5th Street were assumed to enter from US 50 eastbound. This concept was utilized to insure that the worst case scenario was analyzed. The weave analyses can be found in Table 6-8 and
Table 6-9.

The intersection of OH 3rd Street and Elm Street will not have an even lane distribution for the four through lanes on the east approach of OH 3rd Street; with two lanes dedicated to the entrance ramp for I-71 southbound in the No Build (entrance ramp for C-D roadway southbound for the recommended preferred alternative) and two lanes dedicated as through lanes to continue on 3rd Street. Elm Street has four lanes on the south approach; with the leftmost lane dropping to the entrance ramp for I-71 southbound in the No Build (entrance ramp for C-D roadway southbound for the recommended preferred alternative), the adjacent lane having the option to turn left onto OH 3rd Street or continue northbound on Elm Street; and the additional two lanes as through lanes on Elm Street. In order to calculate the lane utilization, an assumption was made that half of the northbound traffic on Elm Street that desired to turn left was going to the entrance ramp. The two westbound lanes dedicated to the entrance ramp will not have the same volume distribution as the two westbound lanes dedicated as through lanes that continue on OH 3rd Street. The "highest single lane volume in lane group" feature in HCS was used to provide the lane utilization due to the logical volume loading of the lanes with the entrance ramp located immediately west of the intersection.

AM Peak
None of the intersections in the recommended preferred alternative operated below LOS D.

PM Peak
None of the intersections in the recommended preferred alternative operated below LOS D.

In the recommended preferred alternative, all intersections will operate at LOS D or better. Additionally, all intersections will have a volume to capacity (v/c) ratio of less than 0.92, as mandated in ODOT's Traffic Academy training for Interchange Justification Studies and Interchange Modification Studies, except for the intersection of OH 4th Street and Central Avenue. This intersection will have a v/c ratio of 0.94 for the westbound through/left movement in the PM peak hour. This movement is on a built up portion of the existing city street where no changes are anticipated for this project. By comparison, the v/c ratio for the same time period in the No Build Alternative is 0.96 for the westbound through/left movement and 1.00 for the northbound left movement. Table 6-21 provides the level of service for the AM and PM peak hours for the recommended preferred alternative. Those intersections highlighted in blue are existing intersections outside of the project limits and are "check in" intersections. The result of all the intersections within the recommended preferred alternative having v/c ratios of less than 0.92, with the exception noted above, and a level of service no lower than LOS D seems to indicate that traffic volumes entering or exiting the freeway system are not being constrained by Cincinnati's downtown grid system.

Table 6-21. Recommended Preferred Alternative Intersection Analyses - Ohio

Pg[1]	Ref	Intersection	LOS Recommended Preferred Alternative	
			AM Peak	PM Peak
9	1	Bank Street & Dalton Avenue	B	B
9	2	Bank Street & Winchell Avenue	B	B
9	3	Central Parkway & Linn Street	B	B
9	4	Bank Street & Linn Street	B	B
9	5	Dalton Avenue & Findlay Street	B	B
9	6	Findlay Street & Western Avenue	B	B
9	7	Findlay Street & Winchell Avenue	B	B
9	8	Dalton Avenue & Liberty Street	B	B
9	9	Western Avenue & Liberty Street	C	C
9	10	Liberty Street & Winchell Avenue	B	B
9	11	Liberty Avenue & Linn Street	B	B
8	12	Ezzard Charles Drive (WB) & Western Avenue	B	B
8	13	Ezzard Charles Drive (WB) & Winchell Avenue	B	B
8	14	Ezzard Charles Drive (EB) & Western Avenue	B	B
8	15	Ezzard Charles Drive (EB) & Winchell Avenue	B	B
8	16	Ezzard Charles Drive & Linn Street	B	B
8	17	Gest Street & Dalton Avenue	B	B
8	18	Gest Street & Western Avenue	B	B
-	*18**	*Gest Street & Western Avenue*	*A*	*B*
8	19	Gest Street & Freeman Avenue	D	D
-	*19**	*Gest Street & Freeman Avenue*	*D*	*D*
7	20	Linn Street & Gest Street	B	B
8	21	Court Street & Linn Street	B	B
7	23	8th Street & Dalton Avenue	B	B
7	24	8th Street & Freeman Avenue	B	B
7	25	8th Street & Linn Street	B	B

Table 6-21. Recommended Preferred Alternative Intersection Analyses - Ohio

Pg[1]	Ref	Intersection	LOS Recommended Preferred Alternative	
			AM Peak	PM Peak
-	26	Western Hills Viaduct & Spring Grove	-	-
7	27	Dalton Avenue & Linn Street	B	B
7	28	6th Street & Linn Street	A	C
7	29	Court Street & Central Avenue	B	B
7	30	9th Street & Central Avenue	B	C
7	31	7th Street & Central Avenue	B	B
7	32	6th Street & Central Avenue	B	B
7	33	5th Street & Central Avenue	C	B
5	34	4th Street & Central Avenue	B	D
5	35	3rd Street & Central Avenue	D	D
5	36	4th Street & Plum Street	B	B
5	37	3rd Street & Plum Street	B	B
5	38	4th Street & Elm Street	B	B
5	39	3rd Street & Elm Street	B	B
5	40	2nd Street & Elm Street	B	B
5	41	3rd Street & Clay Wade Bailey Bridge	C	D
9	43	Central Parkway & McMillan Street	C	D
9	50	Western Hills Viaduct & I-75 SB Ramp	A	A
9	51	Western Hills Viaduct & I-75 NB Ramp	C	B

[1]Page Number refers to Appendix D HCS Results 2035 Alternative I.
*Synchro Results for I-18 and I-19

X	LOS OK, Movement v/c > 0.92
X	LOS E or F
X	Non-Project Intersection

6.2.6 Turn Lane Storage Lengths

The reported turn lane storage lengths include required deceleration and a 50-foot diverging taper. The current turn lane storage length was compared to the required turn lane storage length. The results of this analysis are summarized in Table 6-22 for Kentucky and Table 6-23 for Ohio. The reference column in these tables corresponds to the turn lane storage calculations provided in Appendix E.

Turn lane storage lengths were calculated for all of the intersections within the project limits where work is being performed as well as for all of the intersections immediately adjacent to the project limits. These adjacent intersections are referred to as “check in” intersections and are included in this analysis to insure that the project does not negatively impact the level of service for intersections beyond the project’s limits. These “check in” intersections are outside of the project limits and no work is being conducted at these locations in either Kentucky or Ohio. The calculations are provided to identify instances where existing turn lane storage may need to be lengthened in the future to accommodate increased demand. This increased demand is likely not related to this project but is more likely due to the past 50 years of traffic growth as most of these intersections were designed and constructed in the 1950s.

6.2.6.1.1 Kentucky

Within Kentucky, all of the intersections within the project limits for the recommended preferred alternative were able to be designed to meet Kentucky’s guidelines for turn lane storage lengths except for five:

- Westbound left turn lane at Pike Street and Bullock Street
- Westbound left turn lane at KY 12th Street and Bullock Street
- Westbound right turn lanes at Kyles Lane and the I-71/I-75 northbound ramps
- Eastbound right turn lane at Dixie Highway and the I-71/I-75 southbound ramp
- Westbound right turn lane at Dixie Highway and the I-71/I-75 northbound ramp

At the westbound left turn lane at the intersection of Pike Street and Bullock Street and at the westbound left turn lane at the intersection of KY 12th Street and Bullock Street, the turn lane storage distance required will exceed the distance between the crossroad intersections of Bullock Street on the west and Jillian Way on the east. Therefore it would not be possible to provide sufficient turn lane storage.

The westbound right turn lane at the intersection of Kyles Lane and the I-71/I-75 northbound ramps would need to be lengthened an additional 771 feet. This would require the acquisition of numerous residential properties located in a developed residential community. Therefore the existing storage length will be maintained at this intersection.

The eastbound right turn lane at the intersection of Dixie Highway and the I-71/I-75 southbound ramp will not achieve the appropriate turn storage length. Achieving the appropriate turn storage length would impact an unsignalized intersection at Dixie Highway and Maple Avenue and would require the acquisition of additional property. Therefore the existing storage length will be maintained at this intersection.

The westbound right turn lane at the intersection of Dixie Highway and the I-75 northbound ramp, while technically shown as deficient by three feet, is designed as a slip ramp to bypass the signal at the intersection. As a result of the slip ramp operation, accommodating the additional storage of 3 feet was deemed inappropriate.

Each of these identified intersections which had an approach that didn’t have adequate storage length for its turn lanes in the design year was checked to make sure that it would not have an adverse effect from traffic queues spilling back onto the Interstate System or grid-locking any ramp intersection with a local crossroad. None of these five intersections will have an adverse effect on the Interstate, its ramps, or its ramp intersections. The results of the turn lane storage analysis for Kentucky are summarized in Table 6-22.

6.2.6.1.2 Ohio

Within Ohio, all of the intersections within the project limits for the recommended preferred alternative were able to be designed to meet Ohio’s guidelines for turn lane storage lengths. Any intersections which are noted to not have adequate storage length are outside the project limits and are identified as “check in” intersections. The turn lane storage length for the “check in” intersections is noted for informational purposes only, and there is no intent to increase the storage lengths at this time. Additionally, each "check-in" intersection which had an approach that didn't have adequate storage length for its turn lanes in the design year was checked to make sure that it would not have an adverse effect from traffic queues spilling back onto the Interstate System or grid-locking any ramp intersection with a local crossroad. None of the "check-in" intersections will have an adverse effect on the Interstate, its ramps or its ramp intersections. All, but a few, of the "check-in" intersections are located a quarter-mile or more from the Interstate. The results of the turn lane storage analysis for Ohio are summarized in Table 6-23.

6.3 Signing Plan Analysis

A signage plan analysis was performed to show that the proposed freeway and interchange designs could be signed in conformance with the rules and standards contained in FHWA's Manual on Uniform Traffic Control Devices (MUTCD). Since the interstate system was designed to promote travel between States, many interstate travelers are unfamiliar with their interim and final travel destinations. Travelers must rely on interstate signing to convey clear, concise and accurate information for their guidance.

The roadway design for the Brent Spence Replacement/Rehabilitation Project is non-typical because traffic bound for the Central Business District (CBD) of either Covington or Cincinnati will utilize a collector-distributor (C-D) roadway system. The C-D roadway will have only one exit location from I-71/I-75 in each direction which will provide access to both Covington's and Cincinnati's CBDs. Most cities, especially the size of Covington or Cincinnati, typically have multiple exits to reach CBD destinations. If interstate travelers miss this only exit, they will miss the most direct opportunity to reach either CBD. As a result, the signing plan must be somewhat non-typical to clearly communicate this unique design, but must meet the requirements of MUTCD.

Once travelers exit I-71/I-75 to reach either CBD destination, the C-D roadway then provides access to the CBDs of Covington and Cincinnati. The signing concept relies on the use of individual signs above individual lanes along the interstate and C-D roadway, which contain one to two destinations and a lane arrow to guide travelers to these destinations from the interstate system. In a few locations this concept cannot be used, due to the spacing of exits and the number of lanes available at a required sign location, and meet all the rules prescribed in the MUTCD for number, spacing and destination information; however, the intent of the MUTCD is captured to the extent possible. Proposed departures from the MUTCD shown in the signage plan have been coordinated with KYTC and ODOT. The signing plan for both the Kentucky and Ohio portions of this project is contained in Exhibit 6.

Table 6-22. Recommended Preferred Alternative Turn Lane Lengths - Kentucky

Ref	Intersection	Approach	Turn Movement	# Turn Lanes	# Thru Lanes	Turn Volume	Design Hourly Volume	Cycle Length (in seconds)	Turn Vehicles per Cycle	Turn Volume Storage Length (Incl. Taper)	Storage per Turn Lane	Thru Vehicles per Cycle per Lane	Queue per Thru Lane	Final Turn Lane Length	Storage Length Provided	Adequate Storage Provided?
1	W. 4th St. and Crescent Ave.	NB	Right	1	1	30	390	N/A	N/A	-	-	N/A	N/A	-	245	Yes
		SB	Left	1	1	200	210	N/A	N/A	-	-	N/A	N/A	-	-	-
2	W. 4th St. and Philadelphia St.	NB	Left	1	1	130	340	60	2.2	125	125	5.7	193	193	175	No
		SB	Right	1	1	730	80	60	12.2	500	500	1.3	45	500	305	No
		WB	Left	1	2	70	710	60	1.2	125	125	5.9	201	201	290	Yes
4	W. 4th St. and Clay Wade Bailey Bridge	NB	Left	1	1	120	520	60	2.0	125	125	8.7	295	295	340	Yes
		SB	Right	1	1	300	1110	60	5.0	250	250	18.5	629	629	695	Yes
		WB	Left	1	2	280	650	60	4.7	225	225	5.4	184	225	380	Yes
			Right	1	2	280	580	60	4.7	125	125	4.8	164	164	300	Yes
6	W. 5th St. and Crescent Ave.	SB	Left	1	1	200	50	0	N/A	-	-	N/A	N/A	-	210	Yes
7	W. 5th St. and Philadelphia St.	SB	Left	1	1	120	60	60	2.0	-	-	1.0	34	34	160	Yes
8	W. 5th St. and Bakewell St.	EB	Right	1	2	30	860	0	N/A	-	-	N/A	N/A	-	100	Yes
9	W. 5th St. and Main St.	NB	Right	1	1	160	500	60	2.7	150	150	8.3	283	283	110	No
		SB	Left	1	1	390	1000	60	6.5	300	300	16.7	567	567	230	No
10	Pike St. and Bullock St.	WB	Left	2	1	530	590	60	8.8	375	187.5	9.8	334	334	245, 245	No
11	Pike St. and Jillians Way	NB	Left	1	3	200	1170	60	3.3	175	175	6.5	221	221	424	Yes
			Right	1	3	360	1170	60	6.0	275	275	6.5	221	275	424	Yes
		EB	Left	2	1	410	470	60	6.8	300	150	7.8	266	266	245, 245	Yes
12	W. 12th St. and Bullock St.	SB	Left	1	2	370	540	60	6.2	275	275	4.5	153	275	460	Yes
			Right	1	2	80	540	60	1.3	125	125	4.5	153	153	465	Yes
		WB	Left	1	1	370	90	60	6.2	275	275	1.5	51	275	230	No
13	W. 12th St. and Jillians Way	NB	Right	1	3	460	670	60	7.7	350	350	3.7	127	350	471	Yes
		EB	Left	1	1	230	400	60	3.8	200	200	6.7	227	227	230	Yes
14	Kyles Lane and Dixie Hwy	WB	Left	1	1	380	30	100	10.6	450	450	0.8	28	450	563	Yes
			Right	1	1	830	30	100	23.1	925	925	0.8	28	925	577	No
15	Kyles Lane and I-71/I-75 SB Ramps	SB	Left	2	0	760	0	100	21.1	850	425	N/A	-	425	478, 478	Yes
			Right	1	0	380	0	100	10.6	450	450	N/A	-	450	485	Yes
		EB	Right	1	2	270	700	100	7.5	325	325	9.7	331	331	418	Yes
		WB	Left	1	2	290	860	100	8.1	350	350	11.9	406	406	622	Yes
16	Kyles Lane and I-71/I-75 NB Ramps	NB	Left	1	0	340	0	100	9.4	400	400	N/A	-	400	400	Yes
			Right	1	0	380	0	100	10.6	450	450	N/A	-	450	450	Yes
		EB	Left	1	2	370	750	90	9.3	250	250	9.4	319	319	630	Yes
		WB	Right	1	2	1100	560	90	27.5	1075	1075	7.0	238	1075	304	No
17	Kyles Lane and Highlands Ave	NB	Left	1	1	10	1320	90	0.3	125	125	33.0	1122	1122	125	No

Table 6-22. Recommended Preferred Alternative Turn Lane Lengths - Kentucky

Ref	Intersection	Approach	Turn Movement	# Turn Lanes	# Thru Lanes	Turn Volume	Design Hourly Volume	Cycle Length (in seconds)	Turn Vehicles per Cycle	Turn Volume Storage Length (Incl. Taper)	Storage per Turn Lane	Thru Vehicles per Cycle per Lane	Queue per Thru Lane	Final Turn Lane Length	Storage Length Provided	Adequate Storage Provided?
			Right	1	1	260	1320	90	6.5	300	300	33.0	1122	1122	550	No
		SB	Left	1	1	180	1450	100	5.0	250	250	40.3	1369	1369	255	No
		WB	Right	1	1	330	10	90	8.3	300	300	0.3	9	300	210	No
18	Dixie Hwy and I-71/I-75 SB Ramps	SB	Left	2	0	580	0	100	16.1	475	237.5	N/A	-	238	303, 295	Yes
			Right	1	0	100	0	100	2.8	-	-	N/A	-	0	414	Yes
		EB	Right	1	2	540	630	100	15.0	450	450	8.8	298	450	294	No
		WB	Left	1	2	90	650	100	2.5	125	125	9.0	307	307	325	Yes
19	Dixie Hwy and I-71/I-75 NB Ramps	NB	Left	1	0	250	0	100	6.9	225	225	N/A	-	225	307	Yes
			Right	1	0	130	0	100	3.6	-	-	N/A	-	0	315	Yes
		EB	Left	1	2	60	1150	90	1.5	125	125	14.4	489	489	350	Yes
		WB	Right	1	2	870	1240	90	21.8	125	125	15.5	527	527	524	No
A	W. 9th St. and Jillians Way	NB	Left	1	2	20	300	60	0.3	-	-	2.5	85	85	569	Yes
C	W. 5th St. and Jillians Way	NB	Right	2	0	560	0	60	9.3	-	-	N/A	-	0	2164, 2162	Yes

No proposed work shown
Meets turn lane length requirement
Fails to meet turn lane length requirement
Meets storage requirement, but fails to meet queue length

Table 6-23. Recommended Preferred Alternative Turn Lane Lengths - Ohio

Ref	Intersection	Approach	Turn Movement	# Turn Lanes	# Thru Lanes	Turn Volume	Design Hourly Volume	Cycle Length (in seconds)	Turn Vehicles per Cycle	Turn Volume Storage Length	Storage per Turn Lane	Thru Vehicles per Cycle per Lane	Queue per Thru Lane	Final Turn Lane Length	Storage Length Provided	Adequate Additional Storage Provided?
I-1	Bank St. & Dalton Ave.	Westbound	Right	1	2	450	50	60	8	325	325	1	50	436	280	No
I-1	Bank St. & Dalton Ave.	Northbound	Left	1	2	30	630	60	1	50	50	6	250	250	230	No
I-1	Bank St. & Dalton Ave.	Southbound	Left	1	2	190	850	60	4	175	175	8	325	325	180	No
I-2	Bank St. & Winchell Ave.	Westbound	Right	1	2	70	160	60	2	100	100	2	100	211	Continuous	Yes
I-2	Bank St. & Winchell Ave.	Northbound	Left	1	2	340	350	60	6	250	250	3	150	361	Continuous	Yes
I-3	Central Pkwy & Linn St.	Northbound	Left	1	1	160	90	60	3	150	150	2	100	261	Continuous	Yes
I-3	Central Pkwy & Linn St.	Northbound	Right	1	1	30	90	60	1	50	50	2	100	161	200	Yes
I-3	Central Pkwy & Linn St.	Eastbound	Right	1	2	80	1240	60	2	100	100	11	400	400	300	No
I-4	Bank St. & Linn St.	Southbound	Right	1	2	50	270	60	1	50	50	---	---	161	Free-flow	Yes
I-4	Bank St. & Linn St.	Westbound	Left	1	1	40	80	60	1	50	50	2	100	100	Continuous	Yes
I-4	Bank St. & Linn St.	Westbound	Right	1	1	80	40	60	2	100	100	1	50	150	Continuous	Yes
I-5	Dalton Ave. & Findlay St.	Eastbound	Left	1	1	40	60	60	1	50	50	1	50	100	90	Yes
I-5	Dalton Ave. & Findlay St.	Westbound	Left	1	1	130	10	60	3	150	150	1	50	200	80	No
I-5	Dalton Ave. & Findlay St.	Westbound	Right	1	1	100	10	60	2	100	100	1	50	150	Continuous	Yes
I-5	Dalton Ave. & Findlay St.	Northbound	Left	1	2	10	700	60	1	50	50	6	250	250	70	No
I-5	Dalton Ave. & Findlay St.	Southbound	Left	1	2	170	580	60	3	150	150	5	200	261	200	Yes
I-6	Findlay St. & Western Ave.	Eastbound	Right	1	2	90	180	60	2	100	100	2	100	150	Continuous	Yes
I-6	Findlay St. & Western Ave.	Southbound	Left	1	2	80	220	60	2	100	100	2	100	150	Continuous	Yes
I-8	Dalton Ave. & Liberty St.	Westbound	Left	1	1	130	260	60	3	150	150	5	200	261	Continuous	Yes
I-8	Dalton Ave. & Liberty St.	Westbound	Right	1	1	260	130	60	5	200	200	3	150	311	Continuous	Yes
I-8	Dalton Ave. & Liberty St.	Southbound	Left	1	2	190	470	60	4	175	175	4	175	286	60	No
I-9	Western Ave. & Liberty St.	Westbound	Left	1	2	70	260	60	2	100	100	3	150	150	125	No
I-9	Western Ave. & Liberty St.	Southbound	Left	1	3	70	210	60	2	100	100	2	100	211	100	No
I-11	Linn St. & Liberty St.	Eastbound	Left	1	2	10	270	60	1	50	50	3	150	150	75	No
I-11	Linn St. & Liberty St.	Westbound	Left	1	2	190	300	60	4	175	175	3	150	225	75	No
I-11	Linn St. & Liberty St.	Northbound	Left	1	2	60	380	60	1	50	50	4	175	175	80	No
I-11	Linn St. & Liberty St.	Southbound	Left	1	2	50	320	60	1	50	50	3	150	150	75	No
I-11	Linn St. & Liberty St.	Northbound	Right	1	2	160	380	60	3	150	150	4	175	200	Continuous	Yes
I-11	Linn St. & Liberty St.	Southbound	Right	1	2	30	320	60	1	50	50	3	150	150	Continuous	Yes
I-12	Ezz Charles Dr. & Western	Westbound	Left	1	2	30	30	60	1	50	50	1	50	100	Continuous	Yes
I-13	Ezz Charles Dr. & Winchell	Westbound	Right	1	2	205	245	60	4	175	175	3	150	225	240	Yes
I-13	Ezz Charles Dr. & Winchell	Northbound	Left	1	3	20	880	60	1	50	50	5	200	200	211	Yes
I-14	Ezz Charles Dr. & Western	Southbound	Left	1	3	160	250	60	3	150	150	2	100	261	Continuous	Yes
I-15	Ezz Charles Dr. & Winchell	Eastbound	Left	1	2	10	320	60	1	50	50	3	150	150	176	Yes
I-16	Ezz Charles Dr. & Linn St.	Eastbound	Left	1	2	50	470	60	1	50	50	4	175	175	130	Yes

Table 6-23. Recommended Preferred Alternative Turn Lane Lengths - Ohio

Ref	Intersection	Approach	Turn Movement	# Turn Lanes	# Thru Lanes	Turn Volume	Design Hourly Volume	Cycle Length (in seconds)	Turn Vehicles per Cycle	Turn Volume Storage Length	Storage per Turn Lane	Thru Vehicles per Cycle per Lane	Queue per Thru Lane	Final Turn Lane Length	Storage Length Provided	Adequate Additional Storage Provided?
I-16	Ezz Charles Dr. & Linn St.	Westbound	Left	1	2	30	400	60	1	50	50	4	175	175	90	No
I-16	Ezz Charles Dr. & Linn St.	Northbound	Left	1	2	40	410	60	1	50	50	4	175	175	125	Yes
I-16	Ezz Charles Dr. & Linn St.	Northbound	Right	1	2	30	410	60	1	50	50	4	175	175	75	No
I-16	Ezz Charles Dr. & Linn St.	Southbound	Left	1	2	80	380	60	2	100	100	4	175	175	125	No
I-16	Ezz Charles Dr. & Linn St.	Southbound	Right	1	2	110	380	60	2	100	100	4	175	175	50	No
I-17	Gest St. & Dalton Ave.	Eastbound	Left	1	2	90	180	60	2	100	100	2	100	150	140	Yes
I-17	Gest St. & Dalton Ave.	Westbound	Left	1	2	70	180	60	2	100	100	2	100	211	120	Yes
I-17	Gest St. & Dalton Ave.	Northbound	Left	1	2	70	330	60	2	100	100	3	150	211	140	Yes
I-17	Gest St. & Dalton Ave.	Southbound	Left	1	2	70	820	60	2	100	100	7	275	275	80	No
I-18	Gest St. & Western Ave.	Southbound	Left	2	1	130	100	90	4	175	88	3	150	213	Continuous	Yes
I-18	Gest St. & Western Ave.	Southbound	Right	1	2	100	130	90	3	150	150	2	100	261	Continuous	Yes
I-19	Gest St. & Freeman Ave.	Eastbound	Left	1	2	110	210	90	3	150	150	3	150	261	90	No
I-19	Gest St. & Freeman Ave.	Westbound	Left	1	2	10	170	110	1	50	50	3	150	161	200	Yes
I-19	Gest St. & Freeman Ave.	Westbound	Right	1	2	127	253	110	4	175	175	4	175	286	286	Yes
I-19	Gest St. & Freeman Ave.	Northbound	Left	1	2	10	520	110	1	50	50	8	325	325	250	No
I-19	Gest St. & Freeman Ave.	Northbound	Right	2	2	10	520	110	1	50	25	8	325	325	Continuous	Yes
I-19	Gest St. & Freeman Ave.	Southbound	Left	1	2	300	510	110	10	375	375	8	325	425	425	Yes
I-20	Gest St. & Linn St.	Westbound	Right	1	1	200	240	60	4	175	175	4	175	286	Continuous	Yes
I-20	Gest St. & Linn St.	Southbound	Left	1	1	95	95	60	2	100	100	2	100	211	180	Yes
I-21	Court St. & Linn St.	Westbound	Right	1	1	10	60	60	1	50	50	1	50	100	Continuous	Yes
I-21	Court St. & Linn St.	Northbound	Left	1	2	20	260	60	1	50	50	---	---	125	140	Yes
I-21	Court St. & Linn St.	Northbound	Right	1	2	80	180	60	2	100	100	---	---	211	120	Yes
I-21	Court St. & Linn St.	Southbound	Left	1	2	10	290	60	1	50	50	---	---	100	80	Yes
I-23	8th St. and Dalton Ave.	Eastbound	Left	1	3	120	620	60	2	100	100	4	175	175	210	Yes
I-23	8th St. and Dalton Ave.	Eastbound	Right	1	3	40	620	60	1	50	50	4	175	175	140	Yes
I-23	8th St. and Dalton Ave.	Westbound	Left	1	3	20	620	60	1	50	50	4	175	175	165	Yes
I-23	8th St. and Dalton Ave.	Westbound	Right	1	3	130	240	60	3	150	150	2	100	200	680	Yes
I-23	8th St. and Dalton Ave.	Northbound	Left	1	2	70	200	60	2	100	100	2	100	211	90	No
I-23	8th St. and Dalton Ave.	Southbound	Left	1	2	230	520	60	4	175	175	5	200	286	120	No
I-24	8th St. and Freeman Ave.	Eastbound	Left	1	3	50	670	60	1	50	50	4	175	175	180	Yes
I-24	8th St. and Freeman Ave.	Eastbound	Right	1	3	270	350	60	5	200	200	2	100	250	700	Yes
I-24	8th St. and Freeman Ave.	Westbound	Left	1	3	220	610	60	4	175	175	4	175	225	180	Yes
I-24	8th St. and Freeman Ave.	Westbound	Right	1	3	110	610	60	2	100	100	4	175	175	780	Yes
I-24	8th St. and Freeman Ave.	Northbound	Left	1	3	70	660	60	2	100	100	4	175	211	175	Yes

Table 6-23. Recommended Preferred Alternative Turn Lane Lengths - Ohio

Ref	Intersection	Approach	Turn Movement	# Turn Lanes	# Thru Lanes	Turn Volume	Design Hourly Volume	Cycle Length (in seconds)	Turn Vehicles per Cycle	Turn Volume Storage Length	Storage per Turn Lane	Thru Vehicles per Cycle per Lane	Queue per Thru Lane	Final Turn Lane Length	Storage Length Provided	Adequate Additional Storage Provided?
I-24	8th St. and Freeman Ave.	Southbound	Left	1	3	90	460	60	2	100	100	3	150	211	180	Yes
I-24	8th St. and Freeman Ave.	Southbound	Right	1	3	90	280	60	2	100	100	2	100	211	710	Yes
I-25	8th St. and Linn St.	Eastbound	Left	1	3	230	570	60	4	175	175	4	175	225	120	No
I-25	8th St. and Linn St.	Eastbound	Right	1	3	160	230	65	3	150	150	2	100	200	760	Yes
I-25	8th St. and Linn St.	Westbound	Left	1	3	150	540	65	3	150	150	4	175	200	120	No
I-25	8th St. and Linn St.	Northbound	Left	1	3	300	270	65	6	250	250	2	100	361	190	No
I-25	8th St. and Linn St.	Northbound	Right	1	3	50	270	65	1	50	50	2	100	161	Continuous	Yes
I-25	8th St. and Linn St.	Southbound	Left	1	3	140	510	65	3	150	150	4	175	261	120	No
I-27	Dalton and Linn St.	Eastbound	Left	1	1	10	500	60	1	50	50	9	350	350	Continuous	Yes
I-27	Dalton and Linn St.	Eastbound	Right	1	1	500	10	60	9	350	350	1	50	461	Continuous	Yes
I-27	Dalton and Linn St.	Westbound	Left	1	2	10	540	60	1	50	50	5	200	200	260	Yes
I-27	Dalton and Linn St.	Northbound	Left	1	2	100	160	60	2	100	100	2	100	211	110	Yes
I-27	Dalton and Linn St.	Southbound	Right	1	3	30	630	60	1	50	50	4	175	175	530	Yes
I-28	6th St. and Linn St.	Southbound	Left	1	2	680	500	60	12	450	450	---	---	561	100	No
I-29	Court St. and Central Ave.	Eastbound	Left	1	1	40	340	60	1	50	50	6	250	250	75	No
I-29	Court St. and Central Ave.	Westbound	Left	1	1	130	160	60	3	150	150	3	150	200	80	No
I-29	Court St. and Central Ave.	Westbound	Right	1	1	30	160	60	1	50	50	3	150	150	80	No
I-29	Court St. and Central Ave.	Northbound	Left	1	2	30	170	60	1	50	50	2	100	100	Continuous	Yes
I-29	Court St. and Central Ave.	Northbound	Right	1	2	190	160	60	4	175	175	2	100	225	Continuous	Yes
I-30	W. 9th St. and Central Ave.	Northbound	Left	1	4	115	385	60	2	100	100	2	100	150	Continuous	Yes
I-31	7th St. W. and Central Ave.	Northbound	Right	1	2	200	190	60	4	175	175	2	100	225	Continuous	Yes
I-32	6th St. W. and Central Ave.	Northbound	Left	2	2	90	200	60	2	100	50	2	100	150	140	Yes
I-33	W. 5th St. and Central Ave.	Eastbound	Left	1	3	110	1330	60	2	100	100	8	325	325	330	Yes
I-33	W. 5th St. and Central Ave.	Eastbound	Right	1	3	80	1330	60	2	100	100	8	325	325	475	Yes
I-33	W. 5th St. and Central Ave.	Southbound	Left	2	2	30	160	60	1	50	25	2	100	150	150	Yes
I-34	4th St. and Central Ave.	Westbound	Right	1	2	140	1180	100	4	175	175	17	600	600	Continuous	Yes
I-34	4th St. and Central Ave.	Northbound	Left	2	2	330	480	100	10	375	188	7	275	288	210	No
I-35	3rd St. and Central Ave.	Eastbound	Left	2	1	170	300	100	5	200	100	9	350	350	140	No
I-35	3rd St. and Central Ave.	Eastbound	Right	1	2	300	170	100	9	350	350	3	150	400	Continuous	Yes
I-35	3rd St. and Central Ave.	Westbound	Left	1	2	420	480	100	12	450	450	7	275	500	Continuous	Yes
I-35	3rd St. and Central Ave.	Northbound	Left	2	2	350	360	110	11	400	200	6	250	300	130	No
I-36	4th St. and Plum St.	Westbound	Left	1	3	70	1270	60	2	100	100	8	325	325	Continuous	Yes
I-36	4th St. and Plum St.	Southbound	Right	1	2	60	30	60	1	50	50	1	50	100	50	Yes
I-38	4th St. and Elm St.	Northbound	Left	1	3	148	442	60	3	150	150	3	150	200	Continuous	Yes
I-38	4th St. and Elm St.	Westbound	Right	1	3	388	1162	60	7	275	275	7	275	325	130	No

Table 6-23. Recommended Preferred Alternative Turn Lane Lengths - Ohio

Ref	Intersection	Approach	Turn Movement	# Turn Lanes	# Thru Lanes	Turn Volume	Design Hourly Volume	Cycle Length (in seconds)	Turn Vehicles per Cycle	Turn Volume Storage Length	Storage per Turn Lane	Thru Vehicles per Cycle per Lane	Queue per Thru Lane	Final Turn Lane Length	Storage Length Provided	Adequate Additional Storage Provided?
I-39	3rd St. and Elm St.	Northbound	Left	1	3	130	220	60	3	150	150	2	100	200	Continuous	Yes
I-39	3rd St. and Elm St.	Westbound	Right	1	4	290	1970	60	5	200	200	9	350	350	Continuous	Yes
I-40	2nd St. and Elm St.	Eastbound	Left	1	5	510	2660	60	9	350	350	9	350	400	230	No
I-41	3rd St. and Bailey Bridge	Eastbound	Right	2	1	450	100	75	10	375	188	3	150	288	85	No
I-41	3rd St. and Bailey Bridge	Westbound	Left	1	1	245	245	75	6	250	250	6	250	300	154	No
I-41	3rd St. and Bailey Bridge	Westbound	Right	1	1	410	20	75	9	350	350	1	50	400	150	No
I-41	3rd St. and Bailey Bridge	Northbound	Left	2	1	310	160	70	7	276	138	4	175	238	170	No
I-41	3rd St. and Bailey Bridge	Northbound	Right	1	1	210	160	70	5	200	200	4	175	250	170	No
I-41	3rd St. and Bailey Bridge	Southbound	Right	1	1	60	200	75	2	100	100	5	200	200	200	Yes

No proposed work shown
Meets turn lane length requirement
Fails to meet turn lane length requirement
Meets storage requirement, but fails to meet queue length

7.0 Cost Estimates

The 2010 construction cost estimates were prepared as outlined by the Ohio Department of Transportation's (ODOT's) *Procedure for Construction Budget Estimating* (May 2010) and by use of the Transport Estimator, Version 2.5a, with 2010 catalogs. The inflation cost percentage was calculated as outlined by ODOT's *Procedure for Construction Budget Estimating* (May 2010) utilizing the FY10'-11' Business Plan Inflation Calculator. For the inflation cost percentage calculations, the date of July 22, 2010 was used for the Estimation Start Date with the mid-point of construction year based on anticipated contract dates. Based on these dates, the semi-annually compounded growth inflation cost percentage was calculated for the project. The inflation cost percentage is noted as Contingency on the cover page of the cost estimates provided in Appendix I of the *Preferred Alternative Verification Report* (May 2011) as per the ODOT's procedures.

For quantity takeoff purposes, the project corridor was divided into contract segments eight segments in Kentucky and seven segments in Ohio. Costs were not calculated for segment KY 1 because it will be developed as a separate project in the next design phase. One contract segment in Ohio was split into two separate contracts (OH-1 and OH-1A) for the I-471 interchange. The first contract will be for constructing the interchange to accommodate the maintenance of traffic while the project was being constructed and the second contract will be to bring the interchange back to its original configuration.

The estimated quantities were calculated by manual take-offs from scale drawings and electronic CADD files utilizing plans and cross sections. The number of new lanes and shoulders determined the proposed work limits. In transition areas where the number of lanes changes, the cross sections were averaged and multiplied by the distance between the stations where the cross sections begin and end. The numbers of existing lanes and shoulders were counted to determine the demolition quantities. The recommended preferred alternative was reduced into the item numbers and cost item descriptions from the current ODOT Construction Estimator database. The unit prices and quantities for the recommended preferred alternative are provided in Appendix I of the *Preferred Alternative Verification Report* (May 2011).

7.1 Total Costs

The total estimated project costs for the recommended preferred alternative are construction costs which include a design contingency, a construction inflation factor based on median construction date for each construction contract, right of way for roadway and utility relocations, major utility, and project development costs Table 7-1. The associated costs for the new Ohio River Bridge, rehabilitation of the existing Brent Spence Bridge, and the Western Hills Viaduct Interchange single point urban interchange (SPUI) and tight urban diamond interchange (TUDI) options are also included in the costs for the recommended preferred alternative. The total cost for the recommended preferred alternative with the TUDI Option 1 design at the Western Hills Viaduct is $2.48 billion.

Table 7-1. Total Cost Estimates for Mainline Recommended Preferred Alternative in Projected Build Year Dollars

Component	Construction Costs (millions)	Construction Costs Inflation (millions)	Real Estate Costs (millions)	Utility Costs (millions)	Project Development Costs (millions)	Total Estimated Costs (millions)
Kentucky	$362.3	$204.4	$20.20	-	$54.5	$641.4
Ohio	$474.5	$255.8	$18.3	$93.0	$55.1	$896.7
WHV-SPUI	$160.1	$82.1	$4.6	$0.2	$22.6	$269.6
WHV-Tight Diamond	$84.8	$43.5	$1.3	$0.2	$12.0	$141.8
Existing Bridge	$40.6	$26.6	-	-	$6.3	$73.5
New Bridge	$474.2	$194.4	-	-	$61.6	$730.2
Totals						
With Tight Diamond	$1,436.4	$724.7	$39.8	$93.2	$189.5	$2,483.6

7.1.1 Right of Way Cost

Right of way cost estimates for both Kentucky and Ohio were done in accordance with Ohio's Office of Real Estate Guidelines with the exception of damages. Real property values utilized for this cost estimate were developed based upon appraised value indications from the Hamilton County Auditor's (Ohio) and Property Valuation Administrator's (Kentucky) records in the appropriate jurisdictions. The cost estimates are not of sufficient detail to be used for acquisition estimates, but are used as a benchmark to prepare the relative real estate costs for the recommended preferred alternative. No actual appraisals were conducted. All valuations were created using readily available tax records. No entry to the property was allowed. An inflation factor was applied to the real estate costs.

The total new right of way required for the recommended preferred alternative is 35.53 acres (24.88 acres in Kentucky and 10.65 acres in Ohio), including the TUDI at WHV. Right of way cost estimates broken down by construction contract and by state, and include labor costs, non-labor costs, and inflation. The total right of way cost for the recommended preferred alternative would be $39,798,000 ($20,204,000 for Kentucky and $19,594,000 for Ohio). Detailed right of way costs broken up by construction contract are provided in Table 7-2 for Kentucky and Table 7-3 Ohio.

Table 7-2. Right of Way Costs – Recommended Preferred Alternative – Kentucky

Construction Contract	Total Labor	Total Non-Labor	Inflation	Total Right of Way Costs
KY-5	$353,000.00	$4,728,000	$417,000	$5,498,000
KY-6	$192,000.00	$3,674,000	$317,000	$4,183,000
KY-7	$,895,000.00	$8,831,000	$797,000	$10,523,000
Kentucky Total:				**$20,204,000**

Table 7-3. Right of Way Costs – Recommended Preferred Alternative – Ohio

Construction Contract	Total Labor	Total Non-Labor	Inflation	Total Right of Way Costs
OH-2	$9,000	$9,000	$1,000	$19,000
OH-3	$36,000	$3,000	$2,000	$41,000
OH-4	$22,000	$4,270,000	$262,000	$4,554,000
OH-5	$159,000	$1,037,000	$98,000	$1,294,000
OH-7	$379,000	$12,270,000	$1,037,000	$13,686,000
Ohio Total:				**$19,594,000**

7.1.2 Utility Cost

The costs for utility relocations will be calculated by KYTC District 6 and ODOT District 8 and added to the utility cost estimates. As a supplement to ODOT calculations of utility costs, the Project Team received preliminary utility relocation costs from public utility companies, which have been included in the estimated costs. Refer to Appendix I of the *Preferred Alternative Verification Report* (May 2011) Project Cost table. The real estate utility costs have been included in the right of way cost for each contract segment.

The Project Team has been in close coordination with Duke Electric and Duke Transmission Group regarding their facilities located along the western side of the I-71/I-75 corridor. As a result of this coordination, Duke Electric and Duke Transmission Group completed an assessment of the costs and relocation impacts.

7.1.3 Project Development Cost

In order to completely include all project costs in the estimates, project development costs, which consist of detailed design and construction management, are included. In Kentucky, the detailed design cost is calculated to be eight percent of the construction cost (2010 dollars) adjusted for three percent inflation compounded to mid-year design. In Ohio, the detailed design costs are calculated using three to ten percent (per ODOT) of the construction cost (2010 dollars) with no inflation adjustment. The construction management cost was calculated at three percent of the construction cost including inflation adjusted for three percent inflation compounded to mid-year of construction for both Ohio and Kentucky.

7.2 Schedule

Key dates for the Brent Spence Bridge Replacement/Rehabilitation Project activities are:

- Environmental Assessment
  - FHWA Review and Approval - 2011
  - Prepare Notice of Availability (NOA) - 2011
  - Publish NOA – 2011
- Hold Concurrence Point
  - Prepare and Hold public hearing - 2012
- Finding of No Significant Impact (FONSI)
  - Development Draft of FONSI - 2012
  - FHWA Review and Approval - 2012
  - FHWA Issues FONSI - 2012

The detail design and construction schedule will be finalized upon issuing of the FONSI. The Brent Spence Bridge Replacement/Rehabilitation Project corridor has been divided into multiple design and construction contract packages. Tentative dates are:

- Begin Detailed Design - 2011
- Right of Way Acquisition Start – November 2012
- Right of Way Acquisition End - October 2014
- Begin Construction - April 2014
- End Construction - July 2022

8.0 Environmental Overview

Information on environmental resources and characteristics of the study area was collected to assess the potential environmental impacts of the conceptual alternatives considered and then the feasible alternatives. The following reports have been completed to date through the Ohio Department of Transportation's (ODOT's) Project Development Process (PDP). These reports identify the affected environment and development of conceptual alternatives for the Brent Spence Bridge Replacement/Rehabilitation Project. The *Draft Environmental Assessment* (November 2010) is the most current environmental document and is included in Appendix F.

- *Existing and Future Conditions Report* (February 2006),
- *Phase I History/Architecture Survey – Kenton County, Kentucky* (April 2010),
- *Phase I History/Architecture Survey – Hamilton County, Ohio* (June 2007),
- *Phase II History/Architecture Survey – Hamilton County, Ohio* (October 2008),
- *Phase II History/Architecture Survey – Hamilton County, Ohio* (September 2009),
- *Phase I History/Architecture Survey Addendum Report for the Western Hills Viaduct Interchange – Hamilton County, Ohio* (June 2010),
- *Determination of Effects Report (Draft, February 2011),*
- *Archaeological Existing Conditions and Disturbance Assessment – Hamilton County, Ohio (September 2010),*
- *Ecological Survey Report – Kentucky* (December 2009),
- *Level One Ecological Survey Report – Ohio* (March 2010),
- *Environmental Site Assessment Screening* (April 2007),
- *Environmental Site Assessment Screening- Western Hills Viaduct* (May 2010),*Phase I Environmental Site Assessments* (April 2010),
- *Draft Environmental Assessment* (November 2010),
- *Air Quality Technical Report: Mobile Source Air Toxics* (November 2010),
- *Air Quality Technical Report: Carbon Monoxide* (November 2010), and
- *Draft Qualitative $PM_{2.5}$ Hot-Spot Analysis (April 2011).*

8.1 Environmental Impacts Summary

The recommended preferred alternative will be compatible with existing land use plans, will support the Queensgate redevelopment plans, and will help Cincinnati and Covington facilitate its economic renewal goals. The impacts of the recommended preferred alternative are summarized below:

- The total new right of way required is 31.37 acres for the recommended preferred alternative.
- The recommended preferred alternative will potentially have 58 displacements (43 residential and 15 commercial).
- Goebel Park and Queensgate Playground and Ballfields will be impacted.
- Other community facilities will also have property impacts. These include the Notre Dame Academy property, the Beechwood Elementary and High schools, and Central Church of the Nazarene property.
- While displacements are expected in low-income populations, no high and disproportionate impacts are expected to environmental justice (EJ) communities. Impacts to parks within EJ communities will be mitigated.
- The recommended preferred alternative will impact approximately 3,340 linear feet of intermittent streams, 1.38 acres of wetlands, and habitat for the Indiana bat and running buffalo clover. No impacts to significant ecological resources are anticipated from this project.
- One additional site in Ohio is recommended for a Phase I Environmental Site Assessment. Seventeen sites are recommended for Phase II ESA investigations. Two sites are located in Kentucky and 15 sites are located in Ohio.
- National Register of Historic Places listed and eligible properties will be impacted. The recommended preferred alternative will have an adverse effect on two historic properties.
- The greatest amount of potential visual impact will be in the residential land uses to west of the existing Brent Spence Bridge on the south bank of the Ohio River. The area with the least amount of potential impact will be in the suburban residential areas south of Covington.
- The recommended preferred alternative will impact five Section 4(f) resources (parks and historic properties).
- One Section 6(f) resource, Goebel Park will be impacted by the recommended preferred alternative.

9.0 Conclusion

The purpose of this Access Point Request Document is to verify that the recommended preferred alternative will not have an adverse effect on the Interstate System from both operational or safety perspectives compared to the No Build Alternative.

Safety discussions generally revolve about two types of safety: (1) nominal safety and (2) substantive safety. Highway engineers are used to thinking about safety in terms of adherence to design criteria such as those published in the AASHTO "Green Book" or their State Design Manual. This is referred to as nominal safety. A road is considered nominally safe if it meets the minimum standard of care and is current with respect to published standards and guidelines. The performance of a highway as determined by crash frequency and severity is referred to as substantive or quantitative safety. Substantive safety is the actual or expected performance of a highway in terms of its crash rate and the resulting severities. Substantive safety is a function not only of the basic characteristics of the road, but also a function of maintenance, law enforcement, and other resources devoted to its operations.

Until recently there was no recognized document and procedures for calculating substantive safety. However, with the release of the AASHTO Highway Safety Manual (2010), expected future crashes and their severities on existing or proposed roadways can now be calculated for two-lane roadways, rural multi-lane highways and urban and suburban arterials. Research is currently underway to develop a methodology and procedures for predicting future crashes on freeways and their interchanges and is expected to be included in the 2nd Edition of the Highway Safety Manual. As a result, it is not possible at this time to predict and quantify future crashes for the existing or proposed freeway sections and their interchanges. Lacking the ability to predict future substantive safety for the freeway sections, safety is addressed in terms of past accidents and nominal safety for the existing freeway sections, and nominal safety for the proposed freeway sections.

From an operations perspective, this is determined by comparing the capacity analyses results for the No Build Alternative to those for the recommended preferred alternative. Capacity analyses are also compared at the first intersection on local roadways outside the project limits and the first interchanges on the Interstate System outside the project limits to verify these roadways will not be degraded from the No Build Alternative by the recommended preferred alternative. Safety is typically determined by the degree to which the design of the recommended preferred is in compliance with the project's design criteria, as evidenced by the number and type of design exceptions required along the alignment.

9.1 Operations

The level of service (LOS) projections determined by the capacity analyses were used to determine the operation effects of the recommended preferred alternative on the Interstate System. LOS D is the design standard for the Brent Spence Bridge Replacement/Rehabilitation Project. Therefore, any location along the recommended preferred alternative where the level of service will be LOS D or better (LOS A, LOS B or LOS C) in the design year (2035) was determined to meet the project design goals. Additionally, in areas where the level of service for the recommended preferred alternative will be less than LOS D (LOS E or LOS F) in 2035, but equal to or improved from that of the No Build Alternative, was determined to meet the project design standard. For example, if the level of service at a location for the No Build Alternative is LOS E, the level of service of the recommended preferred alternative in the same area may either be equal to LOS E or be improved to LOS A, LOS B, LOS C, or LOS D, without any degradation considered to have occurred to the Interstate System.

Projects which add capacity to an Interstate System typically have a low level of service at the project limits where the expanded number of lanes within the proposed project is reduced to connect into the existing number of lanes. Such areas are located in the recommended preferred alternative at the following locations:

- I-71/I-75 south of Dixie Highway (Kentucky)
- I-75 north of Western Hills (Ohio)
- I-71 east of the I-75/I-71 Interchange (Ohio)

For both the Commonwealth of Kentucky and the State of Ohio, the existing freeway system within the project limits is overcapacity and is the primary cause of congestion on the freeways. Roadways that are overcapacity and congested typically have a higher than normal rate of rear-end and angle accidents. The proposed project adds additional freeway lanes, as well as collector distributor (C-D) roadways and service roads to gather, distribute, and move traffic that would otherwise be forced to exclusively use the high speed mainline freeway lanes. The additional types of roadways coupled with the additional freeway lanes should eliminate congestion and minimize accidents. Where congestion existed on the existing freeway system, it was caused by the lack of freeway lanes; not by the lack of capacity within the local street network to receive existing traffic from the freeway. With the addition of C-D lanes and additional freeway lanes, the freeway system will be vastly improved over the No Build Alternative in the design year and the local street network will still be able to receive all exiting traffic from the freeway without being overcapacity.

The following sections discuss the operations of the recommended preferred alternative compared to the No Build Alternative.

9.1.1 Kentucky

9.1.1.1 Freeway Segments

At the southern end of the project, I-71/I-75 currently has three mainline lanes in the northbound direction and four in the southbound direction. Calculations show that in the design year (2035) I-71/I-75 in the No Build Alternative will have numerous locations through the Buttermilk Pike, Dixie Highway, and Kyles Lane interchanges where the levels of service will be LOS E or LOS F. In the recommended preferred alternative, I-71/I-75 will be widened to six mainline lanes in each direction just north of the Kyles Lane Interchange. For southbound I-71/I-75, the expanded number of lanes must be reduced to connect to the existing number of lanes at the southern project limit. Since the additional lanes in the recommended preferred alternative can carry more traffic than the No Build Alternative, the level of service will fall below LOS D in the area surrounding the Dixie Highway and Kyles Lane interchanges. I-71/I-75 operates at LOS F south of the Dixie Highway Interchange in the northbound direction for both the recommended preferred alternative and the No Build Alternative. In the southbound direction, I-71/I-75 operates at LOS F between the Kyles Lane and Dixie Highway interchanges in the recommended preferred alternative. For this same freeway segment, the No Build Alternative operates at LOS E. The No Build Alternative operates at a better level of service at this location because less traffic is able to reach this location due to constrained traffic conditions in the northern freeway segments. LOS D or better in this area can be obtained if KYTC decides to extend the additional lanes in the recommended preferred alternative to the south.

In addition to the freeway locations mentioned above at the southern limits of the project, there are two freeway locations where the level of service is below LOS D:

- I-71 mainline northbound north of the KY 9th Street entrance ramp where the level of service is LOS E in the AM (Reference F-21 from Table 6-4).
- I-71/I-75 southbound south of the Bullock Street entrance ramp where the level of service is LOS E in the PM (Reference F-6 from Table 6-4).

At both locations the LOS E obtained in the recommended preferred alternative is an extremely good LOS E (almost LOS D). In the No Build Alternative these same two locations are at LOS F.

9.1.1.2 Ramps Junctions (Entrance and Exit)

All of the ramp junctions in Kentucky for the recommended preferred alternative will have a LOS D or better in the design year, except at two locations:

- The I-71/I-75 northbound exit to Dixie Highway where the level of service is LOS F in the AM and PM (Reference R-12 from Table 6-13).
- The I-71/I-75 southbound exit to Kyles Lane where the level of service is LOS E in the PM (Reference R-5 from Table 6-13).

If an additional lane is added to I-71/I-75 northbound immediately south of the Dixie Highway Interchange, the level of service at the exit to Dixie Highway will rise to LOS D. The LOS E at the I-71/I-75 southbound exit to Kyles Lane is an extremely good LOS E (almost LOS D). In the No Build Alternative these same two locations have identical levels of service.

9.1.1.3 Weave Segments

There are no weave segments on I-71/I-75 northbound or southbound in Kentucky.

9.1.1.4 Intersections

All but one of the intersections in Kentucky which will be constructed or reconstructed in the recommended preferred alternatives will operate at LOS D or higher. Three of the adjacent intersections will be below LOS D:

- Kyles Lane at Dixie Highway, where the LOS is F in the AM and PM. This is currently a six-year plan project utilizing Congestion, Mitigation, and Air Quality Improvement (CMAQ) funds. (Reference I-14 from Table 6-18).
- Kyles Lane at Highland Avenue, where the level of service is LOS F in the AM and PM (Reference I-17 from Table 6-18).
- West KY 5th Street at Bakewell Street, where the level of service is LOS F in the AM (Reference I-8 from Table 6-18).

These three intersections will not be reconstructed as part of the recommended preferred alternative. In the No Build Alternative, the intersections with Kyles Lane at Dixie Highway and Highland Avenue will also be at LOS F, and the intersection at West KY 5th Street at Bakewell Street will be at LOS E.

Only one of the 19 intersections studied in Kentucky will be degraded by the recommended preferred alternative. This is the intersection of West KY 5th Street at Bakewell Street. Due to right of way and the context of the area immediately surrounding this intersection, KYTC does not propose to add additional lanes to restore the level of service to LOS E.

9.1.1.5 Turn Lane Storage Lengths

Within Kentucky, all of the intersections were able to be designed to meet Kentucky's guidelines for turn lane storage lengths except for five:

- Westbound left turn lane at Pike Street and Bullock Street
- Westbound left turn lane at KY 12th Street and Bullock Street
- Westbound right turn lanes at Kyles Lane and the I-71/I-75 northbound ramps
- Eastbound right turn lane at Dixie Highway and the I-71/I-75 southbound ramp
- Westbound right turn lane at Dixie Highway and the I-71/I-75 northbound ramp

At the westbound left turn lane at the intersection of Pike Street and Bullock Street and at the westbound left turn lane at the intersection of KY 12th Street and Bullock Street, the turn lane storage distance required will exceed the distance between the crossroad intersections of Bullock Street on the west and Jillian Way on the east. Therefore it would not be possible to provide sufficient turn lane storage.

The westbound right turn lane at the intersection of Kyles Lane and the I-71/I-75 northbound ramps would need to be lengthened an additional 771 feet. This would require the acquisition of numerous residential properties located in a developed residential community. Therefore the existing storage length will be maintained at this intersection.

The eastbound right turn lane at the intersection of Dixie Highway and the I-71/I-75 southbound ramp will not achieve the appropriate turn storage length. Achieving the appropriate turn storage length would impact an unsignalized intersection at Dixie Highway and Maple Avenue and would require the acquisition of additional property. Therefore the existing storage length will be maintained at this intersection.

The westbound right turn lane at the intersection of Dixie Highway and the I-75 northbound ramp, while technically shown as deficient by three feet, is designed as a slip ramp to bypass the signal at the intersection. As a result of the slip ramp operation, accommodating the additional storage of 3 feet was deemed inappropriate.

9.1.2 Ohio

9.1.2.1 Freeway Segments

At the northern end of the project, I-75 northbound north of the Western Hills Viaduct Interchange will be LOS E for the mainline lanes in the PM. The LOS E obtained at this location is an extremely good LOS E (almost LOS D). Unlike the project limits of many freeway projects where the freeway adjacent to the project limits is old and in need of additional lanes, the Mill Creek Expressway project is concurrently under design to the north. Additional lanes were not added at this location to raise the level of service to LOS D because the LOS E was contained to one freeway segment and did not extend into other freeway segments upstream or downstream on I-75. The LOS E is very close to being LOS D; and it would be very difficult and costly to add an additional lane for this isolated location and keep lane balance on I-75. When this location in the recommended preferred alternative is compared to the same location in the No Build Alternative, the level of service for the No Build Alternative north of the Western Hills Viaduct Interchange would be LOS F.

At the eastern end of the project, I-71 northbound splits apart from US 50 in Fort Washington Way with two mainline lanes, which will be at LOS F in the design year for the recommended preferred alternative. This same section of I-71 would be at LOS F in the design year for the No Build Alternative. The recommended preferred alternative allows approximately 12 percent more traffic to reach this location than in the No Build Alternative due to the additional mainline lanes at the southern project limits which permit more vehicles to enter the project. Congestion at this location could potentially cause long queues to develop at some point in the design life of the project. These long queues could obstruct the mainline of I-71 northbound as well as the northbound C-D roadway system which provides access to and from the cities of Covington and Cincinnati. Potential design solutions have been identified, but they would require substantial additional cost and are beyond the scope of this project. The potential design solutions could involve modifications to the Lytle Tunnel, which has a park and buildings on top of it; and removal of an existing entrance ramp from OH 2nd Street to I-71 northbound, and could potentially violate the terms of the *I-71 Corridor Transportation Study* (1998), which is the major investment study (MIS) for I-71. The *I-71 Corridor Transportation Study* (1998) determined that no additional through lanes could be added to the I-71 corridor within the MIS's project limits, which includes the I-71 portion of the Brent Spence Bridge Replacement/Rehabilitation Project. By the terms of the MIS, additional capacity within the corridor would be created by a light rail system, rather than by additional highway lanes. Due to these reasons, ODOT and FHWA (Ohio) recommended that design solutions would not be implemented at this location at this time.

With the exceptions noted at the project limits for I-75 northbound and I-71 northbound, there are five other freeway segments where the level of service will be LOS E in the recommended preferred alternative during the AM in the design year:

- I-75 southbound between the Western Hills Viaduct diverge and the Western Hills Viaduct merge (Reference F-2 from Table 6-5).
- I-75 southbound between the C-D roadway southbound diverge and the I-71 northbound diverge (Reference F-5 from Table 6-5).
- I-75 northbound between the US 50 westbound diverge and the OH 4th Street merge (Reference F-34 from Table 6-5).
- I-71 northbound between the Brent Spence Bridge and the I-75 southbound merge (Reference F-44 & F-45 from Table 6-5).

While the recommended preferred alternative is different geometrically compared to the No Build Alternative, all the locations noted in the recommended preferred alternative would be at LOS E in the No Build Alternative. Additional lanes were considered at these locations to raise the level of service to LOS D, but the three segment locations which affect I-71 northbound would have required another lane on the proposed Brent Spence Bridge and major reconstruction in the Fort Washington Way, which was constructed approximately 10 years ago. Given the cost, lack of right of way and the context of the Fort Washington Way area, this was determined not to be possible. The other three locations would have made it extremely difficult to maintain lane balance due to the number of lanes on the roadway into which they would be interconnected.

9.1.2.2 Ramp Junctions (Entrance and Exit)

For the recommended preferred alternative, all of the ramp terminals in Ohio are at LOS D or better, except for the C-D roadway ramp to I-71 northbound at the western end of the Fort Washington Way (Reference R-16 from Table 6-14). The C-D roadway ramp does not exist in the No Build Alternative. However, its comparable movement in the No Build Alternative is the Pike Street entrance ramp in Kentucky, which would also operate at LOS F. ODOT and FHWA (Ohio) recommended that design solutions would not be implemented at this location at this time for the C-D roadway northbound entrance ramp to I-71 and FWW as discuss in Section 9.1.2.1. If KYTC does not build a fourth lane and three lanes continue to exist for I-71/I-75 northbound in Kentucky, south of the Dixie Highway Interchange, the I-71/I-75 northbound traffic will be constrained. The reduced traffic volumes at the merge for the C-D roadway ramp to I-71 northbound would result in this ramp junction operating at LOS D. If Kentucky eventually adds a fourth lane, the level of service would be LOS F due to the additional traffic volumes. It was agreed by ODOT and FHWA (Ohio) that if Kentucky adds a fourth lane, congestion would be evaluated at a later date as part of the consideration of the I-71 corridor as discussed in Section 9.1.2.1.

9.1.2.3 Weave Segments

There is only one weaving section within the recommended preferred alternative located on the I-71 southbound on-ramp to Winchell Avenue. This area has LOS C for both the AM and PM.

9.1.2.4 Intersections

There are 41 intersections, either being reconstructed as part of the recommended preferred alternative, or located immediately adjacent to those intersections being reconstructed. All of the 41 intersections operate at LOS D or better.

9.1.2.5 Turn Lane Storage Lengths

Within Ohio, all of the intersections within the project limits were able to be designed to meet Ohio's guidelines for turn lane storage lengths.

9.2 Safety

The Access Point Request Document requires documentation that the recommended preferred alternative will not degrade the Interstate System with regard to operations or safety when compared to the No Build Alternative. Currently, there are no data, processes or procedures for calculating and quantifying future crashes on either a proposed freeway or the existing freeway to provide a comparative analysis using substantive safety. Designing roadways which meet the design criteria or guidelines of an agency is referred to as meeting nominal safety. The design criteria of highway agencies are derived by considering both operations and safety. The values given within the design criteria represent the best blend of both operations and safety. Therefore, roadways are considered nominally safe when they meet an agency's design criteria. In addition, roadways are also considered nominally safe when the permitting authority has approved requested design exceptions. In addition to the Access Point Request Document, requested design exceptions must also show that safety will not be degraded by not meeting the design criteria. Below is a brief summary of the requested design exceptions for the recommended preferred alternative where it was not possible to meet the design criteria in both Kentucky and Ohio.

9.2.1 Kentucky

The recommended preferred alternative will require only one design exception in Kentucky. The criterion for grade is violated in one section on the I-75 southbound exit ramp to Kyles Lane. The maximum grade criterion in Kentucky is six percent. The existing grade for this ramp is an upgrade of 6.5 percent. This grade will be increased to 8.1 percent under the recommended preferred alternative, due to wide right of way limits required for the connection to the existing elevation at the ramp terminal. This steep slope is less than 500 feet long and provides an exit ramp to Kyles Lane on which traffic has to decelerate.

9.2.2 Ohio

There are a total of 60 design exceptions for the recommended preferred alternative in Ohio. These design exceptions include:

- 13 design exceptions for horizontal degree of curve
- 33 for horizontal stopping sight distance
- 10 for vertical stopping sight distance
- one for grade
- one for paved shoulder width
- one for horizontal taper rate

  one for curve widening

10.0 Recommendations

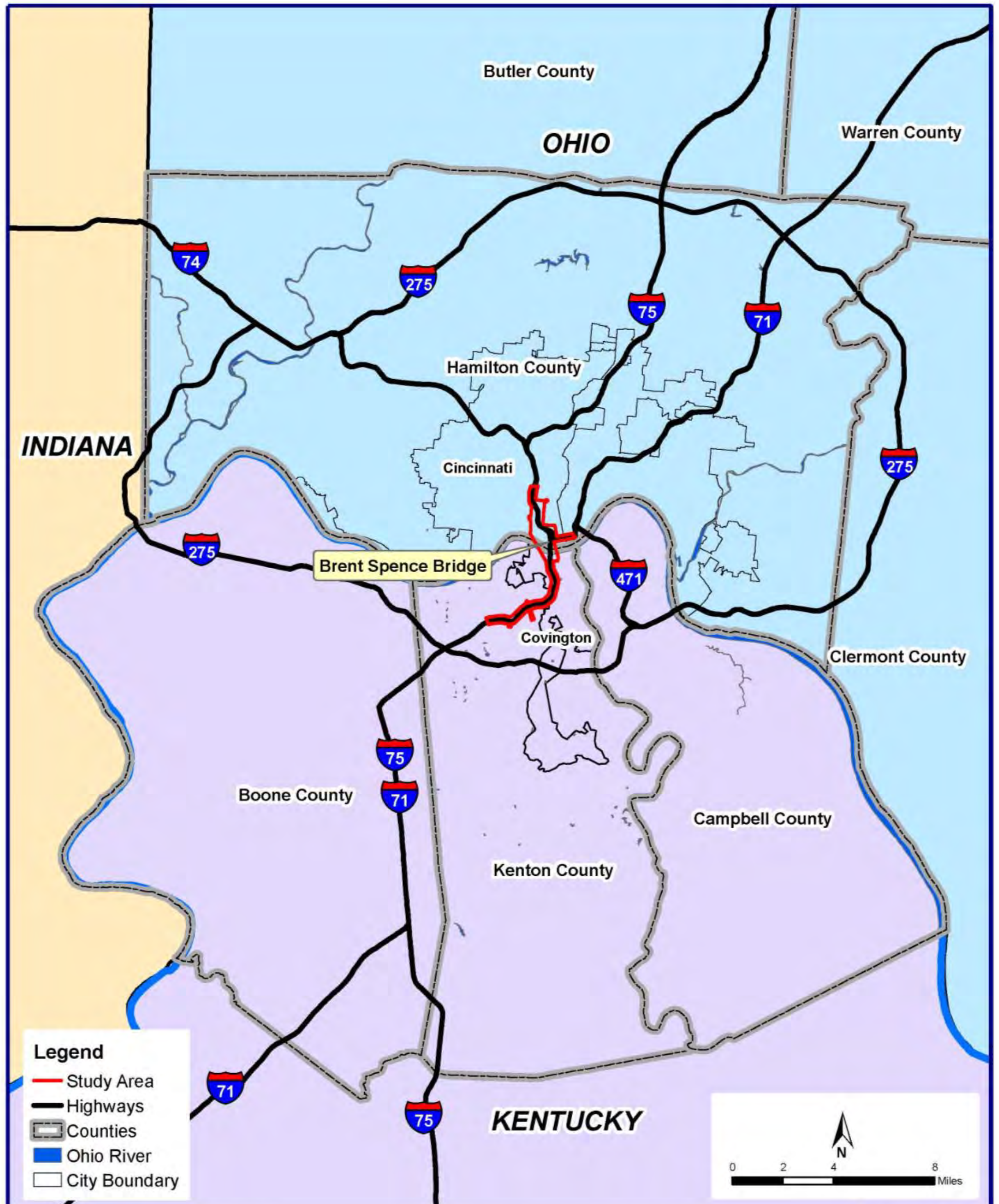
The recommended preferred alternative for the Brent Spence Bridge Replacement/Rehabilitation Project is designed to meet current design standards and the latest operational and safety concepts. The existing facility was constructed in accordance with design criteria and the operational and safety concepts from the early development of the Interstate System in the 1950s and 1960s. The proposed design will add capacity which is needed to accommodate 2035 traffic projections. The recommended preferred alternative is designed to operate at level of service (LOS) D, and improves the numerous locations along I-71/I-75 which currently operate at LOS F.

The proposed design of the recommended preferred alternative was developed using the “corridor approach”. Beginning from the north at the I-275 interchange with I-75, the Ohio Department of Transportation (ODOT) is planning the redesign and reconstruction of I-75 south to the Ohio River where the Kentucky Transportation Cabinet (KYTC) is extending the corridor approach approximately four miles south into Kentucky. Traffic developed for I-75 as part of the “corridor approach” was jointly developed by KYTC and ODOT using the Ohio Kentucky Indiana Regional Council of Governments (OKI) traffic demand model with a common design year to have seamless design traffic that would assist in creating a seamless design for the corridor. The recommended preferred alternative will use the current geometric design criteria, which has periodically been updated based on proven operations and research. Current design concepts which are considered state-of-the-art are embedded in the design of the recommended preferred alternative including providing lane balance and lane continuity, avoiding left-hand entrances and exits, avoiding drop lanes, avoiding partial interchanges, avoiding weaving maneuvers, providing a minimum interchange spacing of one mile, providing exits which can be signed according to the Manual on Uniform Traffic Control Devices (MUTCD), and minimizing conflict points to reduce driver indecision and increase safety.

The recommended preferred alternative, from an operational perspective, meets LOS D for practically the entire 7.8 mile project corridor, with a few exceptions where an extremely good LOS E is provided. While there are a number of requested design exceptions, all of the design exceptions are for speeds equal to or better than the existing conditions, with two exceptions, as noted in Table 5-5. Most of the design exceptions provide a better speed than the existing conditions. Conflict points, which serve as a surrogate for determining the safety of a highway facility, have been dramatically reduced when compared to the existing design.

It is well documented that there is a common tie between economic development and an effective transportation system. The existing design and operations of I-75 is currently plagued with gridlock, long queues, and substantial delay during the peak hours. In an era of “just in time” delivery, both Cincinnati and Covington need good interstate transportation to continue to grow their economic base.

For all the above noted reasons, this Access Point Request Document is recommended for approval, based on satisfying the eight policy statements in the *Interstate System Access Information Guide* (August 2010).

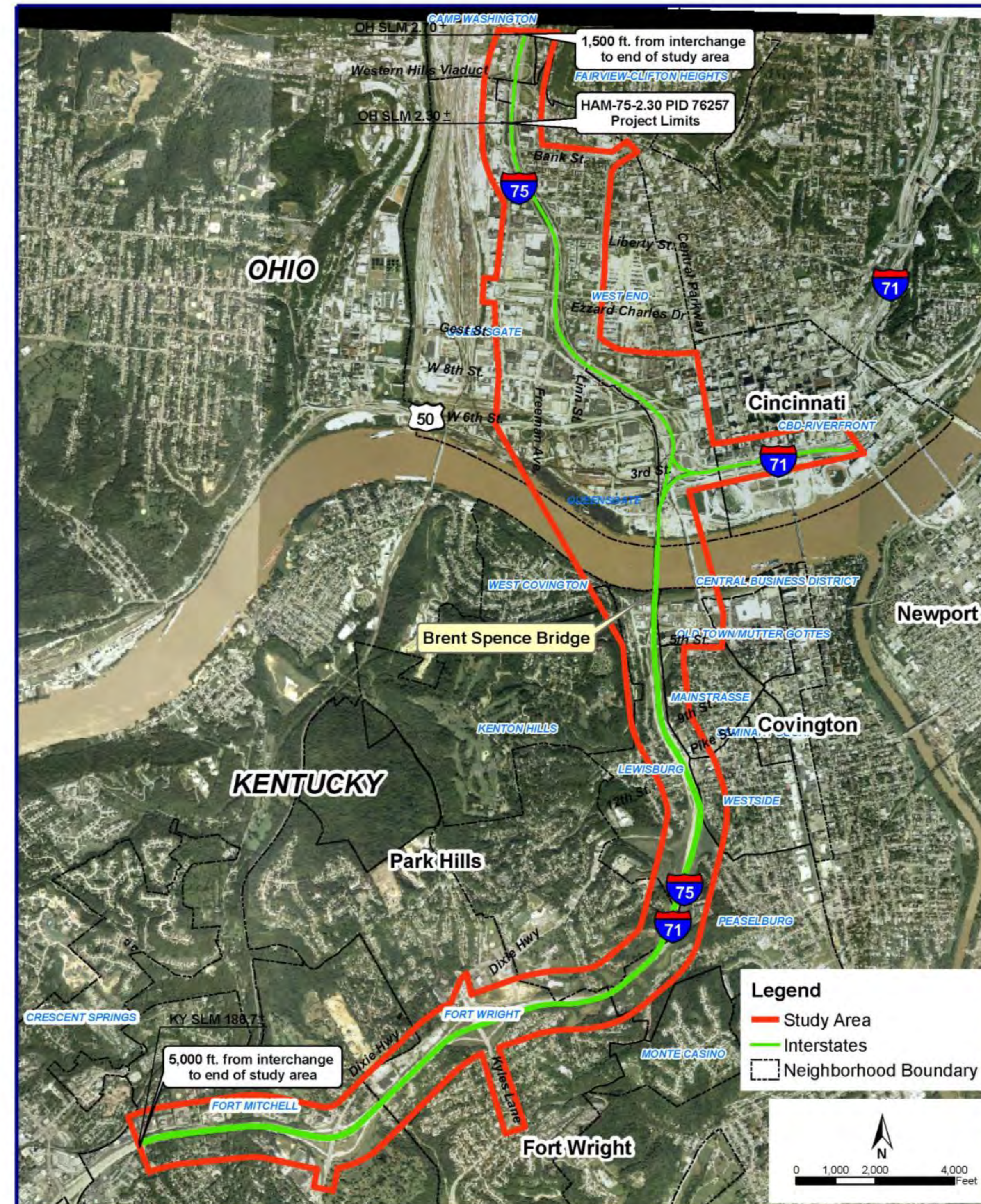


U.S. Department of Transportation
Federal Highway Administration

PROJECT LOCATION

EXHIBIT 1

Prepared by: PARSONS BRINCKERHOFF

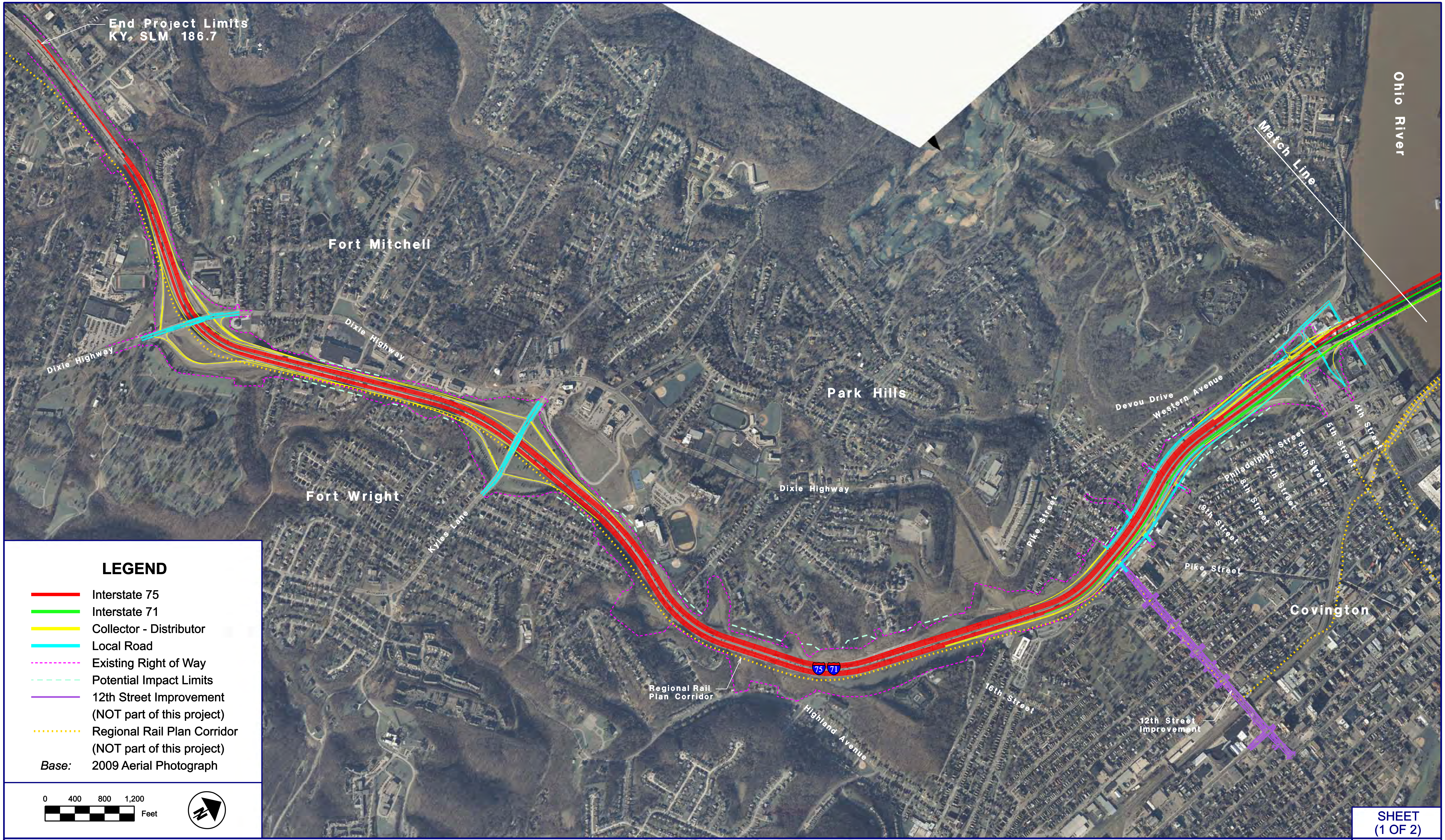


U.S. Department of Transportation
Federal Highway Administration

STUDY AREA

EXHIBIT 2

Prepared by: PARSONS BRINCKERHOFF



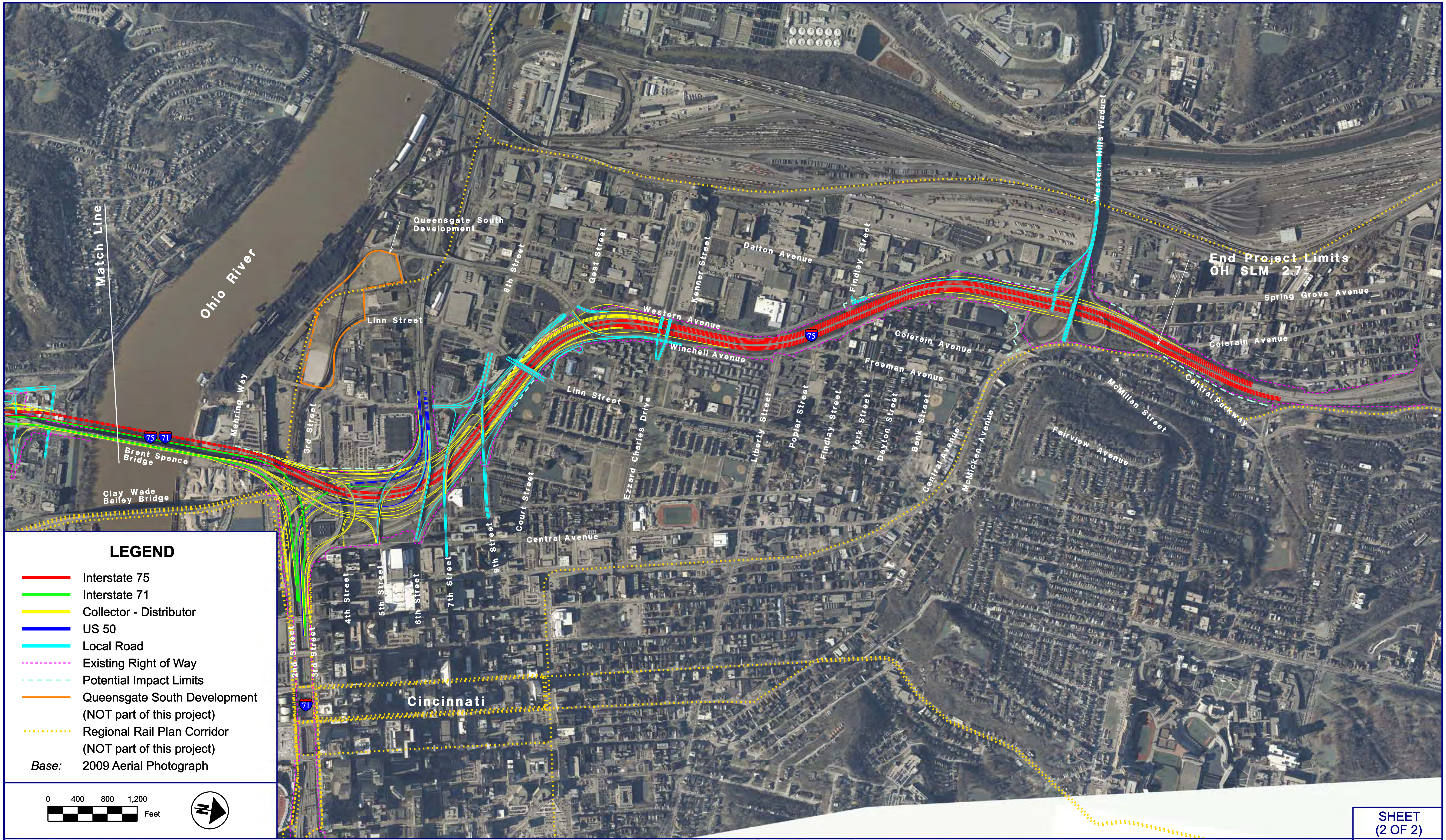
U.S. Department of Transportation
Federal Highway Administration

RECOMMENDED PREFERRED ALTERNATIVE (KENTUCKY)

SHEET (1 OF 2)

EXHIBIT 3A

Prepared by: PARSONS BRINCKERHOFF



U.S. Department of Transportation
Federal Highway Administration

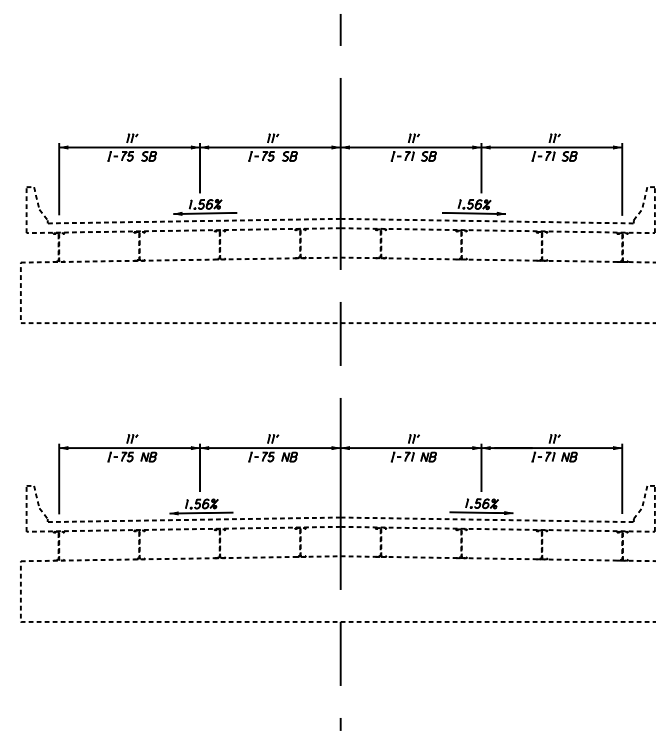
RECOMMENDED PREFERRED ALTERNATIVE (OHIO)

SHEET (2 OF 2)

EXHIBIT

3B

Prepared by:
PARSONS BRINCKERHOFF



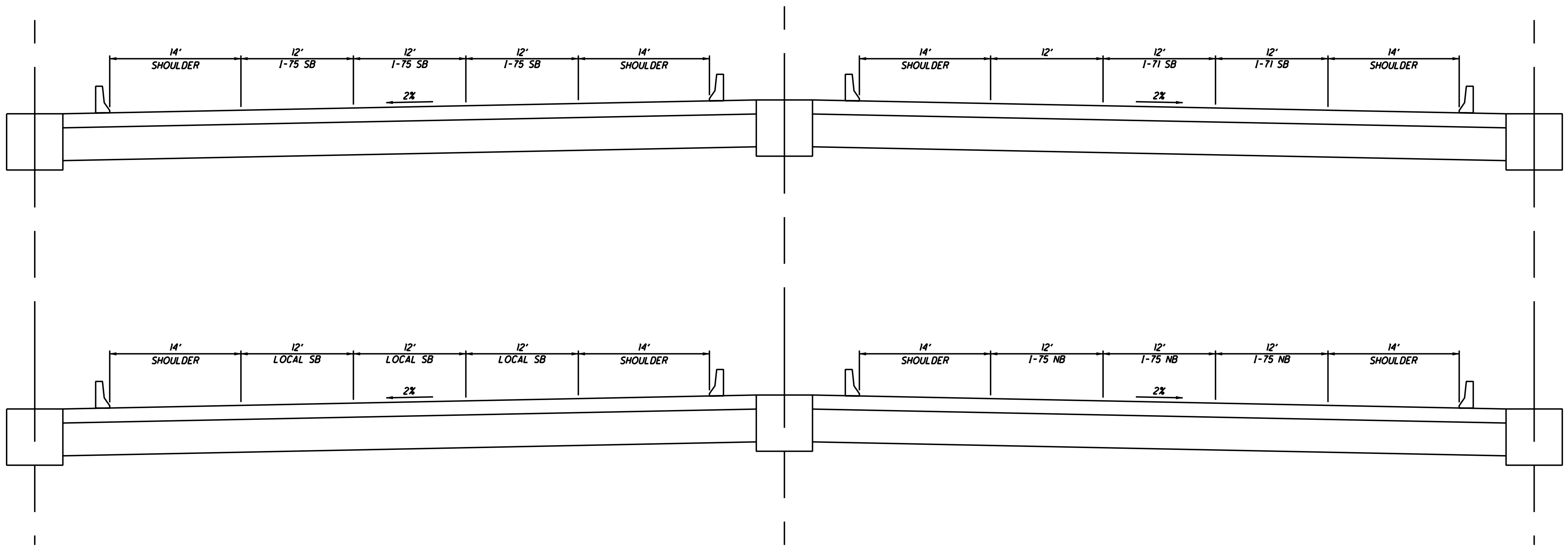
EXISTING BRENT
SPENCE BRIDGE

U.S. Department of Transportation
Federal Highway Administration

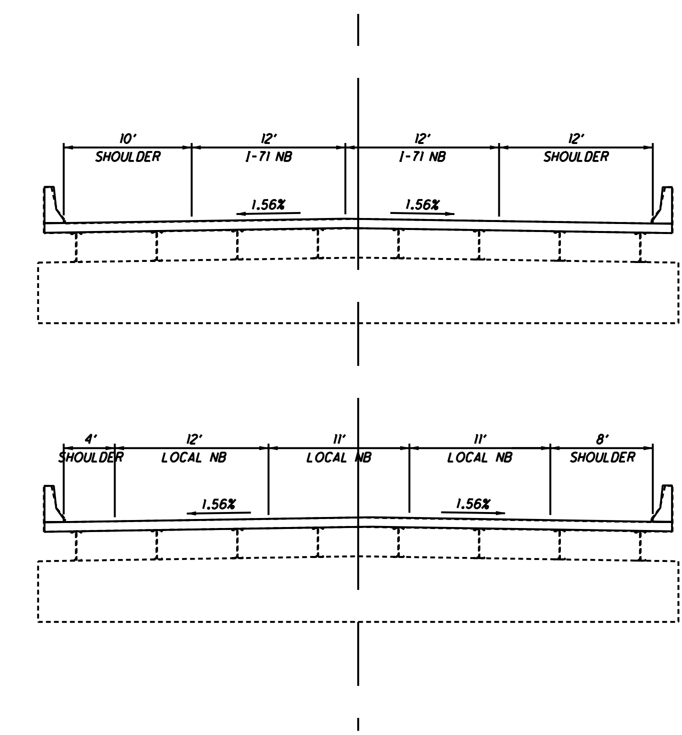
BRIDGE CROSS SECTIONS
NO BUILD ALTERNATIVE

EXHIBIT
4

Prepared by:
PARSONS BRINCKERHOFF



MAIN SPAN BRIDGE



EXISTING BRENT SPENCE BRIDGE

U.S. Department of Transportation
Federal Highway Administration

BRIDGE CROSS SECTIONS
RECOMMENDED PREFERRED ALTERNATIVE

EXHIBIT
5

Prepared by
PARSONS BRINCKERHOFF

BRENT SPENCE BRIDGE
REPLACEMENT STUDY

EXHIBIT 6

ALTERNATIVE I
CONCEPTUAL SIGNING PLAN

LEGEND

MAINLINE SIGNS

C-D ROAD SIGNS

U.S. Department of Transportation
Federal Highway Administration

STATE OF OHIO DEPARTMENT OF TRANSPORTATION

KENTUCKY TRANSPORTATION CABINET

Brent Spence Bridge
Replacement/Rehabilitation Project

Sign Layouts

ODOT PID No. 75119
HAM-71/75-0.00/0.22
KYTC Project Item No. 6-17

August 2011

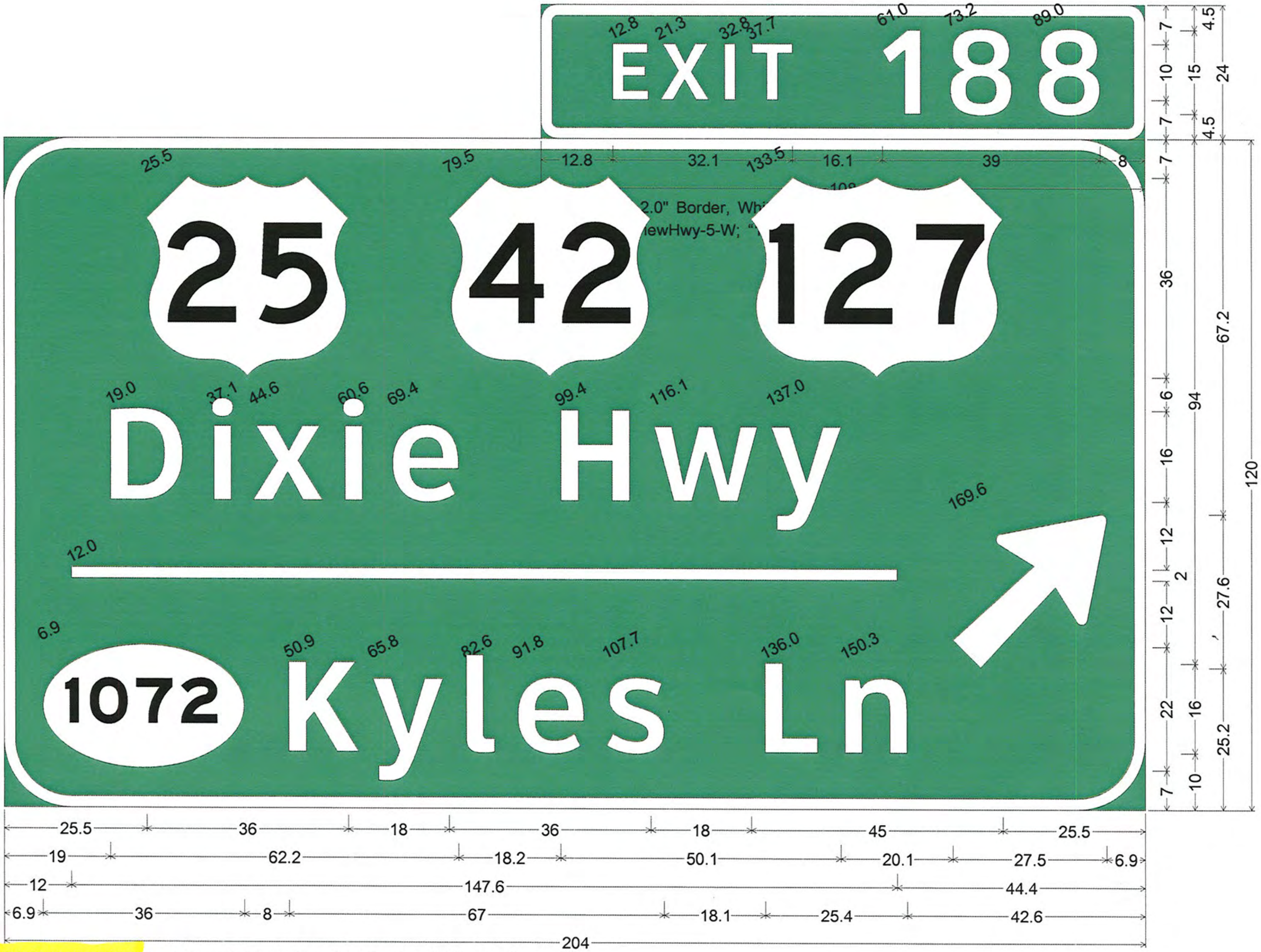




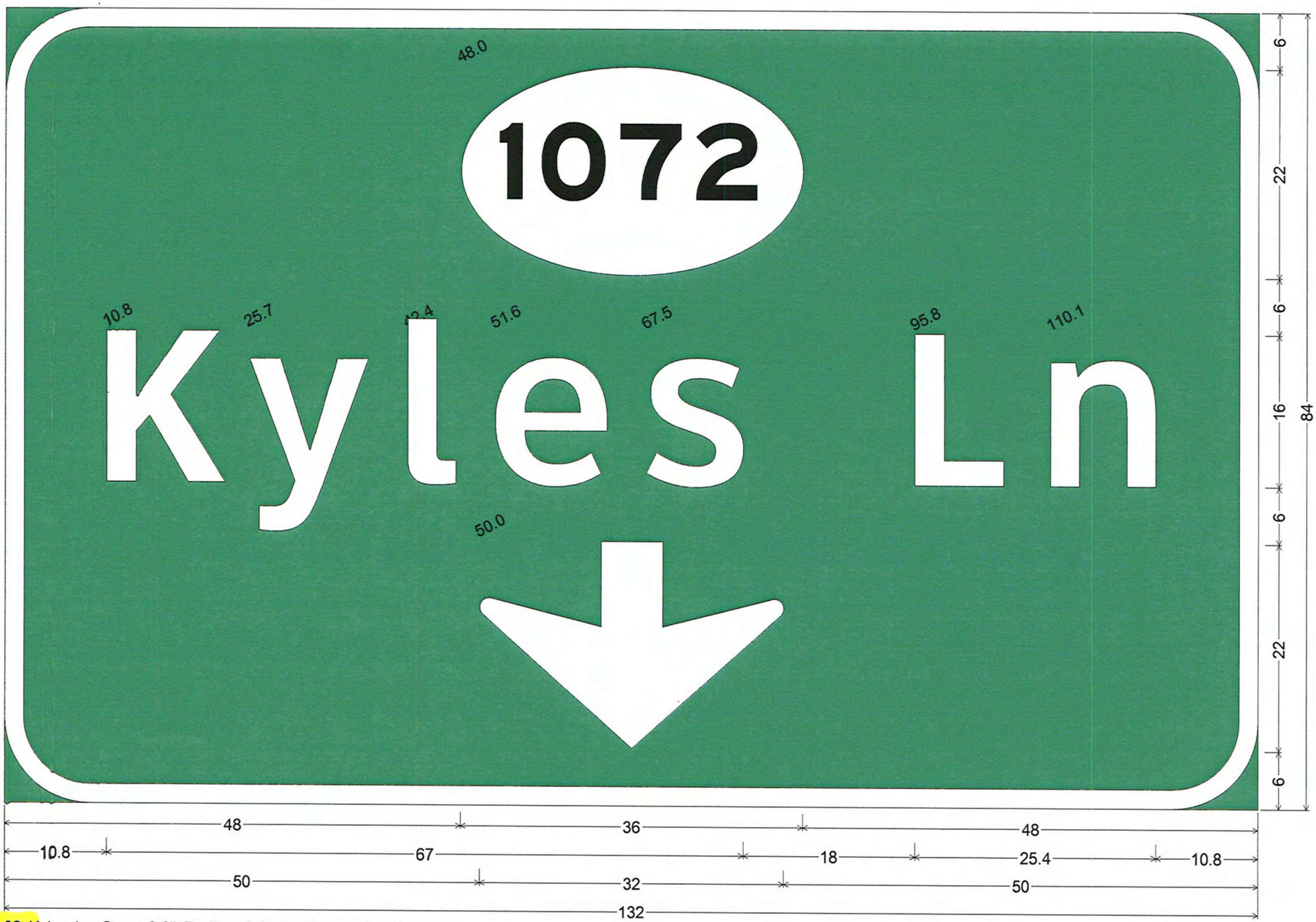



Prepared by:
PARSONS BRINCKERHOFF

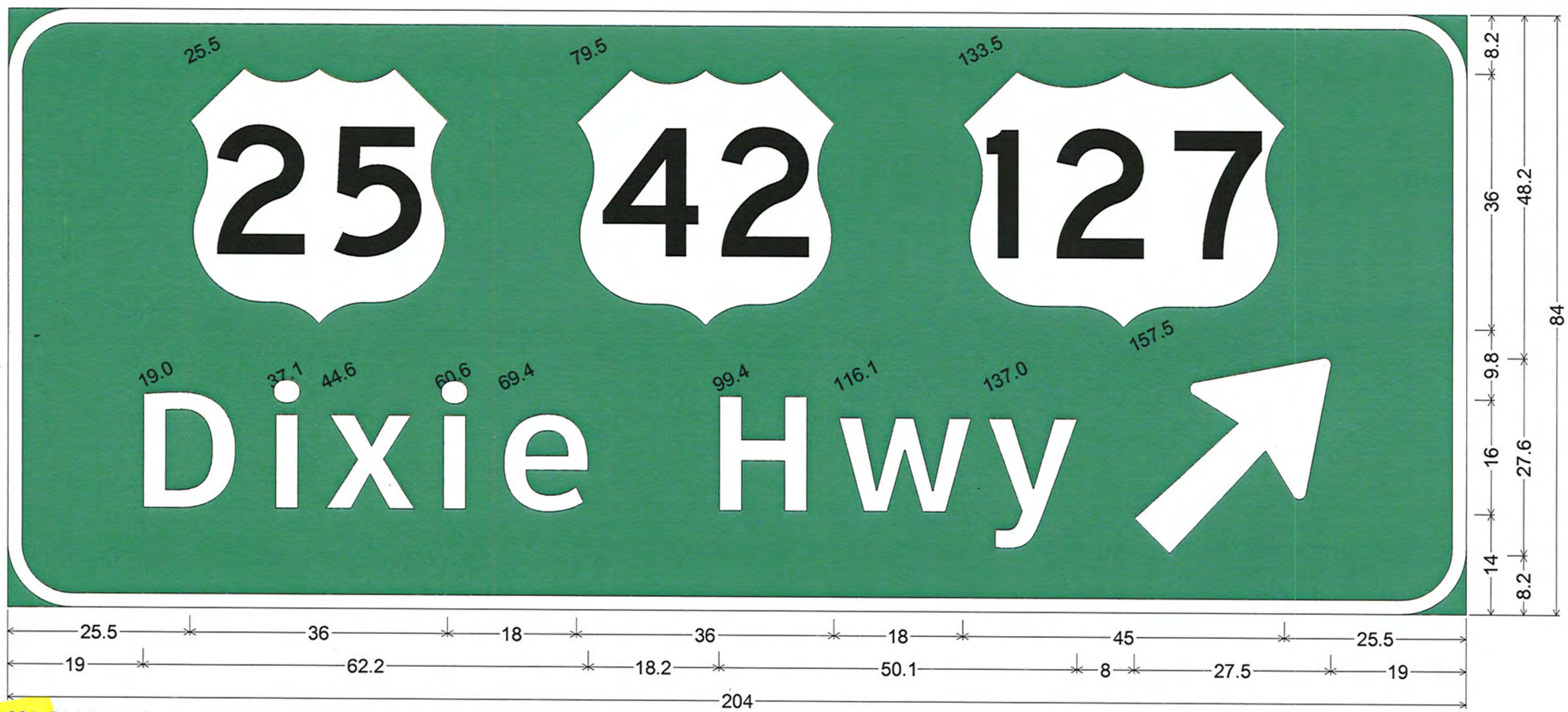
3.0" Radius, 2.0" Border, White on Green;
"EXIT" ClearviewHwy-5-W; "188" ClearviewHwy-5-W;
01A Ft Mitchell Ft Wright LEVEL 2; 12.0" Radius, 2.0" Border, White on Green;
"Ft Mitchell" ClearviewHwy-5-W; "USE DIXIE HWY" ClearviewHwy-5-W; "Ft Wright" ClearviewHwy-5-W;
"USE KYLES LN" ClearviewHwy-5-W;



01 DixieHwy_KylesLn_Gore; 12.0" Radius, 2.0" Border, White on Green;
US 25 M1-4; US 42 M1-4; US 127 M1-4; "Dixie Hwy" ClearviewHwy-5-W; OVAL; "Kyles Ln" ClearviewHwy-5-W; Arrow A-1 - 35.0" 45°;



02 Kyles Ln Gore; 9.0" Radius, 2.0" Border, White on Green;
OVAL; "Kyles Ln" ClearviewHwy-5-W; Down Arrow C-1 - 22.0" 270°;



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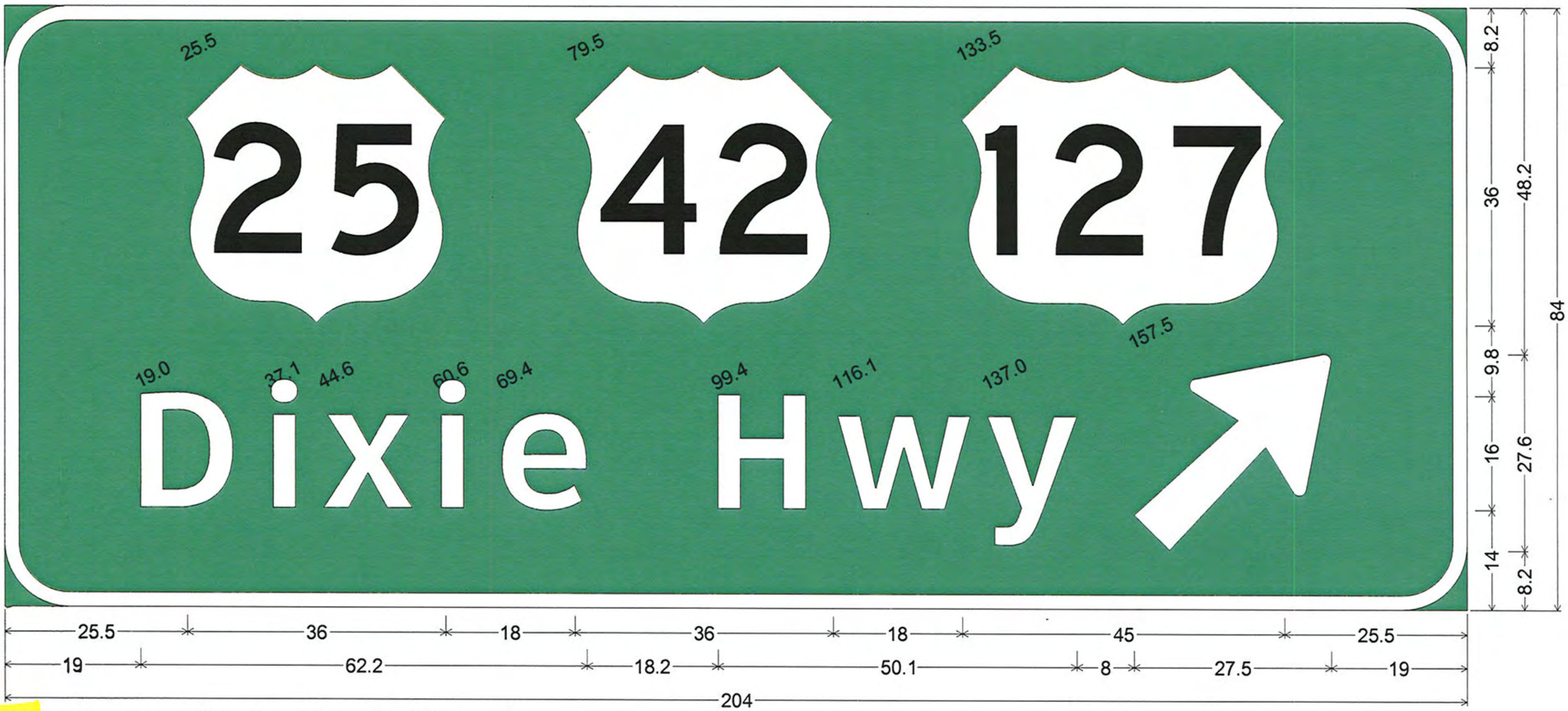
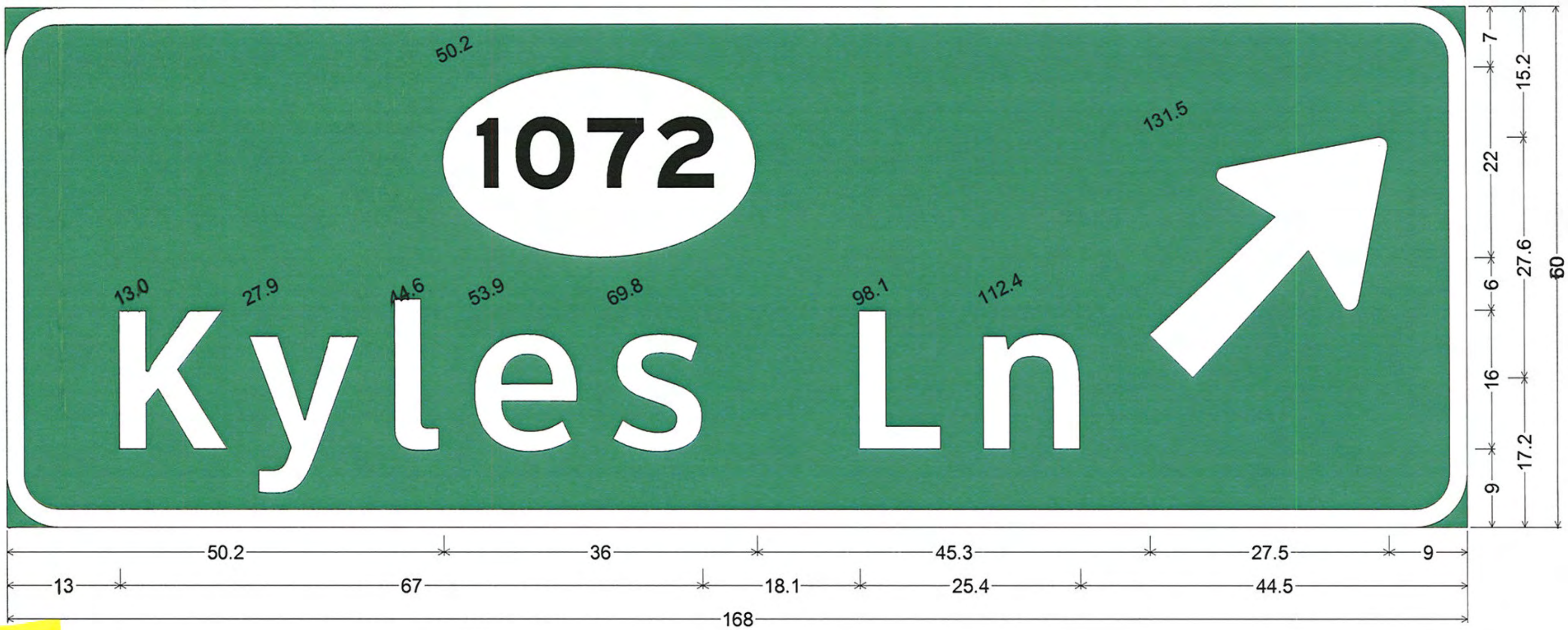
US 25 M1-4; US 42 M1-4; US 127 M1-4; "Dixie Hwy" ClearviewHwy-5-W; Arrow A-1 - 35.0" 45°;

03 75SB 71SB Lexington Louisville; 12.0" Radius, 2.0" Border, White on Green;
Interstate 75 M1-1; Interstate 71 M1-1; “South” ClearviewHwy-5-W; “Lexington” ClearviewHwy-5-W; “Louisville” ClearviewHwy-5-W; Down Arrow C-1 - 22.0" 270°;



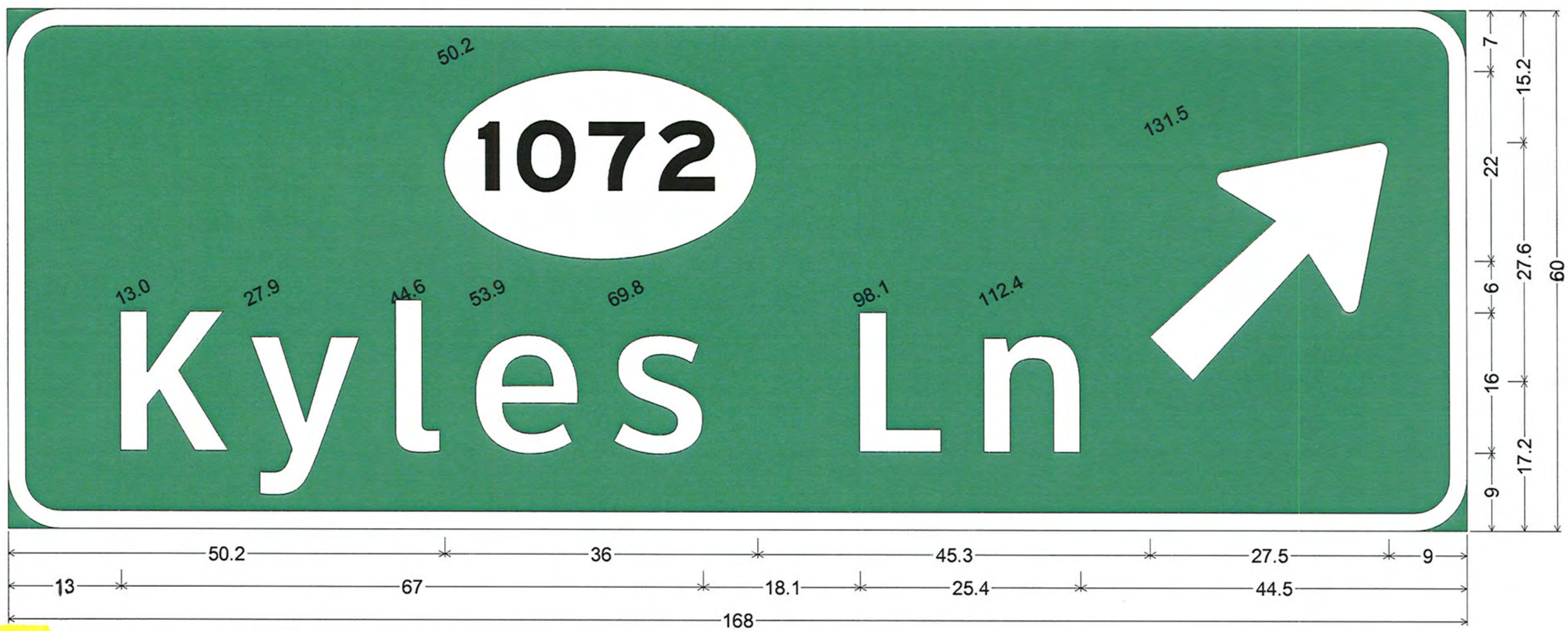
04 DixieHwy_Gore; 9.0" Radius, 2.0" Border, White on Green;
US 25 M1-4; US 42 M1-4; US 127 M1-4; "Dixie Hwy" ClearviewHwy-5-W; Arrow A-1 - 35.0" 45°;

05 75N 71N Cincinnati; 12.0" Radius, 2.0" Border, White on Green;
Interstate 75 M1-1; Interstate 71 M1-1; "North" ClearviewHwy-5-W; "Cincinnati" ClearviewHwy-5-W; Down Arrow C-1 - 22.0" 270°;



06 Kyles Ln Gore; 6.0" Radius, 2.0" Border, White on Green;
OVAL; "Kyles Ln" ClearviewHwy-5-W; Arrow A-1 - 35.0" 45°;

07 Dixie Hwy Gore; 12.0" Radius, 2.0" Border, White on Green;
US 25 M1-4; US 42 M1-4; US 127 M1-4; "Dixie Hwy" ClearviewHwy-5-W; Down Arrow C-1 - 22.0" 270°;



08 Kyles Ln South Gore; 6.0" Radius, 2.0" Border, White on Green;
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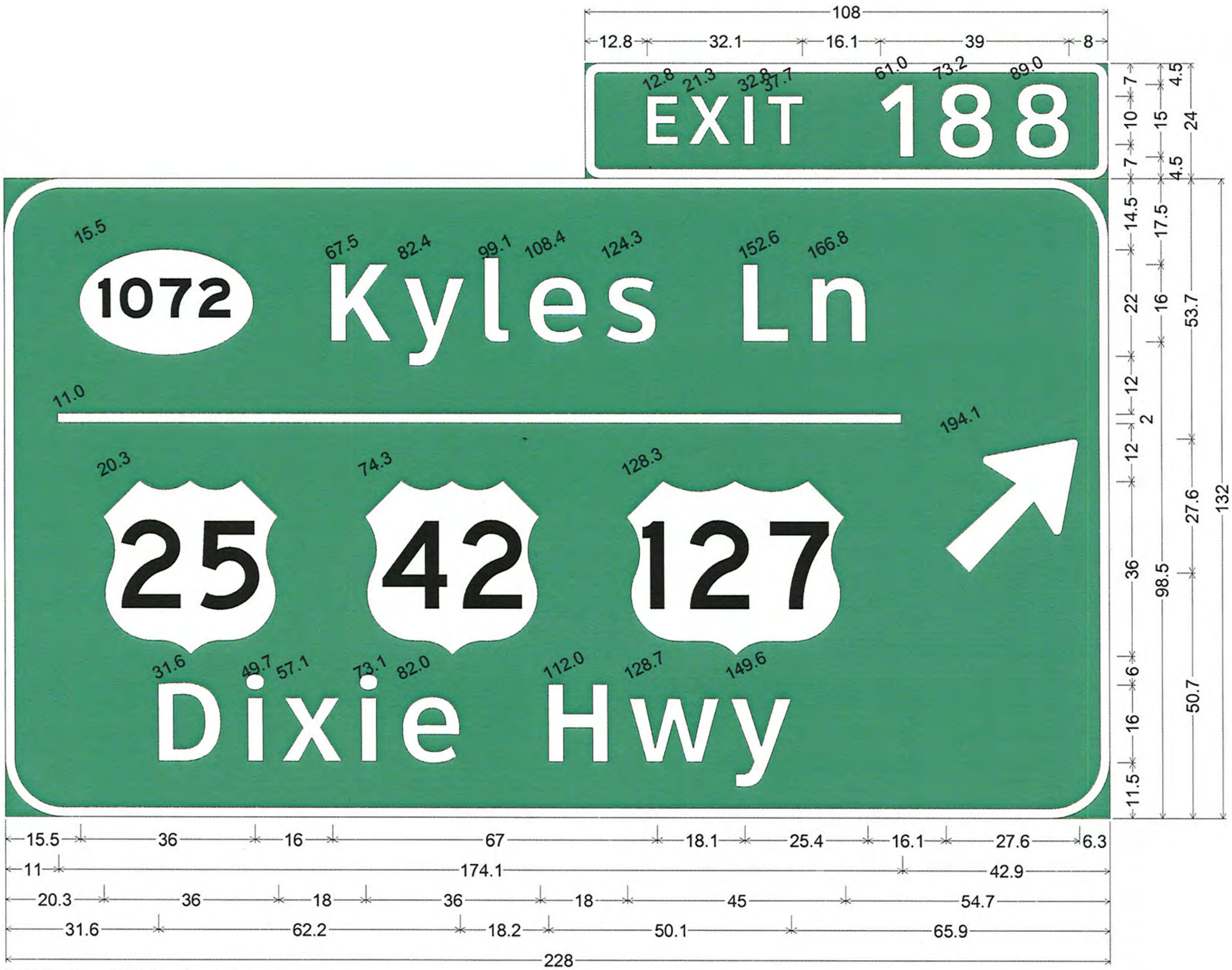
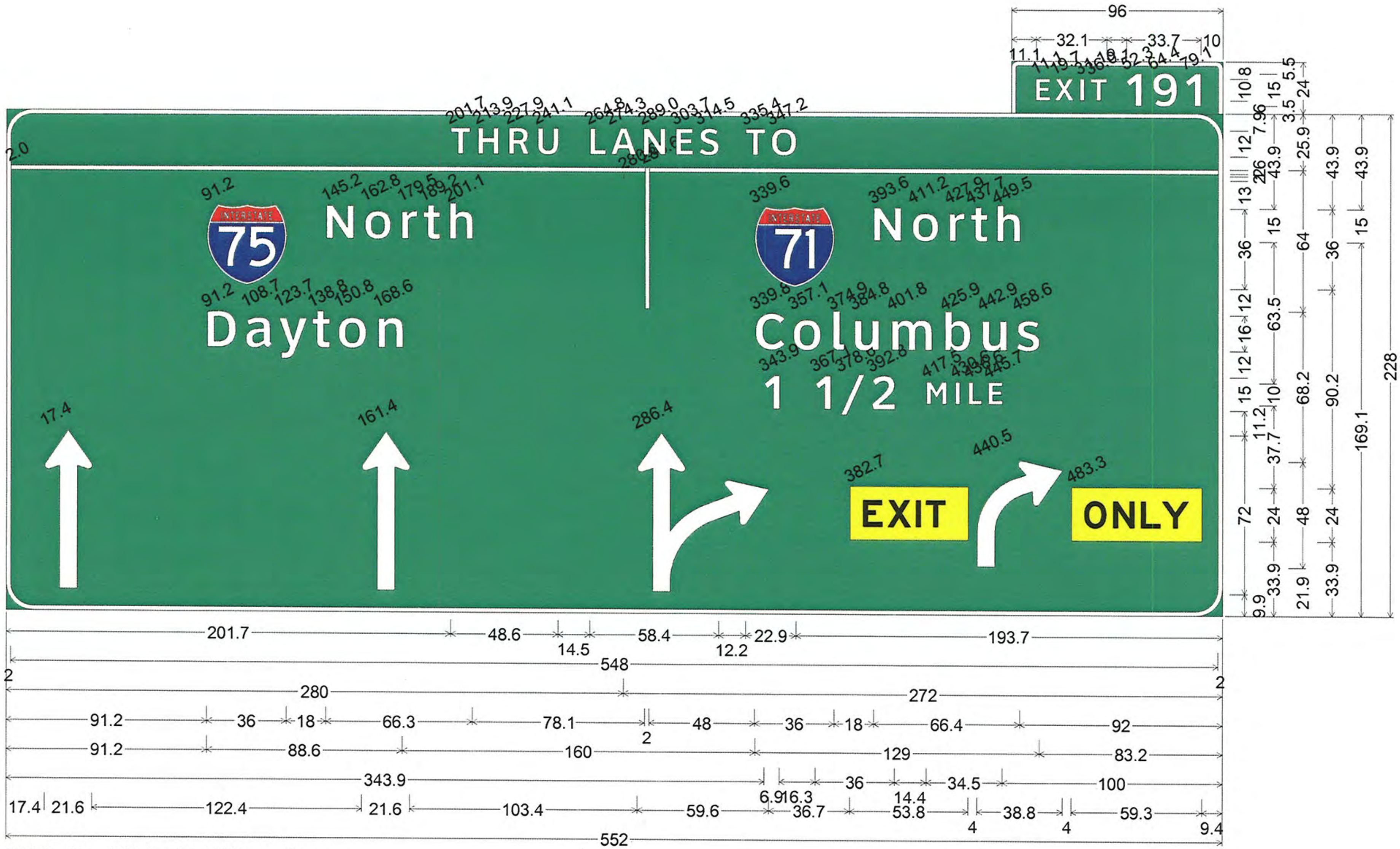
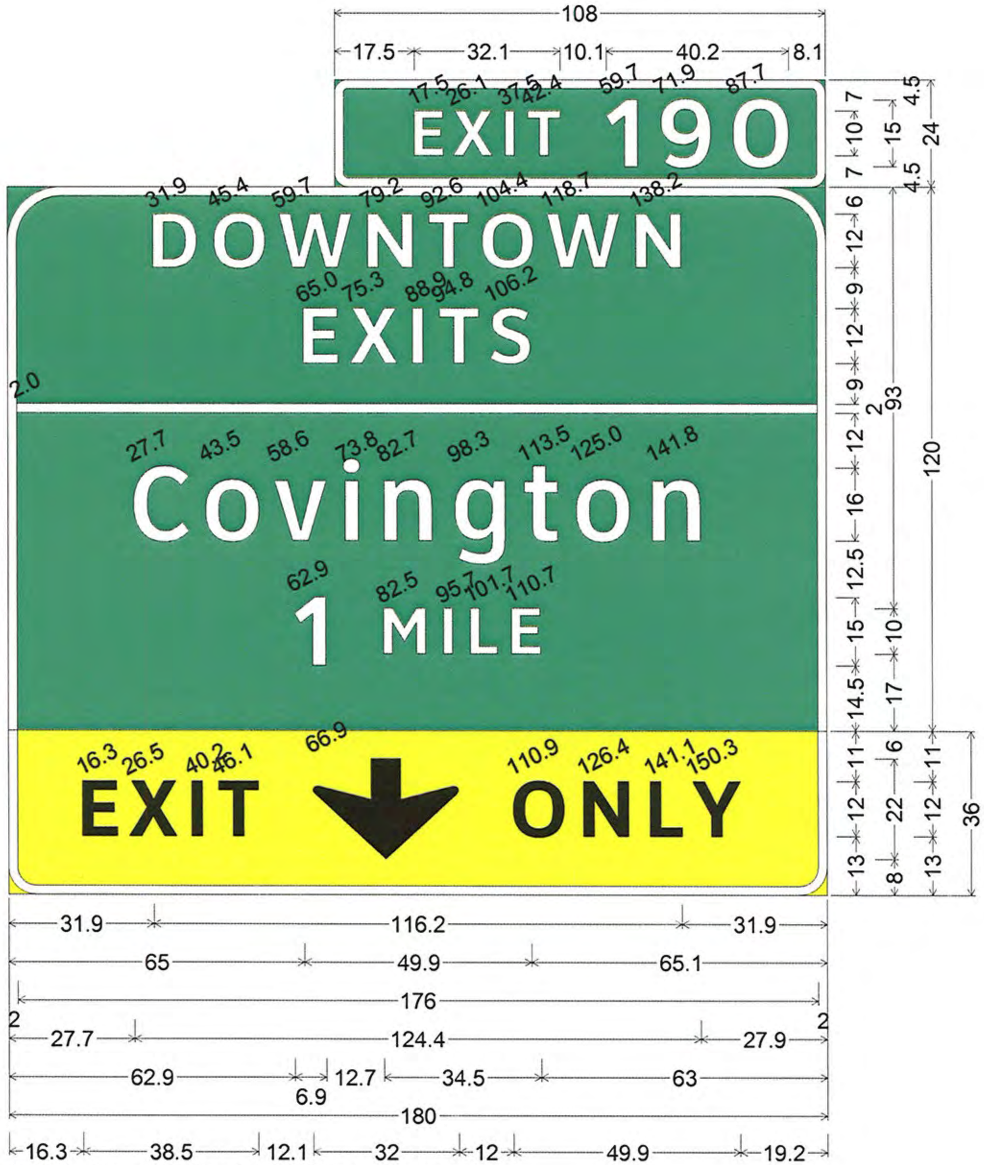


3.0" Radius, 2.0" Border, White on Green;
"EXIT" ClearviewHwy-5-W; "188" ClearviewHwy-5-W;
09 Kyles Ln Dixie Hwy Gore; 12.0" Radius, 2.0" Border, White on Green;
OVAL; "Kyles Ln" ClearviewHwy-5-W; US 25 M1-4; US 42 M1-4; US 127 M1-4; "Dixie Hwy" ClearviewHwy-5-W;
Arrow A-1 - 35.0" 45°;

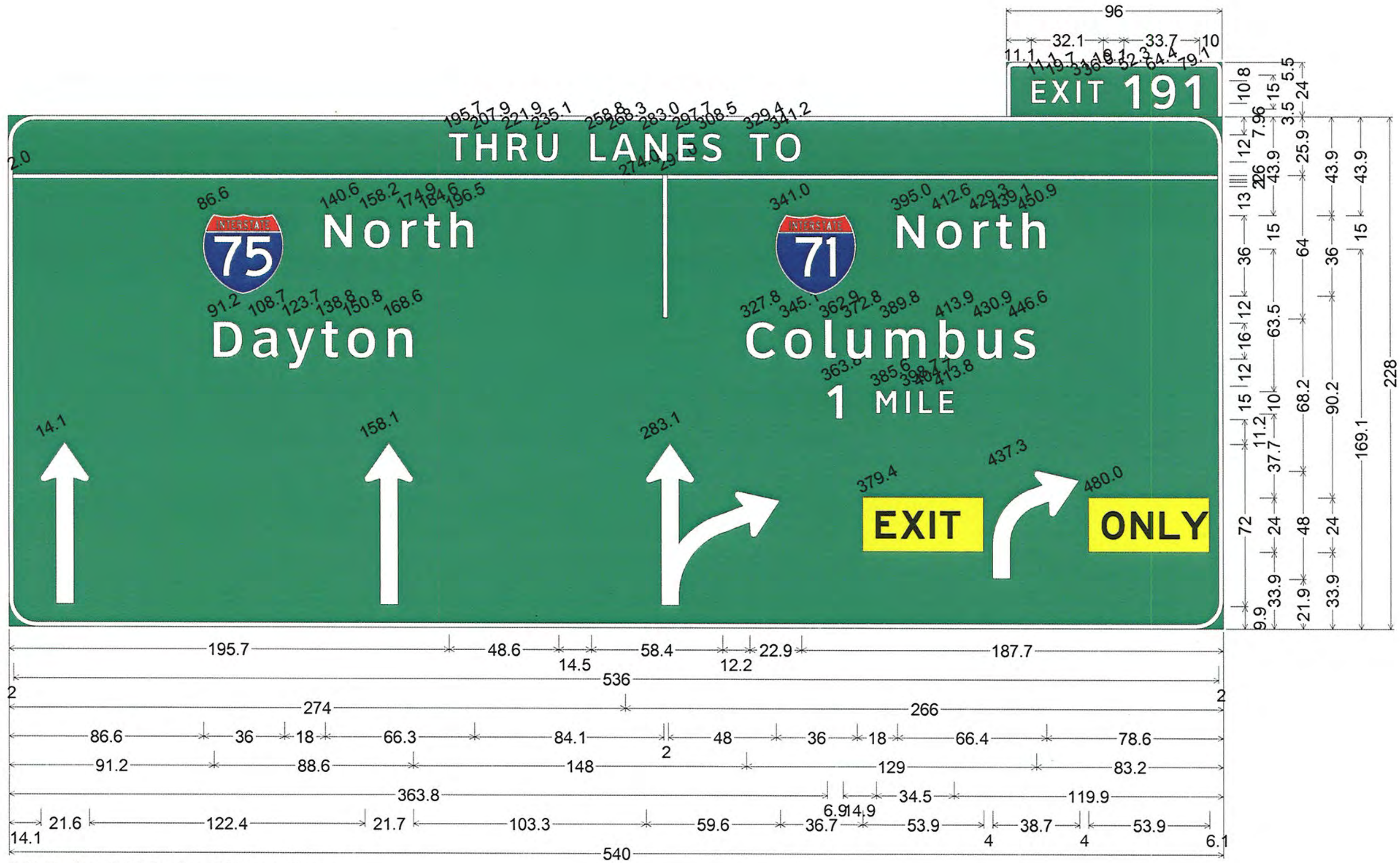


3.0" Radius, 2.0" Border, White on Green;
"EXIT 191" ClearviewHwy-5-W;
10 Thru Lanes To 75N 71N 1-1/2 Mile; 12.0" Radius, 2.0" Border, White on Green;
"THRU LANES TO" ClearviewHwy-5-W; Interstate 75 M1-1; "North" ClearviewHwy-5-W; Interstate 71 M1-1; "North" ClearviewHwy-5-W;
"Dayton" ClearviewHwy-5-W; "Columbus" ClearviewHwy-5-W; " " ClearviewHwy-5-W; "1 1/2 MILE" ClearviewHwy-5-W;
Standard Arrow Custom 72.0" X 21.6" 90°; Standard Arrow Custom 72.0" X 21.6" 90°; through Turn arrow; Exit Plaque LEFT 12" Text;
turn arrow1; Exit Plaque LEFT 12" Text;

3.0" Radius, 2.0" Border, White on Green;
“EXIT” ClearviewHwy-5-W; “190” ClearviewHwy-5-W;
11A Cinci Downtown Exit Only 1 mile;
12.0" Radius, 2.0" Border, White on Green;
“DOWNTOWN” ClearviewHwy-5-W; “EXITS” ClearviewHwy-5-W;
“Cincinnati” ClearviewHwy-4-W; “1 MILE” ClearviewHwy-5-W;
6.0" Radius, 2.0" Border, White on Yellow;
“EXIT” Black ClearviewHwy-5-W; Down Arrow C-1 - 22.0" 270° Black;
“ONLY” Black ClearviewHwy-5-W;

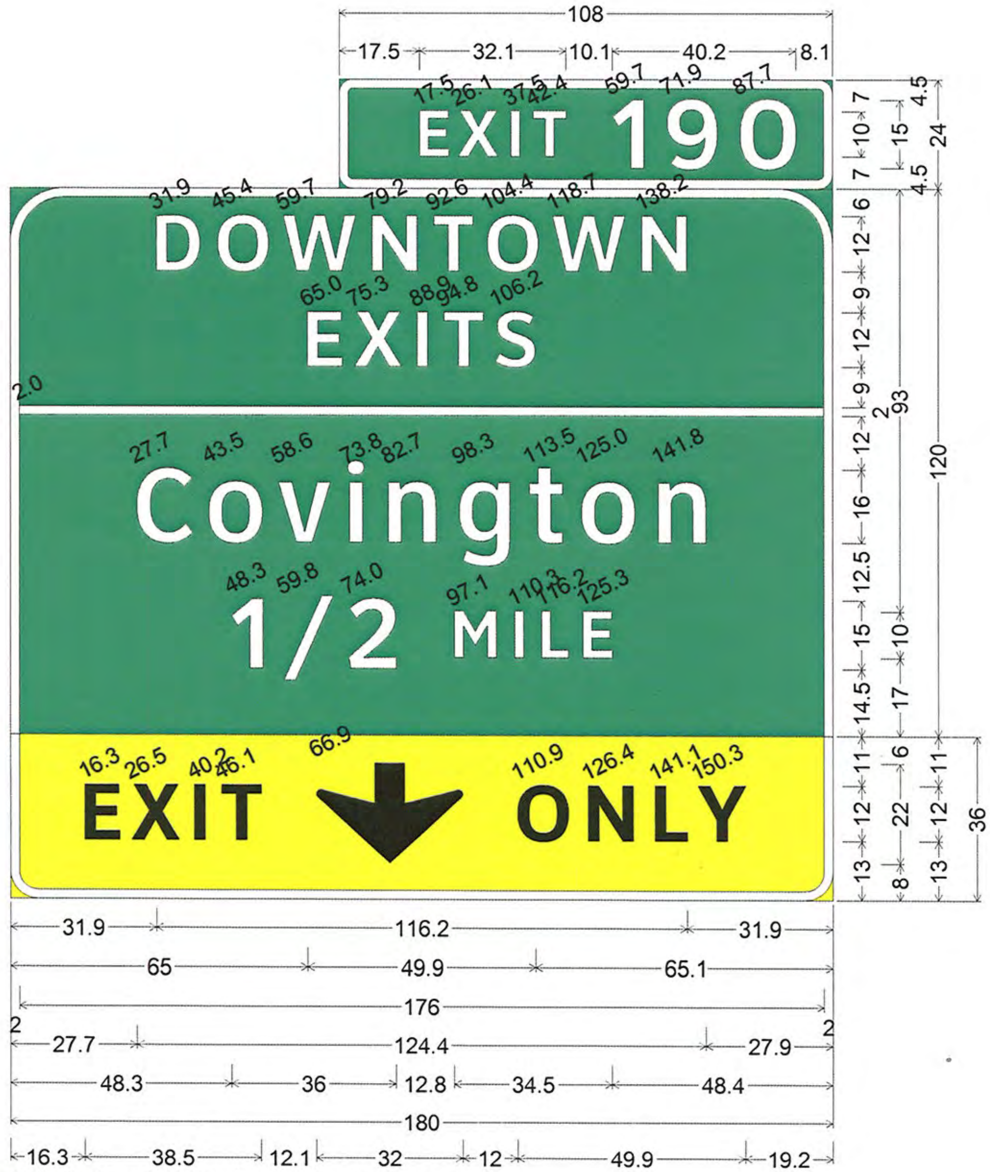


3.0" Radius, 2.0" Border, White on Green;
"EXIT" ClearviewHwy-5-W; "190" ClearviewHwy-5-W;
11B Covington Downtown Exit Only 1 mile;
12.0" Radius, 2.0" Border, White on Green;
"DOWNTOWN" ClearviewHwy-5-W; "EXITS" ClearviewHwy-5-W;
"Covington" ClearviewHwy-4-W; "1 MILE" ClearviewHwy-5-W;
6.0" Radius, 2.0" Border, White on Yellow;
"EXIT" Black ClearviewHwy-5-W; Down Arrow C-1 - 22.0" 270° Black;
"ONLY" Black ClearviewHwy-5-W;



3.0" Radius, 2.0" Border, White on Green;
"EXIT 191" ClearviewHwy-5-W;
12 Thru Lanes To 75N 71N 1 Mile; 12.0" Radius, 2.0" Border, White on Green;
"THRU LANES TO" ClearviewHwy-5-W; Interstate 75 M1-1; "North" ClearviewHwy-5-W; Interstate 71 M1-1; "North" ClearviewHwy-5-W;
"Dayton" ClearviewHwy-5-W; "Columbus" ClearviewHwy-5-W; " " ClearviewHwy-5-W; "1 MILE" ClearviewHwy-5-W;
Standard Arrow Custom 72.0" X 21.6" 90°; Standard Arrow Custom 72.0" X 21.6" 90°; through Turn arrow; Exit Plaque LEFT 12" Text;
turn arrow1; Exit Plaque LEFT 12" Text;

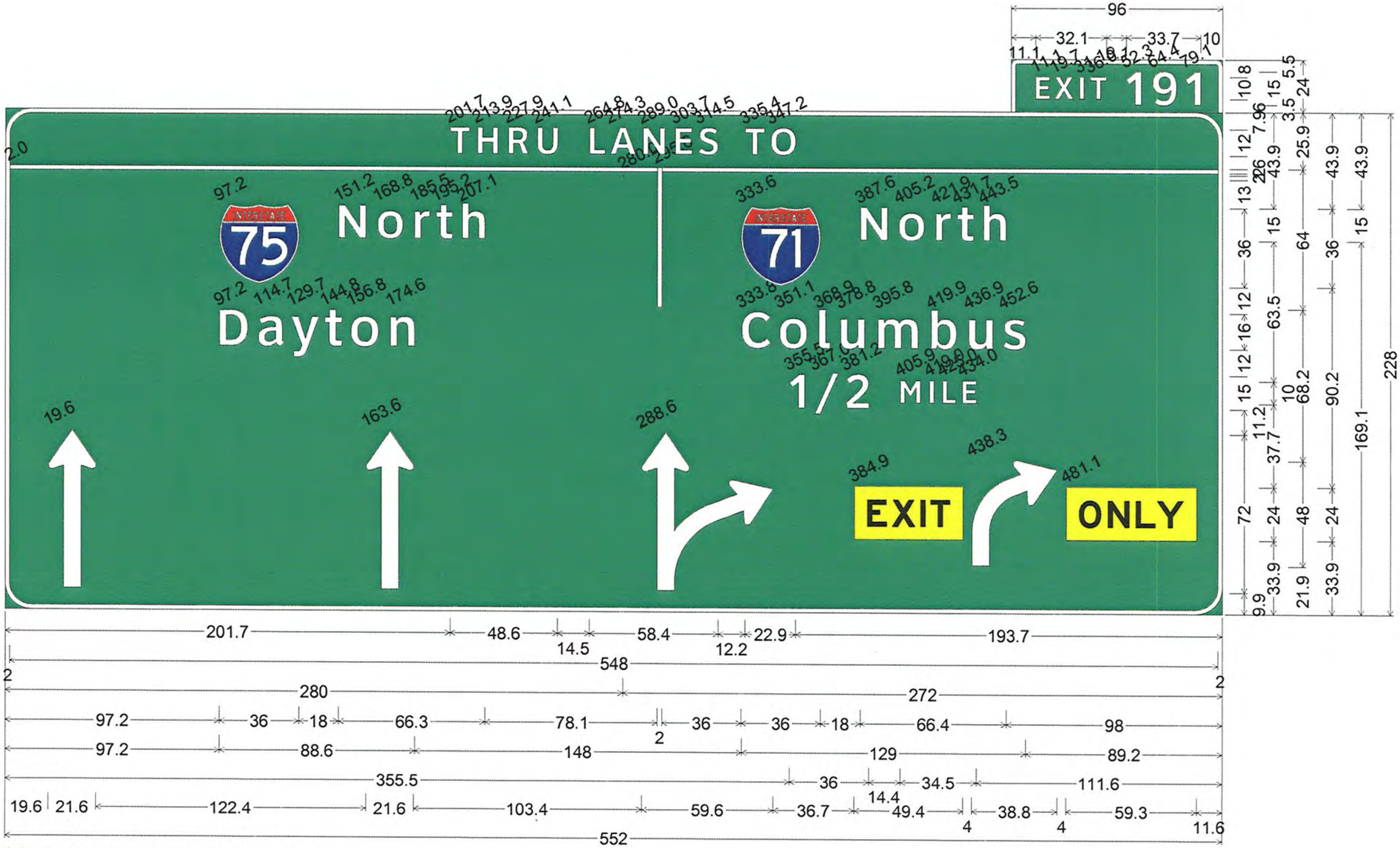
3.0" Radius, 2.0" Border, White on Green;
“EXIT” ClearviewHwy-5-W; “190” ClearviewHwy-5-W;
13A Cinci Downtown Exit Only Half Mile;
12.0" Radius, 2.0" Border, White on Green;
“DOWNTOWN” ClearviewHwy-5-W; “EXITS” ClearviewHwy-5-W;
“Cincinnati” ClearviewHwy-4-W; “1/2 MILE” ClearviewHwy-5-W;
6.0" Radius, 2.0" Border, White on Yellow;
“EXIT” Black ClearviewHwy-5-W; Down Arrow C-1 - 22.0" 270° Black;
“ONLY” Black ClearviewHwy-5-W;



3.0" Radius, 2.0" Border, White on Green;
"EXIT" ClearviewHwy-5-W; "190" ClearviewHwy-5-W;
13B Covington Downtown Exit Only Half Mile;
12.0" Radius, 2.0" Border, White on Green;
"DOWNTOWN" ClearviewHwy-5-W; "EXITS" ClearviewHwy-5-W;
"Covington" ClearviewHwy-4-W; "1/2 MILE" ClearviewHwy-5-W;
6.0" Radius, 2.0" Border, White on Yellow;
"EXIT" Black ClearviewHwy-5-W; Down Arrow C-1 - 22.0" 270° Black;
"ONLY" Black ClearviewHwy-5-W;

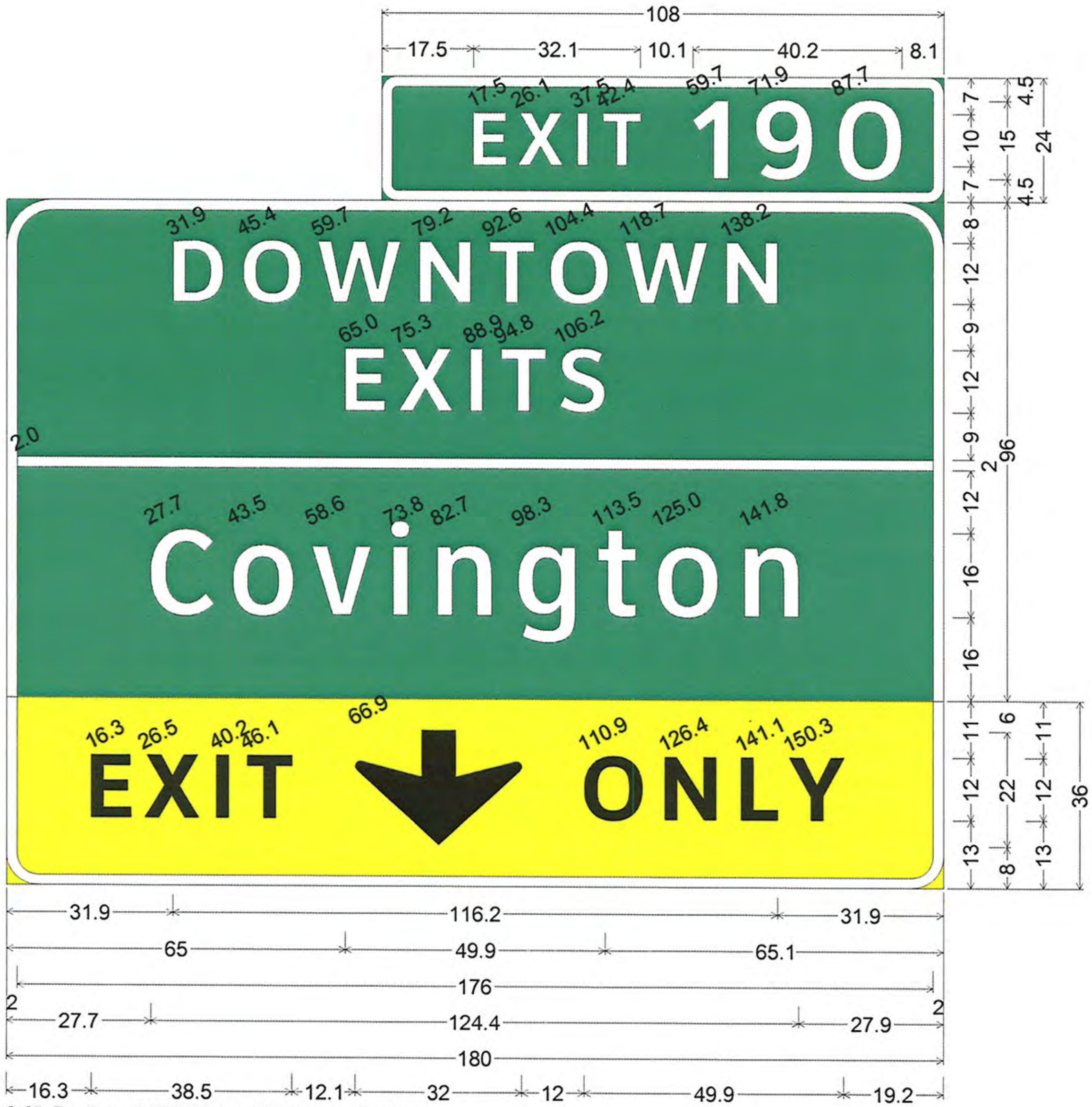
3.0" Radius, 2.0" Border, White on Green;
"EXIT" ClearviewHwy-5-W; "188" ClearviewHwy-5-W;
14 Kyles Ln Dixie Hwy Half Mile; 12.0" Radius, 2.0" Border, White on Green;
OVAL; "Kyles Ln" ClearviewHwy-5-W; US 25 M1-4; US 42 M1-4; US 127 M1-4;
"Dixie Hwy" ClearviewHwy-5-W; "1/2 MILE" ClearviewHwy-5-W;

3.0" Radius, 2.0" Border, White on Green;
"EXIT" ClearviewHwy-5-W; "188" ClearviewHwy-5-W;
14A Ft Wright Ft Mitchell LEVEL 2; 12.0" Radius, 2.0" Border, White on Green;
"Ft Wright" ClearviewHwy-5-W; "USE KYLES LN" ClearviewHwy-5-W; "Ft Mitchell" ClearviewHwy-5-W;
"USE DIXIE HWY" ClearviewHwy-5-W;



3.0" Radius, 2.0" Border, White on Green;
"EXIT 191" ClearviewHwy-5-W;
15 Thru Lanes To 75N 71N Half Mile; 12.0" Radius, 2.0" Border, White on Green;
"THRU LANES TO" ClearviewHwy-5-W; Interstate 75 M1-1; "North" ClearviewHwy-5-W; Interstate 71 M1-1; "North" ClearviewHwy-5-W;
"Dayton" ClearviewHwy-5-W; "Columbus" ClearviewHwy-5-W; " " ClearviewHwy-5-W; "1/2 MILE" ClearviewHwy-5-W;
Standard Arrow Custom 72.0" X 21.6" 90°; Standard Arrow Custom 72.0" X 21.6" 90°; through Turn arrow; Exit Plaque LEFT 12" Text;
turn arrow1; Exit Plaque LEFT 12" Text;

3.0" Radius, 2.0" Border, White on Green;
“EXIT” ClearviewHwy-5-W; “190” ClearviewHwy-5-W;
16A Cincinnati Downtown Exit Only; 9.0" Radius, 2.0" Border, White on Green;
“DOWNTOWN” ClearviewHwy-5-W; “EXITS” ClearviewHwy-5-W; “Cincinnati” ClearviewHwy-4-W;
6.0" Radius, 2.0" Border, White on Yellow;
“EXIT” Black ClearviewHwy-5-W; Down Arrow C-1 - 22.0" 270° Black;
“ONLY” Black ClearviewHwy-5-W;

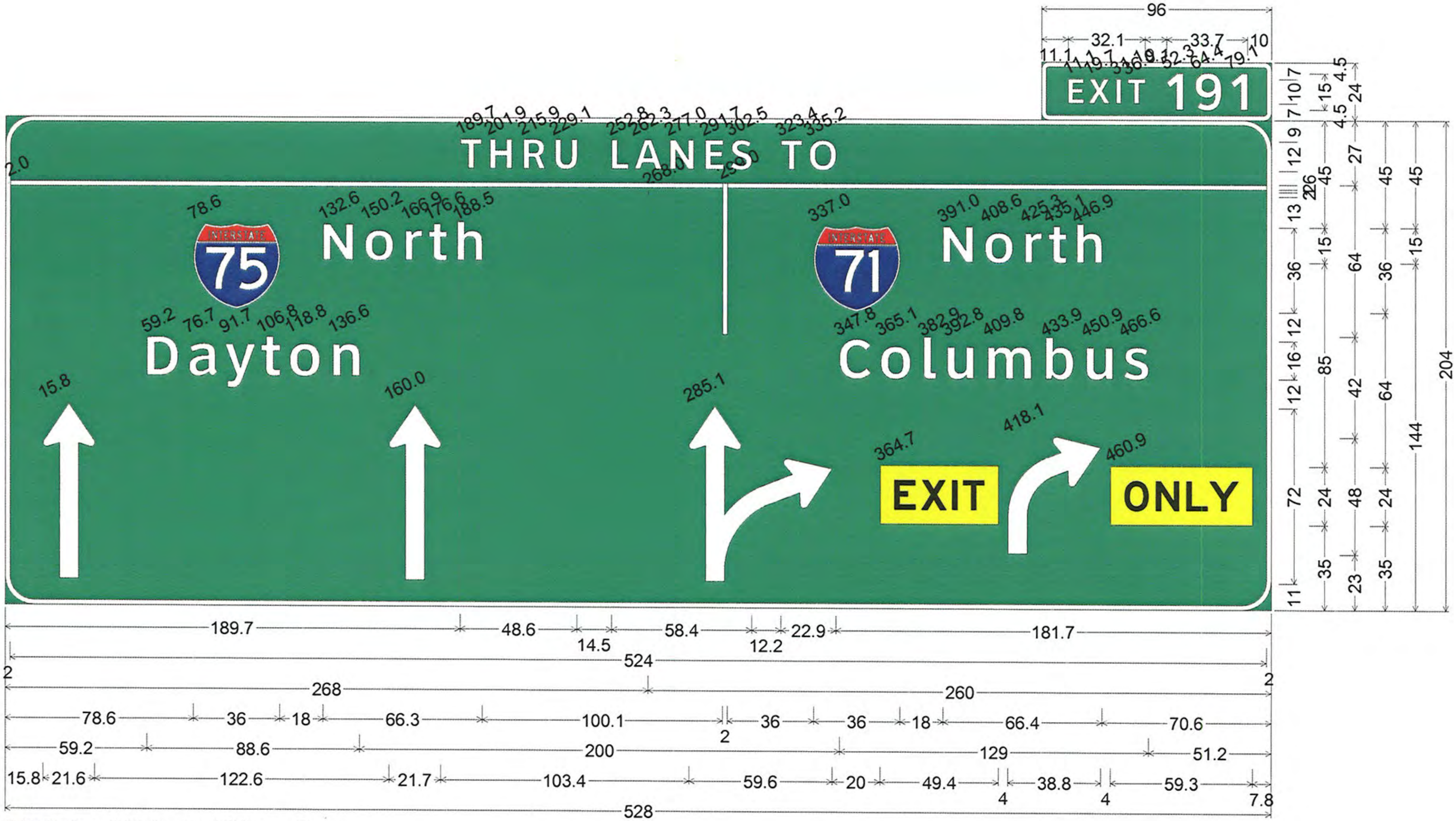


3.0" Radius, 2.0" Border, White on Green;
“EXIT” ClearviewHwy-5-W; “190” ClearviewHwy-5-W;
16B Covington Downtown Exit Only; 9.0" Radius, 2.0" Border, White on Green;
“DOWNTOWN” ClearviewHwy-5-W; “EXITS” ClearviewHwy-5-W;
“Covington” ClearviewHwy-4-W;
6.0" Radius, 2.0" Border, White on Yellow;
“EXIT” Black ClearviewHwy-5-W; Down Arrow C-1 - 22.0" 270° Black;
“ONLY” Black ClearviewHwy-5-W;

3.0" Radius, 2.0" Border, White on Green;
“EXIT” ClearviewHwy-5-W; “188” ClearviewHwy-5-W;
17 Kyles Ln Dixie Hwy 1 Mile; 12.0" Radius, 2.0" Border, White on Green;
OVAL; “Kyles Ln” ClearviewHwy-5-W; US 25 M1-4; US 42 M1-4; US 127 M1-4;
“Dixie Hwy” ClearviewHwy-5-W; “1 MILE” ClearviewHwy-5-W;

18A Cincinnati Thru; 12.0" Radius, 2.0" Border, White on Green;
"DOWNTOWN" ClearviewHwy-4-W; "EXITS" ClearviewHwy-4-W; "Cincinnati" ClearviewHwy-5-W;
Arrow A-0 - 35.0" 90°;

18B Covington Gore Exit Only; 9.0" Radius, 2.0" Border, White on Green;
"DOWNTOWN" ClearviewHwy-4-W; "EXITS" ClearviewHwy-4-W; "Covington" ClearviewHwy-4-W;
6.0" Radius, 2.0" Border, Black on Yellow;
"EXIT" ClearviewHwy-4-W; Arrow A-4 - 25.0" 45°; "ONLY" ClearviewHwy-4-W;

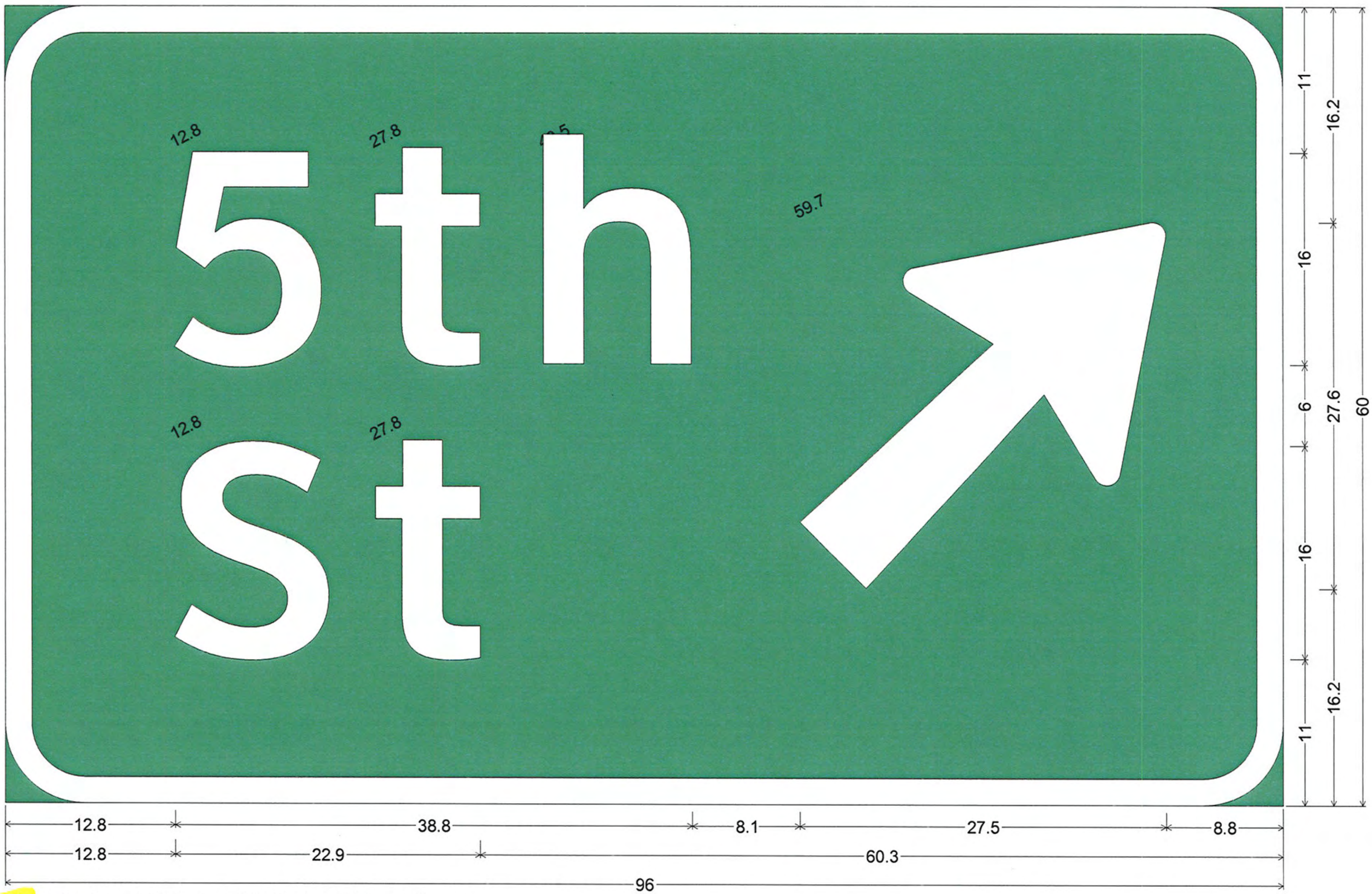


3.0" Radius, 2.0" Border, White on Green;
"EXIT 191" ClearviewHwy-5-W;
19 Thru lanes to 75N 71N Split Gore; 12.0" Radius, 2.0" Border, White on Green;
"THRU LANES TO" ClearviewHwy-5-W; Interstate 75 M1-1; "North" ClearviewHwy-5-W; Interstate 71 M1-1; "North" ClearviewHwy-5-W;
"Dayton" ClearviewHwy-5-W; "Columbus" ClearviewHwy-5-W; Standard Arrow Custom 72.0" X 21.6" 90°; Standard Arrow Custom 72.0" X 21.6" 90°;
through Turn arrow; Exit Plaque LEFT 12" Text;
turn arrow1; Exit Plaque LEFT 12" Text;

20 Thru Lane To 71N Gore; 12.0" Radius, 2.0" Border, White on Green;
Interstate 71 M1-1; "North" ClearviewHwy-5-W; "Columbus" ClearviewHwy-5-W; Down Arrow C-1 - 22.0" 270°;

21 75NB Cinci Dayton DowntownExits Gore;
12.0" Radius, 2.0" Border, White on Green;
"DOWNTOWN" ClearviewHwy-5-W; "EXITS" ClearviewHwy-5-W;
Interstate 75 M1-1; "North" ClearviewHwy-5-W;
"Cincinnati" ClearviewHwy-4-W; "Dayton" ClearviewHwy-4-W;
Down Arrow C-1 - 22.0" 270°;

24 75S Lexington 71S Louisville Bullock; 12.0" Radius, 2.0" Border, White on Green;
"South" ClearviewHwy-5-W; "South" ClearviewHwy-5-W; Interstate 71 M1-1; Interstate 75 M1-1; "Louisville" ClearviewHwy-5-W;
"9th St" ClearviewHwy-5-W; "Lexington" ClearviewHwy-5-W; "12th St" ClearviewHwy-5-W; " " ClearviewHwy-5-W;
Standard Arrow Custom 72.0" X 21.6" 90°; through Turn arrow; turn arrow1;

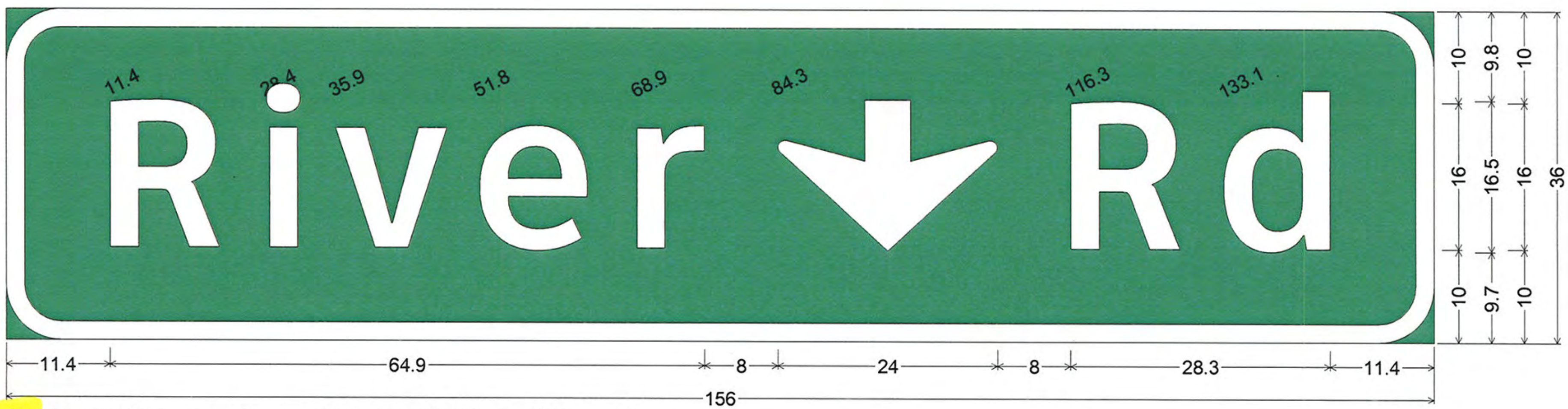


25 5th St Gore; 6.0" Radius, 2.0" Border, White on Green;
"5th" ClearviewHwy-5-W; "St" ClearviewHwy-5-W; Arrow A-1 - 35.0" 45°;

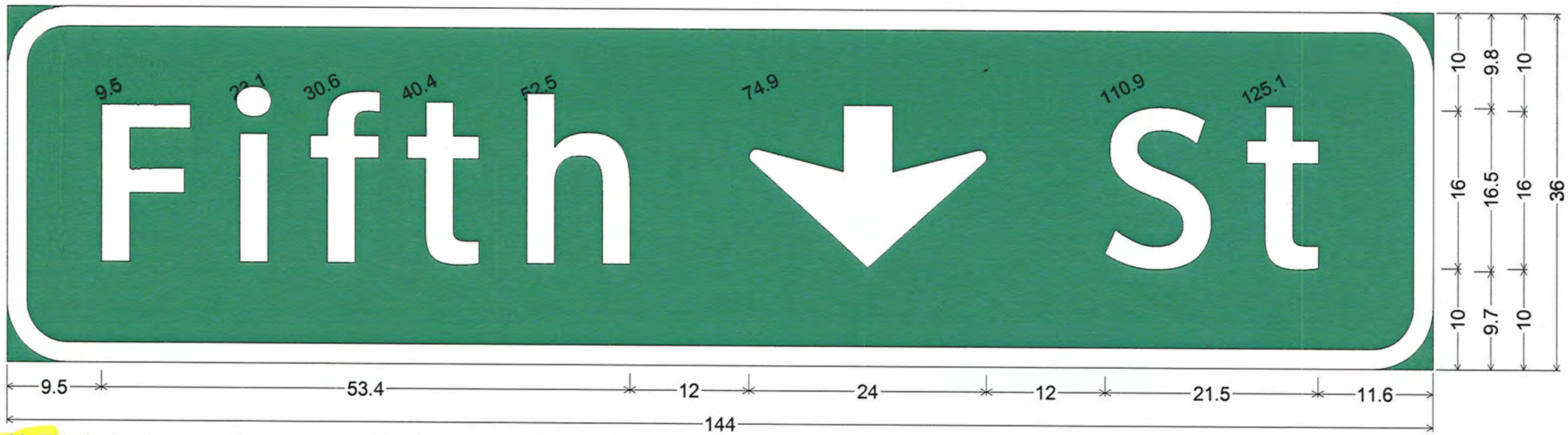
26 US50W River Rd 3Qtr Mile; 12.0" Radius, 2.0" Border, White on Green;
US 50 M1-4; "West" ClearviewHwy-5-W; "River Rd" ClearviewHwy-5-W; "3/4 Mile" ClearviewHwy-5-W;
Down Arrow C-1 - 22.0" 270°;

27 71NB Fifth St 3QTR Mile; 12.0" Radius, 2.0" Border, White on Green;
Interstate 75 M1-1; "North" ClearviewHwy-5-W; "Fifth St" ClearviewHwy-5-W; "3/4 MILE" ClearviewHwy-5-W;
Down Arrow C-1 - 22.0" 270°;

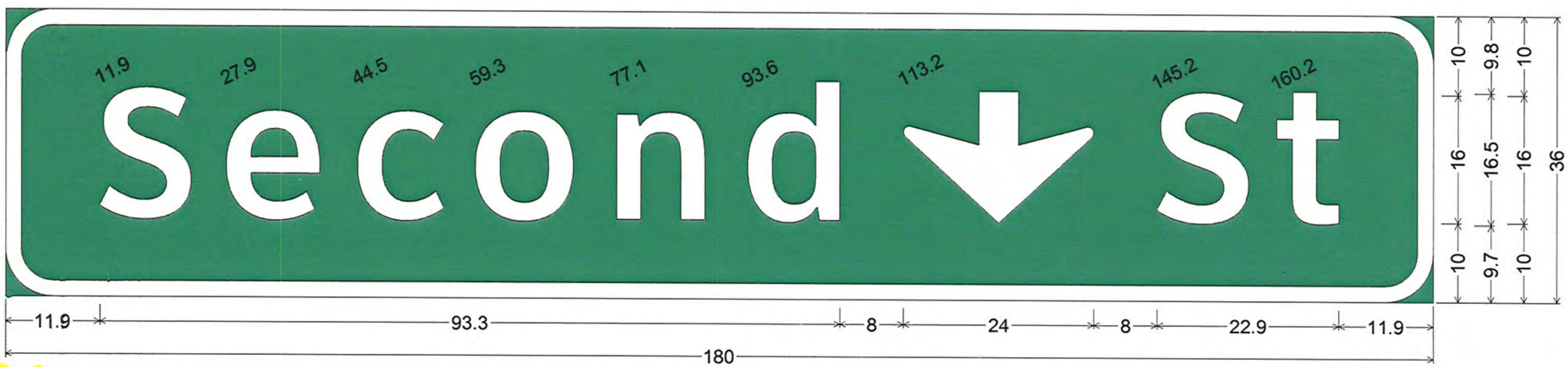
28 71NB 50EB Second St Half Mile; 12.0" Radius, 2.0" Border, White on Green;
"North" ClearviewHwy-5-W; "East" ClearviewHwy-5-W; Interstate 71 M1-1; US 50 M1-4;
"Second St" ClearviewHwy-5-W; "1/2 MILE" ClearviewHwy-5-W; Down Arrow C-1 - 22.0" 270°;



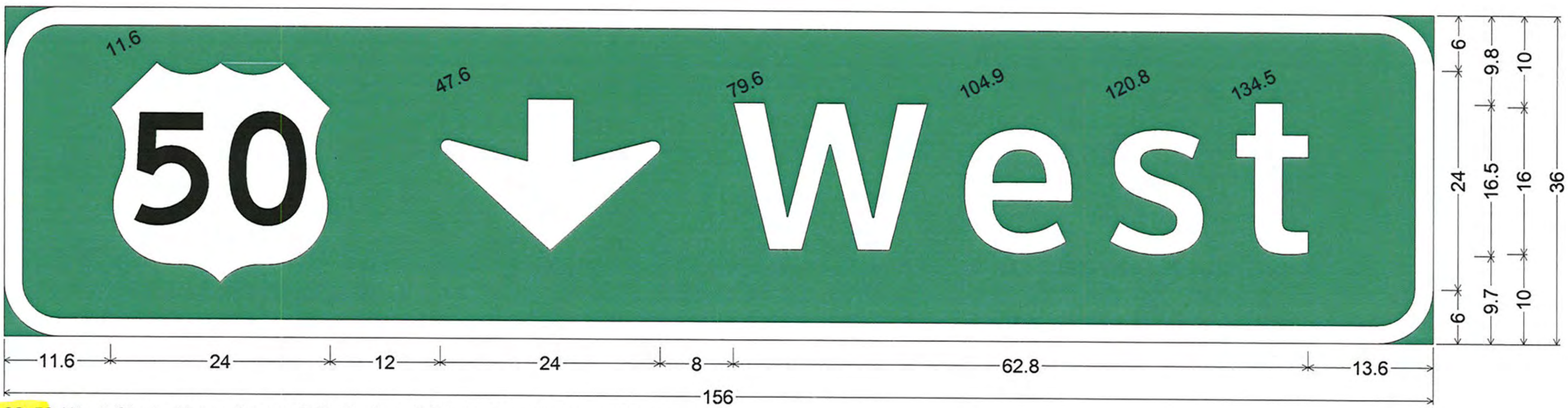
29 River Rd Single Down Arrow; 6.0" Radius, 2.0" Border, White on Green;
"River" ClearviewHwy-5-W; Down Arrow C-2 & C-3 - 16.0" 270°; "Rd" ClearviewHwy-5-W;



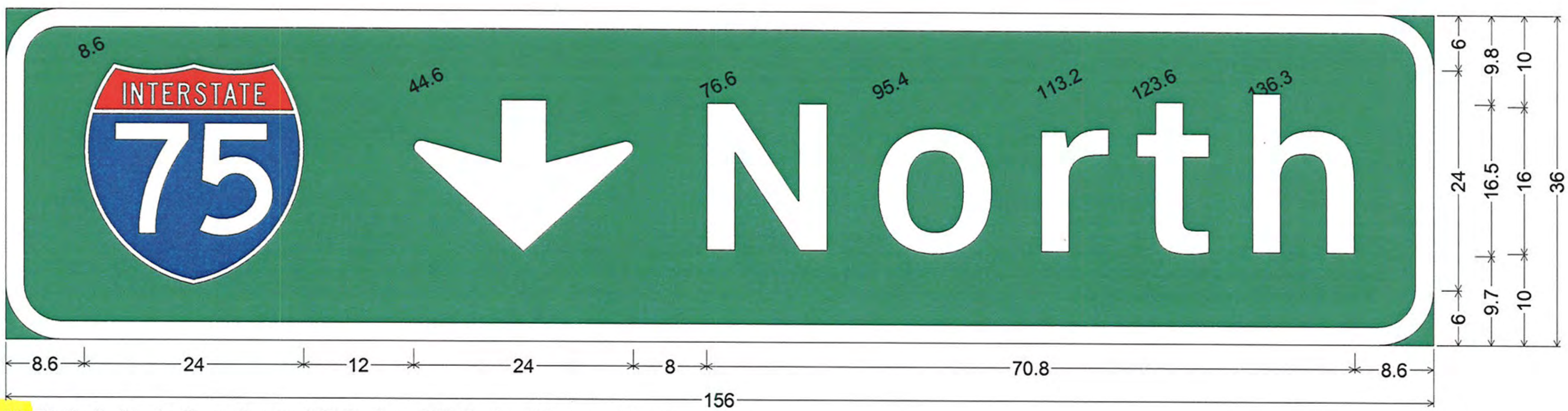
30 Fifth St Single Down Arrow; 6.0" Radius, 2.0" Border, White on Green;
"Fifth" ClearviewHwy-4-W; Down Arrow C-2 & C-3 - 16.0" 270°; "St" ClearviewHwy-4-W;



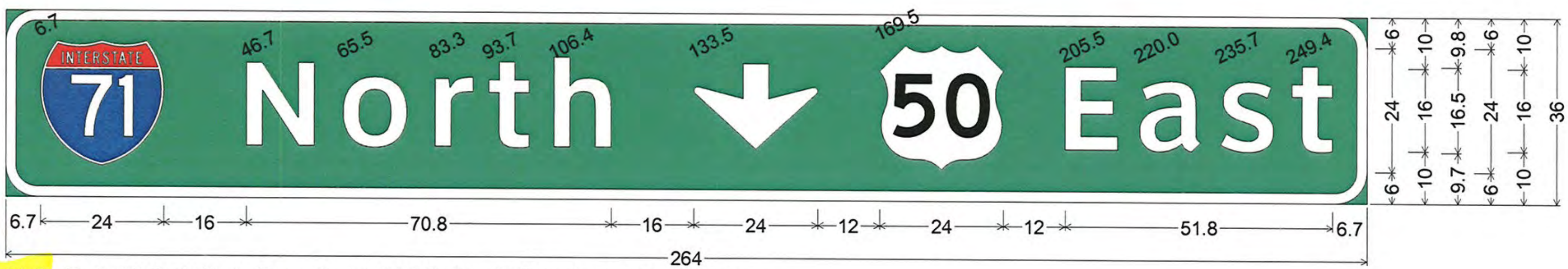
31 Second St Single Down Arrow; 6.0" Radius, 2.0" Border, White on Green;
"Second" ClearviewHwy-5-W; Down Arrow C-2 & C-3 - 16.0" 270°; "St" ClearviewHwy-5-W;



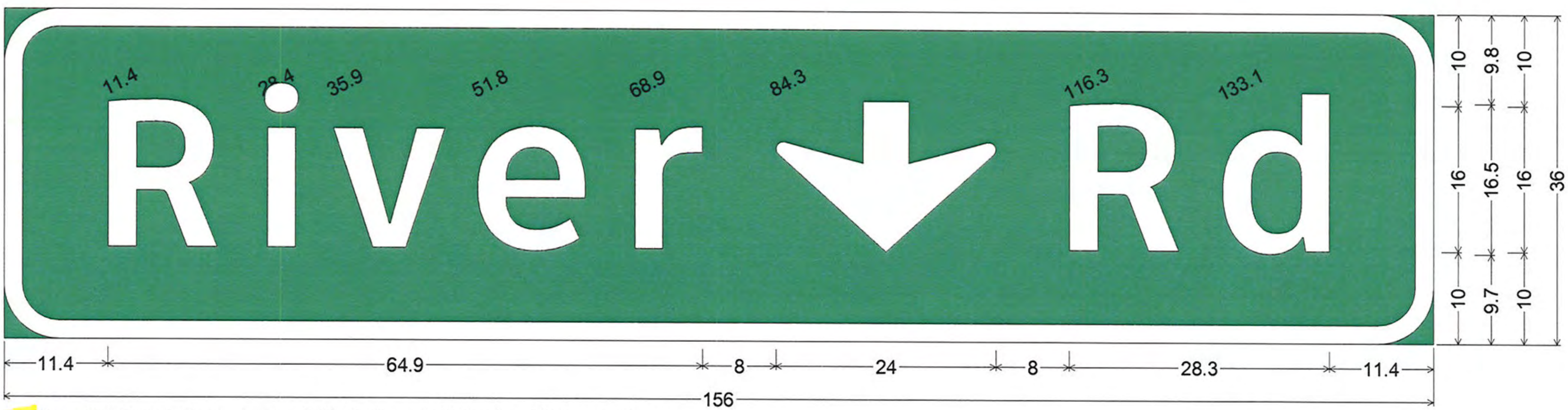
32 50 West Single Down Arrow; 6.0" Radius, 2.0" Border, White on Green;
US 50 M1-4; Down Arrow C-2 & C-3 - 16.0" 270°; "West" ClearviewHwy-5-W;



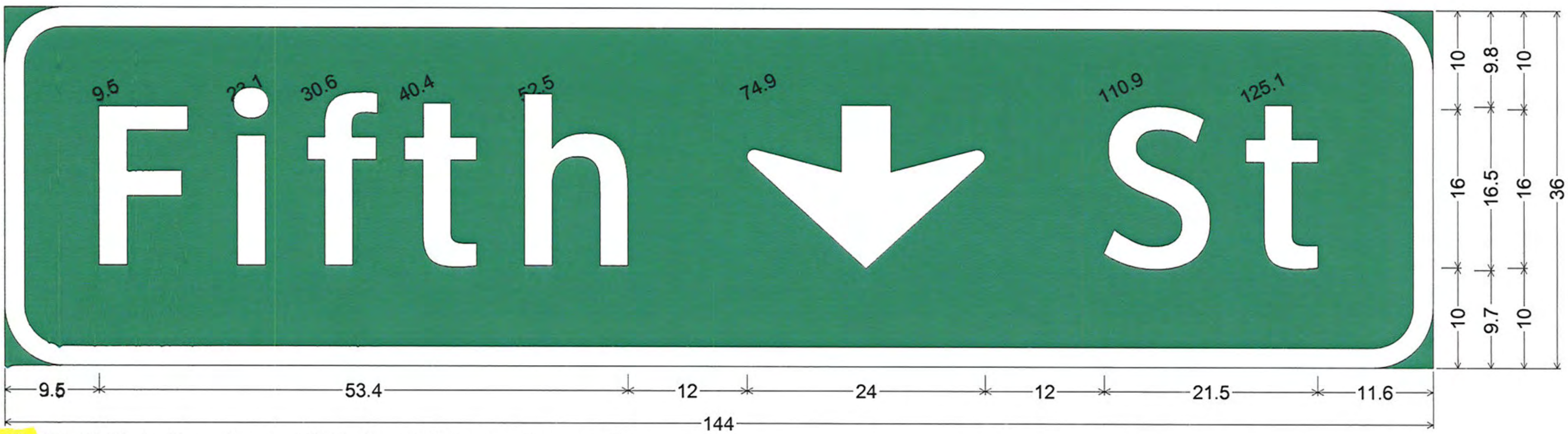
33 75 North Single Down Arrow; 6.0" Radius, 2.0" Border, White on Green;
Interstate 75 M1-1; Down Arrow C-2 & C-3 - 16.0" 270°; "North" ClearviewHwy-5-W;



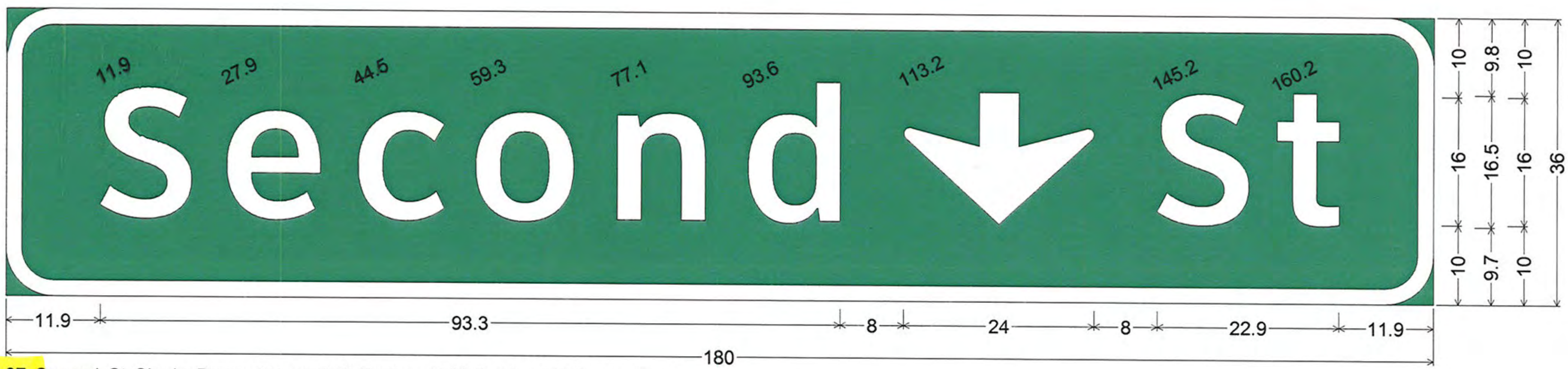
34 71 North 50 East Single Down Arrow; 6.0" Radius, 2.0" Border, White on Green;
Interstate 71 M1-1; "North" ClearviewHwy-5-W; Down Arrow C-2 & C-3 - 16.0" 270°; US 50 M1-4; "East" ClearviewHwy-5-W;



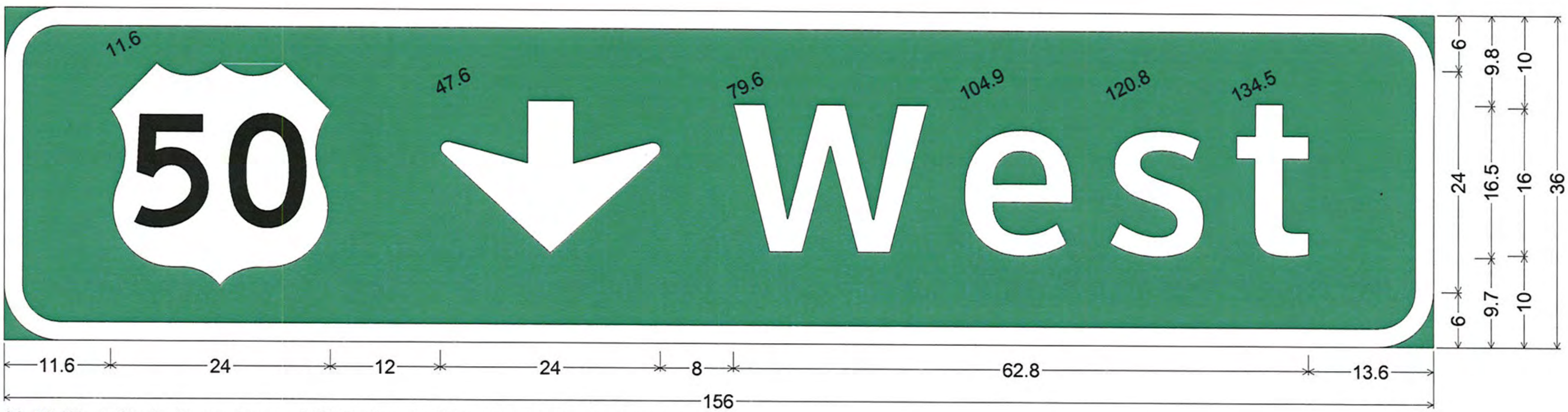
35 River Rd Single Down Arrow; 6.0" Radius, 2.0" Border, White on Green;
"River" ClearviewHwy-5-W; Down Arrow C-2 & C-3 - 16.0" 270°; "Rd" ClearviewHwy-5-W;



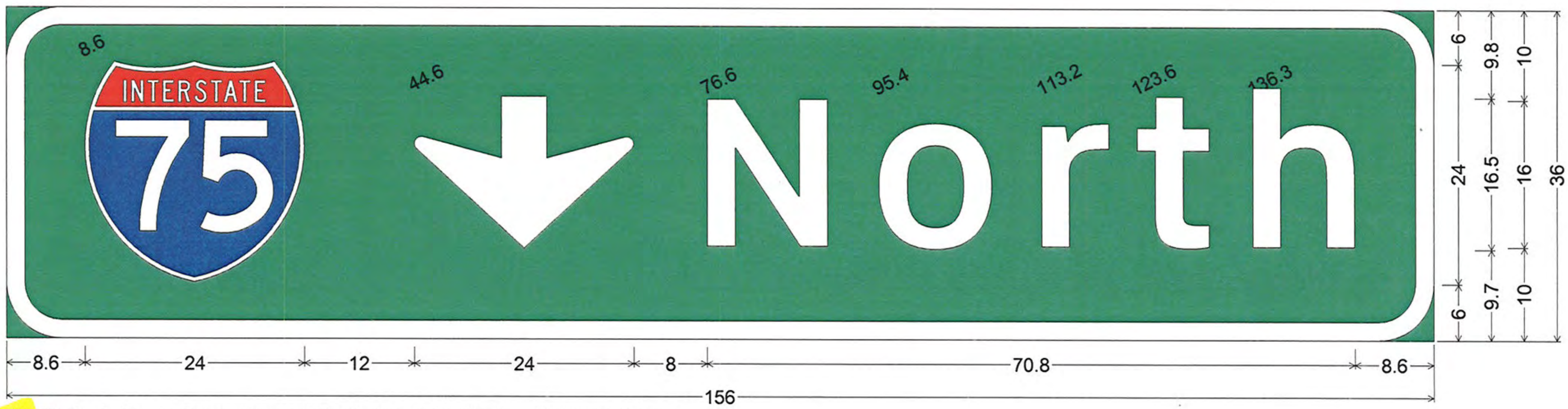
36 Fifth St Single Down Arrow; 6.0" Radius, 2.0" Border, White on Green;
"Fifth" ClearviewHwy-4-W; Down Arrow C-2 & C-3 - 16.0" 270°; "St" ClearviewHwy-4-W;



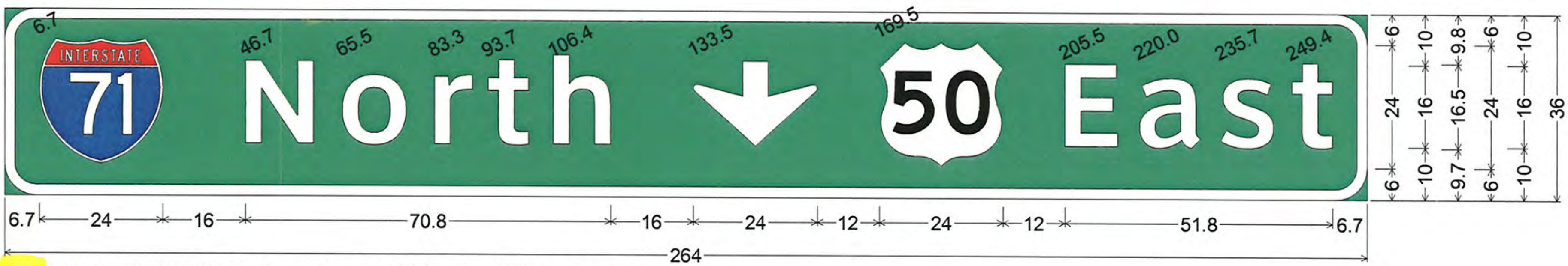
37 Second St Single Down Arrow; 6.0" Radius, 2.0" Border, White on Green;
"Second" ClearviewHwy-5-W; Down Arrow C-2 & C-3 - 16.0" 270°; "St" ClearviewHwy-5-W;



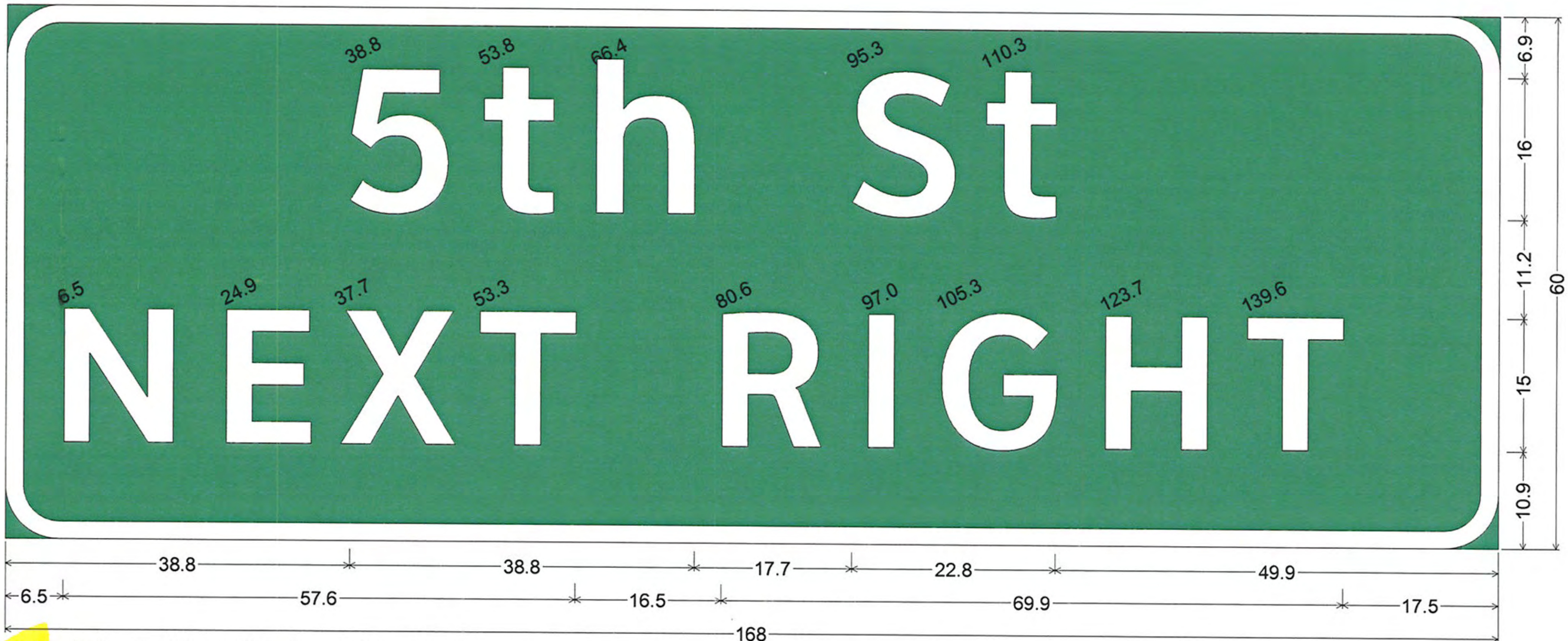
38 50 West Single Down Arrow; 6.0" Radius, 2.0" Border, White on Green;
US 50 M1-4; Down Arrow C-2 & C-3 - 16.0" 270°; "West" ClearviewHwy-5-W;



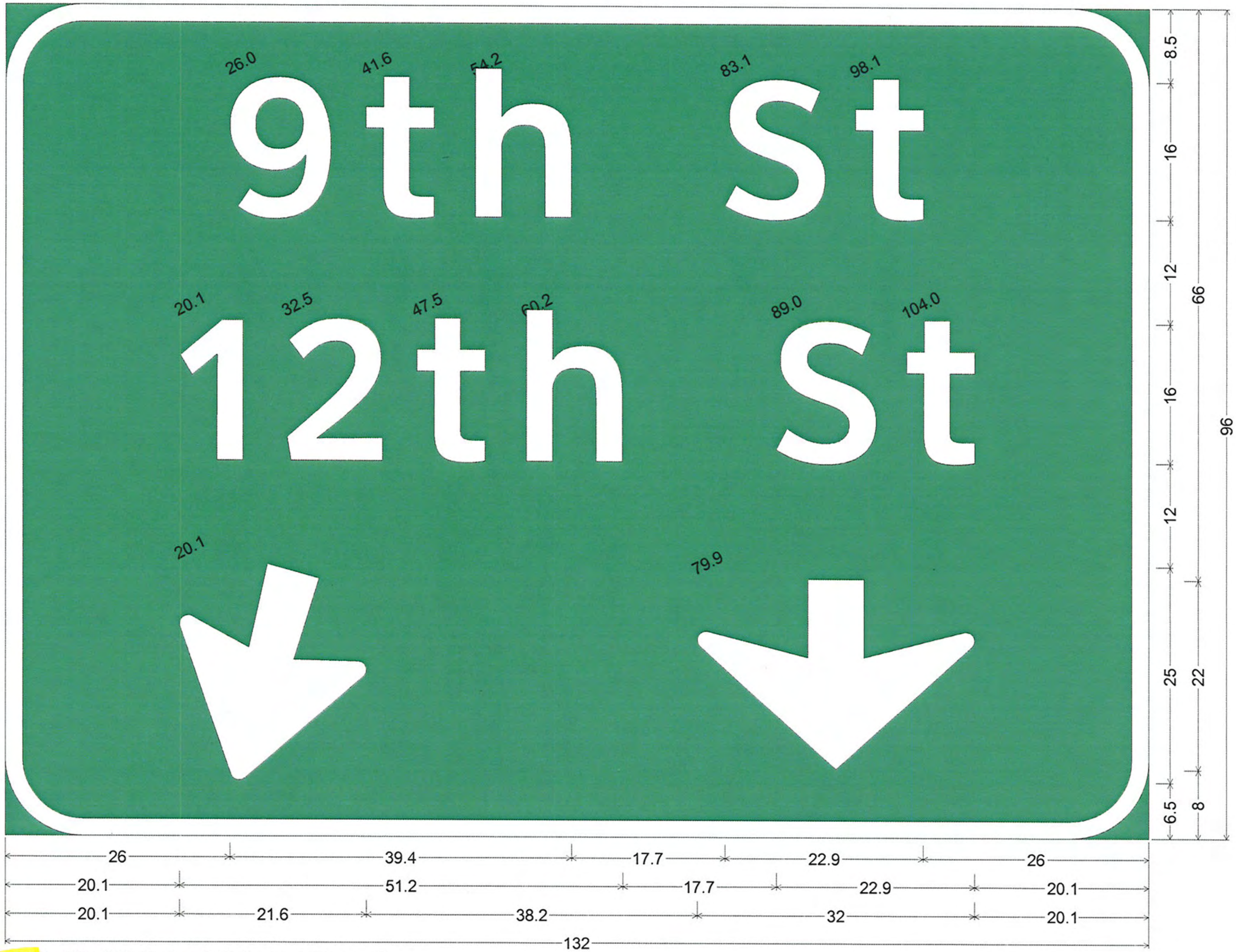
39 75 North Single Down Arrow; 6.0" Radius, 2.0" Border, White on Green;
Interstate 75 M1-1; Down Arrow C-2 & C-3 - 16.0" 270°; “North” ClearviewHwy-5-W;



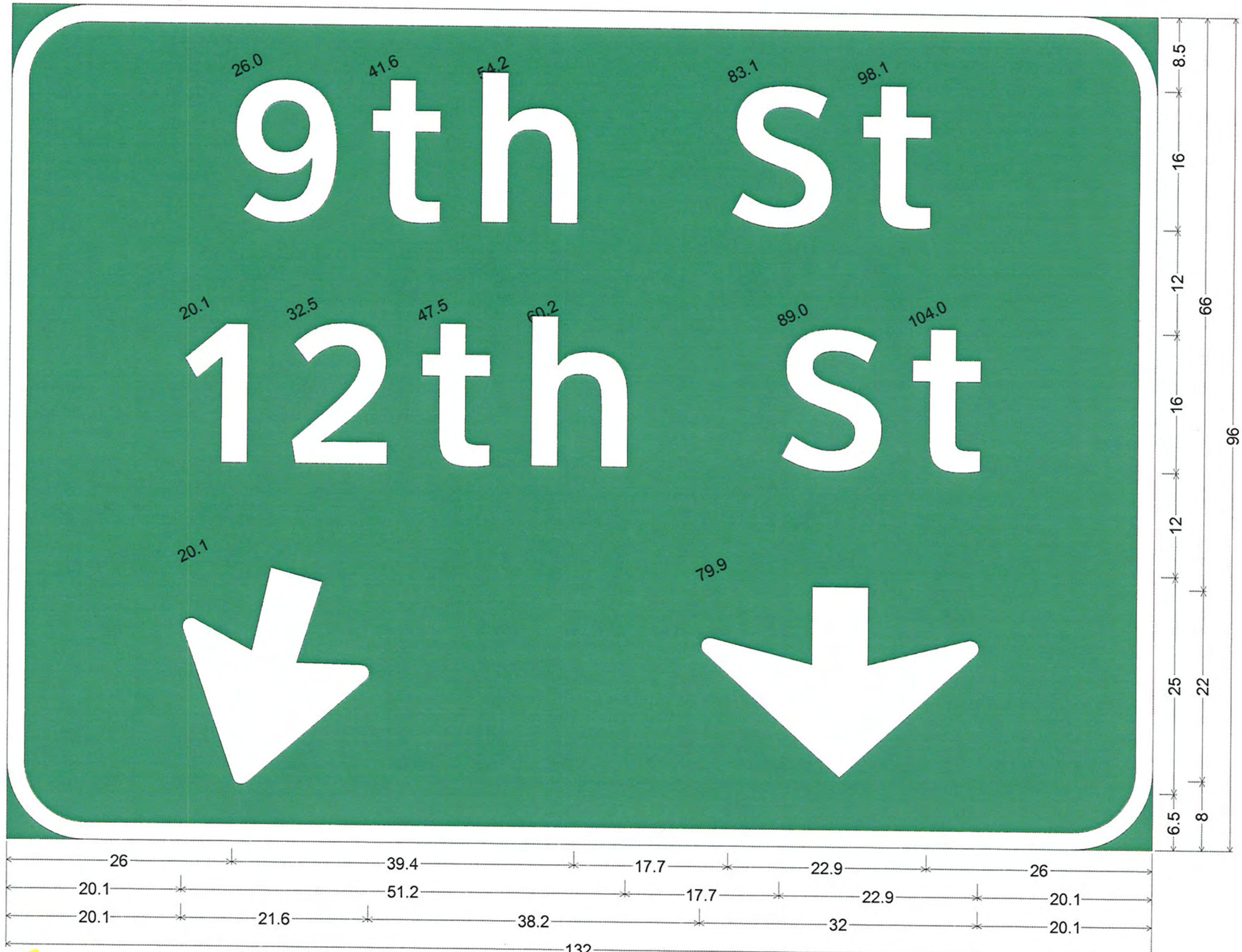
40 71 North 50 East Single Down Arrow; 6.0" Radius, 2.0" Border, White on Green;
Interstate 71 M1-1; "North" ClearviewHwy-5-W; Down Arrow C-2 & C-3 - 16.0" 270°; US 50 M1-4; "East" ClearviewHwy-5-W;



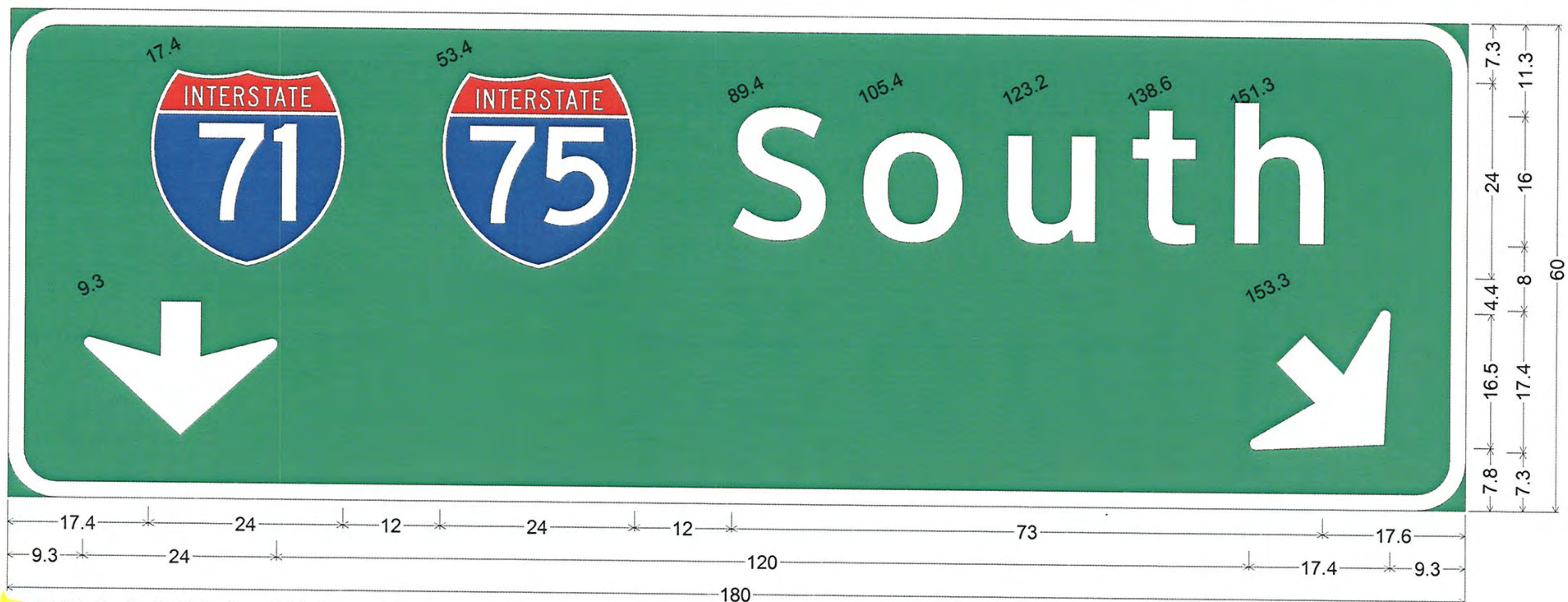
41 5th St Quarter Mile; 6.0" Radius, 2.0" Border, White on Green;
"5th St" ClearviewHwy-5-W; "NEXT RIGHT" ClearviewHwy-5-W;



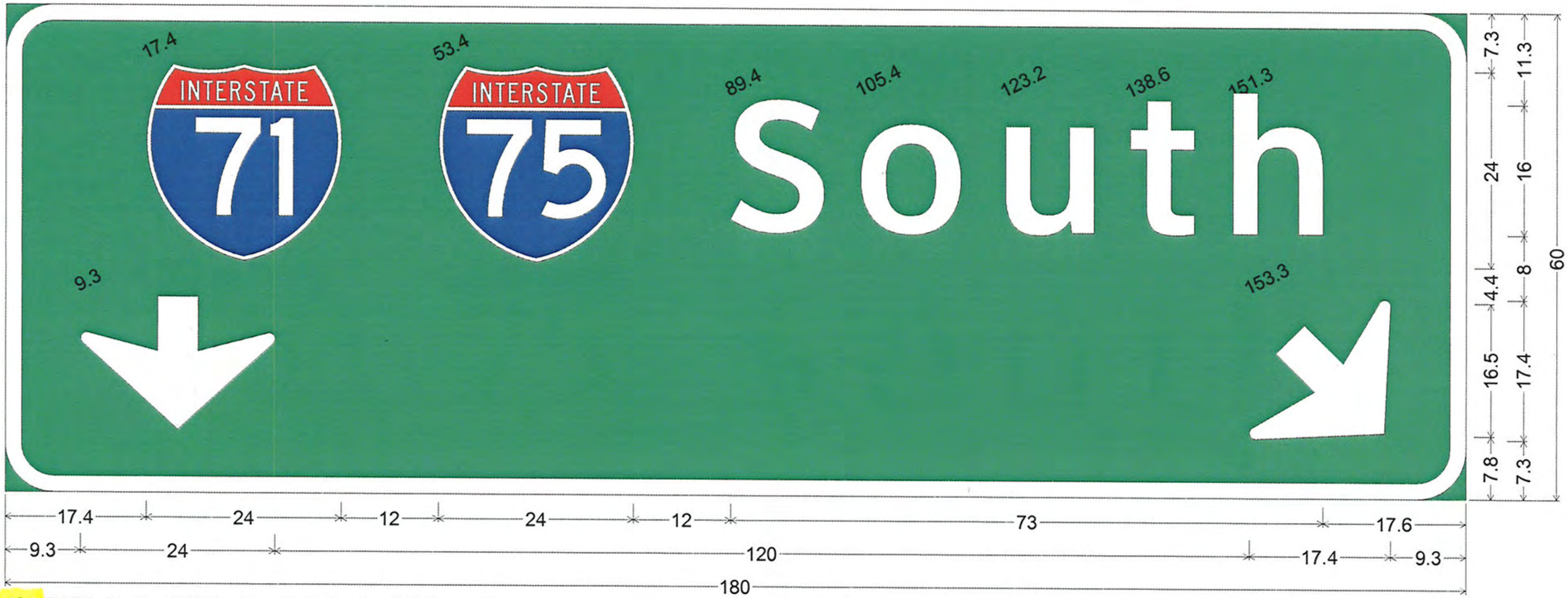
42 9th 12th; 9.0" Radius, 2.0" Border, White on Green;
"9th St" ClearviewHwy-5-W; "12th St" ClearviewHwy-5-W; Arrow B-0 - 25.0" 255°; Down Arrow C-1 - 22.0" 270°;



42A 9th 12th; 9.0" Radius, 2.0" Border, White on Green;
"9th St" ClearviewHwy-5-W; "12th St" ClearviewHwy-5-W; Arrow B-0 - 25.0" 255°; Down Arrow C-1 - 22.0" 270°;



43 71/75 South; 6.0" Radius, 2.0" Border, White on Green;
Interstate 71 M1-1; Interstate 75 M1-1; “South” ClearviewHwy-5-W; Down Arrow C-2 & C-3 - 16.0" 270°; Down Arrow C-2 & C-3 - 16.0" 315°;



43A 71/75 South; 6.0" Radius, 2.0" Border, White on Green;
Interstate 71 M1-1; Interstate 75 M1-1; "South" ClearviewHwy-5-W; Down Arrow C-2 & C-3 - 16.0" 270°; Down Arrow C-2 & C-3 - 16.0" 315°;

46 US50W River Rd Quarter Mile; 12.0" Radius, 2.0" Border, White on Green;
US 50 M1-4; "West" ClearviewHwy-5-W; "River Rd" ClearviewHwy-5-W; "1/4 Mile" ClearviewHwy-5-W;
Down Arrow C-1 - 22.0" 270°;

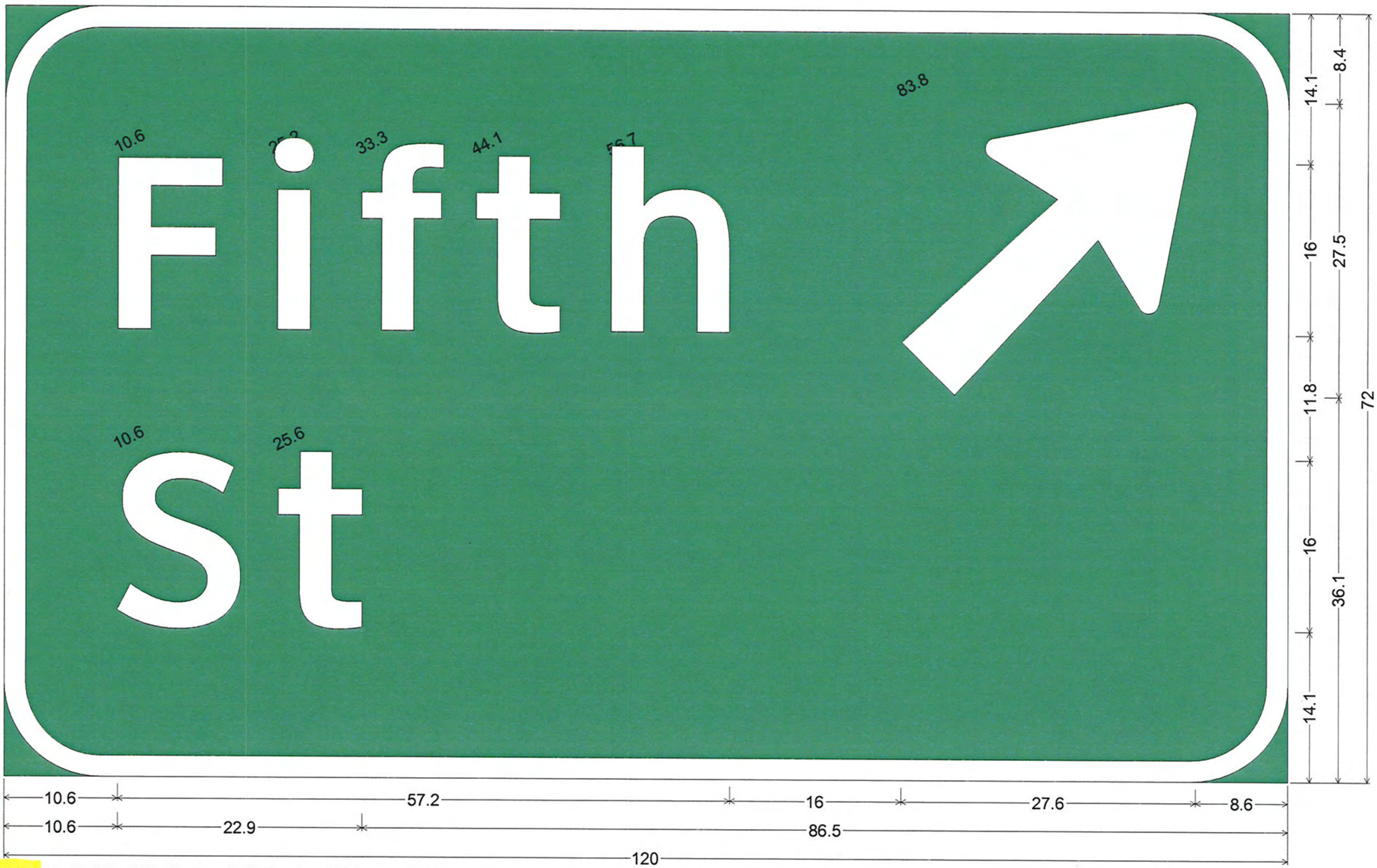
47 71NB Fifth St Quarter Mile; 12.0" Radius, 2.0" Border, White on Green;
Interstate 75 M1-1; “North” ClearviewHwy-5-W; “Fifth St” ClearviewHwy-5-W; “1/4 MILE” ClearviewHwy-5-W;
Down Arrow C-1 - 22.0" 270°;

48 71NB 50EB Second St Gore; 12.0" Radius, 2.0" Border, White on Green;

"North" ClearviewHwy-5-W; "East" ClearviewHwy-5-W; Interstate 71 M1-1; US 50 M1-4; "Second St" ClearviewHwy-5-W; Arrow A-1 - 35.0" 45°;

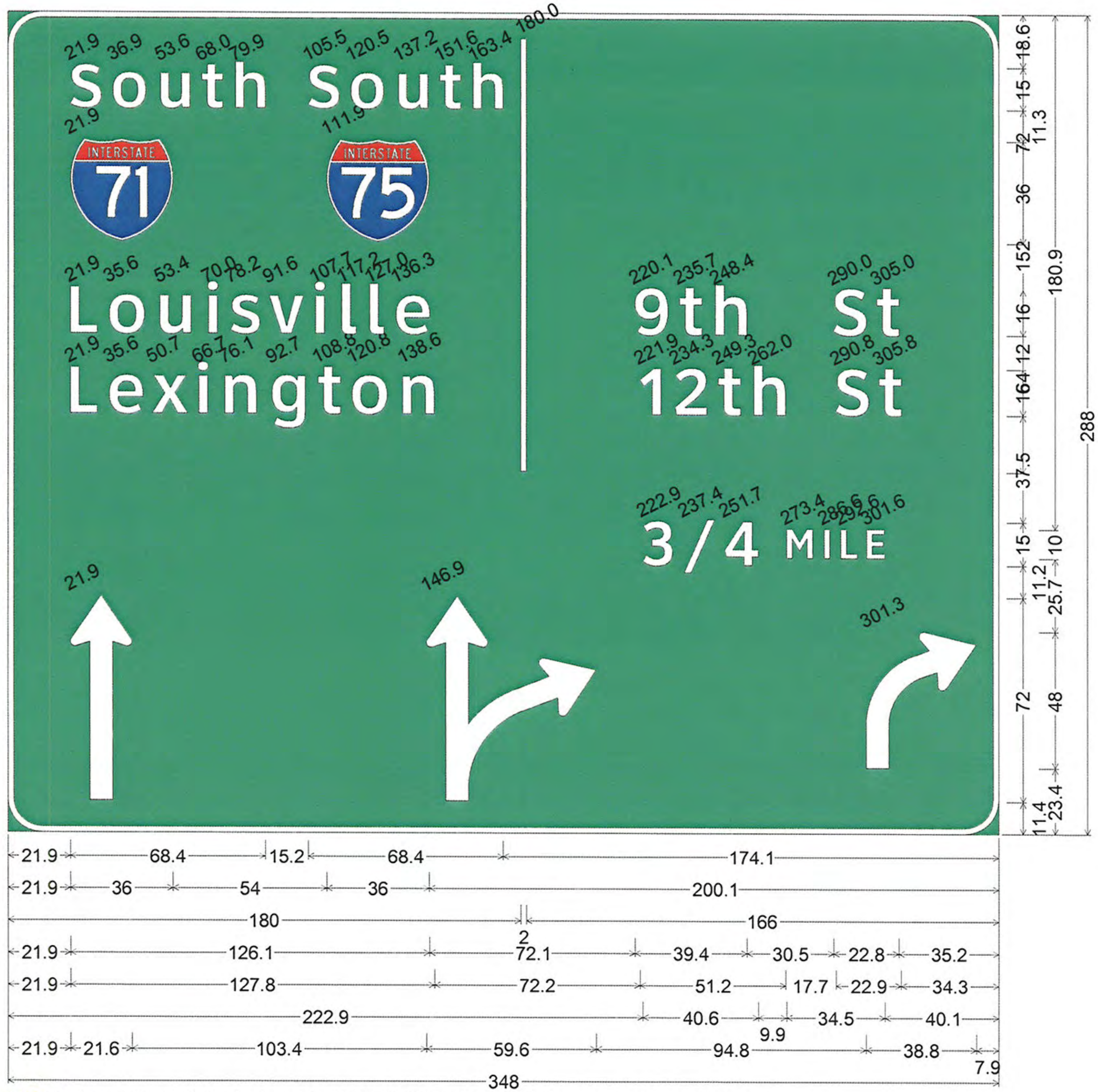
49 US50W River Rd SingleDownArrow; 12.0" Radius, 2.0" Border, White on Green;
US 50 M1-4; "West" ClearviewHwy-5-W; "River Rd" ClearviewHwy-5-W; Down Arrow C-1 - 22.0" 270°;

50 75NB Dayton Single Down Arrow; 12.0" Radius, 2.0" Border, White on Green;
Interstate 75 M1-1; "North" ClearviewHwy-5-W; "Dayton" ClearviewHwy-5-W; Down Arrow C-1 - 22.0" 270°;



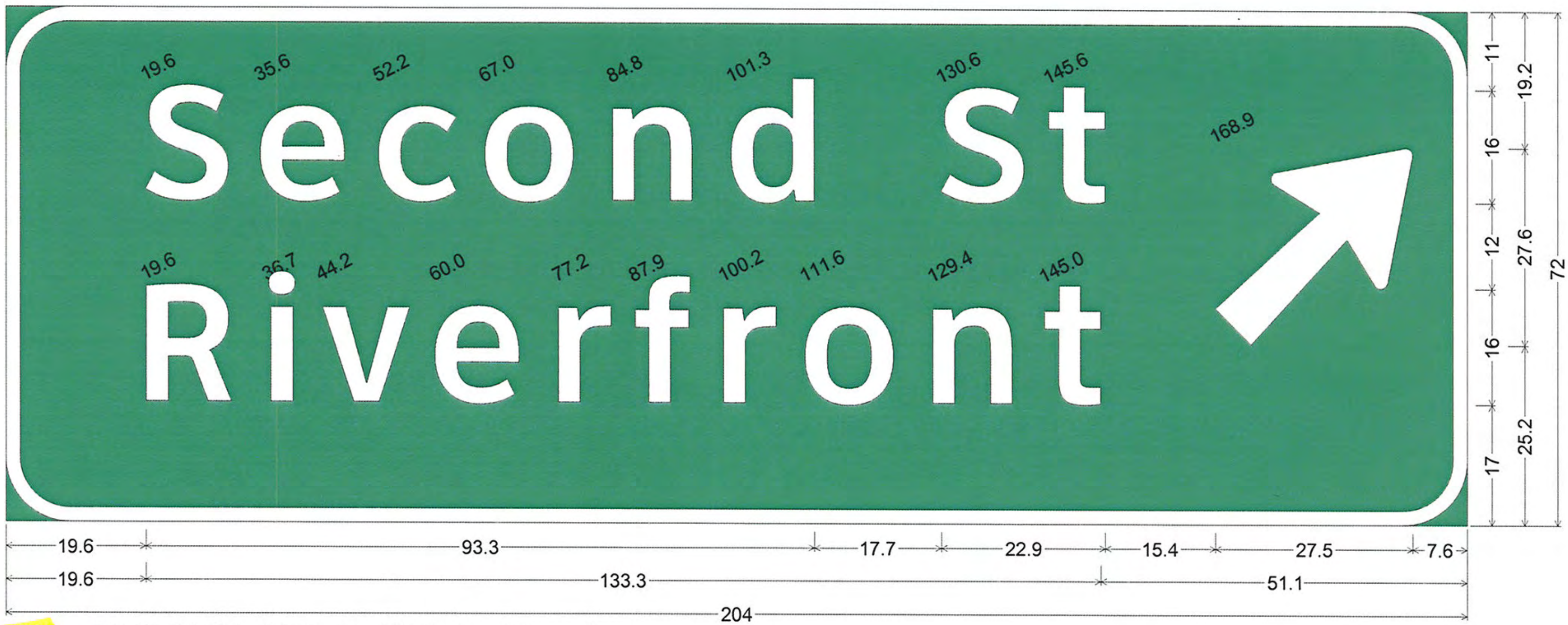
51 Fifth St NB; 9.0" Radius, 2.0" Border, White on Green;
"Fifth" ClearviewHwy-5-W; Arrow A-1 - 35.0" 45°; "St" ClearviewHwy-5-W;

52 5th St Half Mile; 9.0" Radius, 2.0" Border, White on Green;
"5th St" ClearviewHwy-5-W; "1/2" ClearviewHwy-5-W; "MILE" ClearviewHwy-5-W;



53 71S Louisville 75S Lexington 9th 12th; 12.0" Radius, 2.0" Border, White on Green;
"South" ClearviewHwy-5-W; "South" ClearviewHwy-5-W; Interstate 71 M1-1; Interstate 75 M1-1;
"Louisville" ClearviewHwy-5-W; "9th St" ClearviewHwy-5-W; "Lexington" ClearviewHwy-5-W;
"12th St" ClearviewHwy-5-W; " " ClearviewHwy-5-W; " 3/4 MILE" ClearviewHwy-5-W;
Standard Arrow Custom 72.0" X 21.6" 90°; through Turn arrow; turn arrow1;

54 71NB 50EB Columbus; 12.0" Radius, 2.0" Border, White on Green;
"North" ClearviewHwy-5-W; "East" ClearviewHwy-5-W; Interstate 71 M1-1; US 50 M1-4; "Columbus" ClearviewHwy-5-W; Down Arrow C-1 - 22.0" 270°;



55 Second St NB Exit Only; 9.0" Radius, 2.0" Border, White on Green;
"Second St" ClearviewHwy-5-W; "Riverfront" ClearviewHwy-5-W; Arrow A-1 - 35.0" 45°;

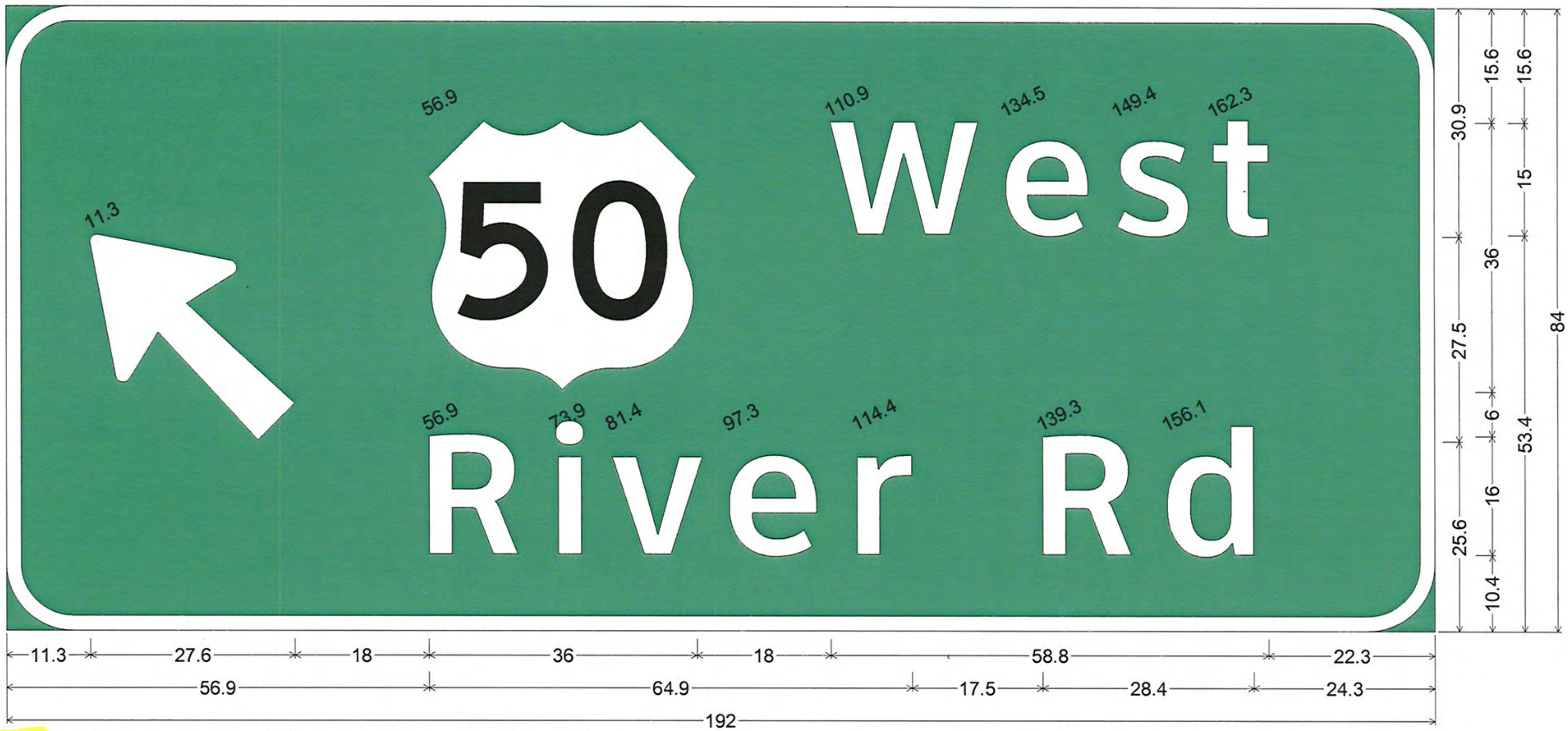
56 71S_Louisville; 12.0" Radius, 2.0" Border, White on Green;
Interstate 71 M1-1; Interstate 75 M1-1; “South” ClearviewHwy-5-W; “Louisville” ClearviewHwy-5-W; “Lexington” ClearviewHwy-5-W;
Down Arrow C-1 - 22.0" 270°; Down Arrow C-1 - 22.0" 270°;

56A US50WB Only; 9.0" Radius, 2.0" Border, White on Green;
US 50 M1-4; "West" ClearviewHwy-5-W; "River Rd" ClearviewHwy-5-W;
6.0" Radius, 2.0" Border, Black on Yellow;
"ONLY" ClearviewHwy-5-W; Down Arrow C-1 - 22.0" 270°;

56B 75NB Dayton Only; 9.0" Radius, 2.0" Border, White on Green;
Interstate 75 M1-1; "North" ClearviewHwy-5-W; "Dayton" ClearviewHwy-5-W;
6.0" Radius, 2.0" Border, Black on Yellow;
"ONLY" ClearviewHwy-5-W; Down Arrow C-1 - 22.0" 270°;

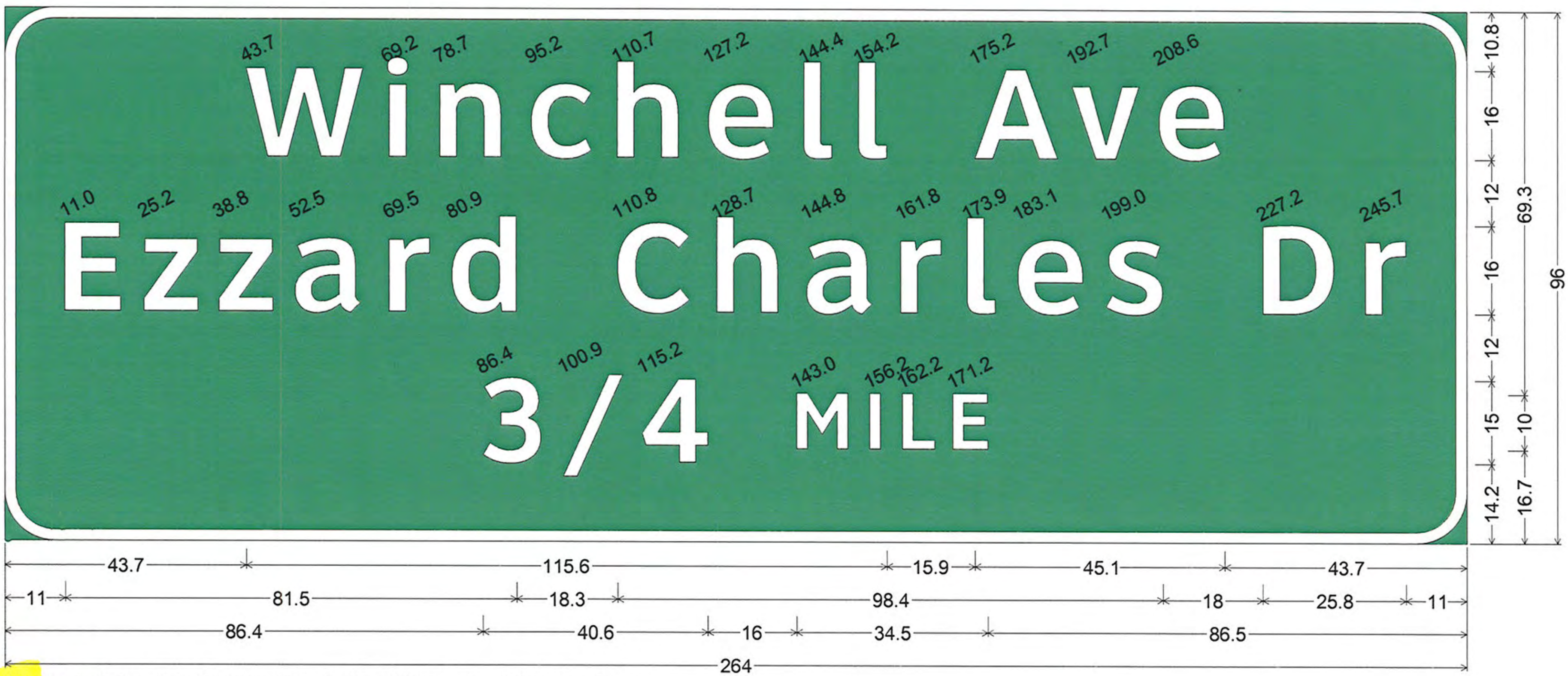
3.0" Radius, 2.0" Border, White on Green;
"EXIT" ClearviewHwy-5-W; "1" ClearviewHwy-5-W;
57 DowntownCovingtion Gore; 6.0" Radius, 2.0" Border, White on Green;
"Downtown" ClearviewHwy-5-W; "Covington" ClearviewHwy-5-W; Arrow A-1 - 35.0" 45°;

3.0" Radius, 2.0" Border, White on Green;
"EXIT" ClearviewHwy-5-W; "1" ClearviewHwy-5-W;
57A DowntownCovingtion QTR Mile; 9.0" Radius, 2.0" Border, White on Green;
"Downtown" ClearviewHwy-5-W; "Covington" ClearviewHwy-5-W; "1/4 MILE" ClearviewHwy-5-W;

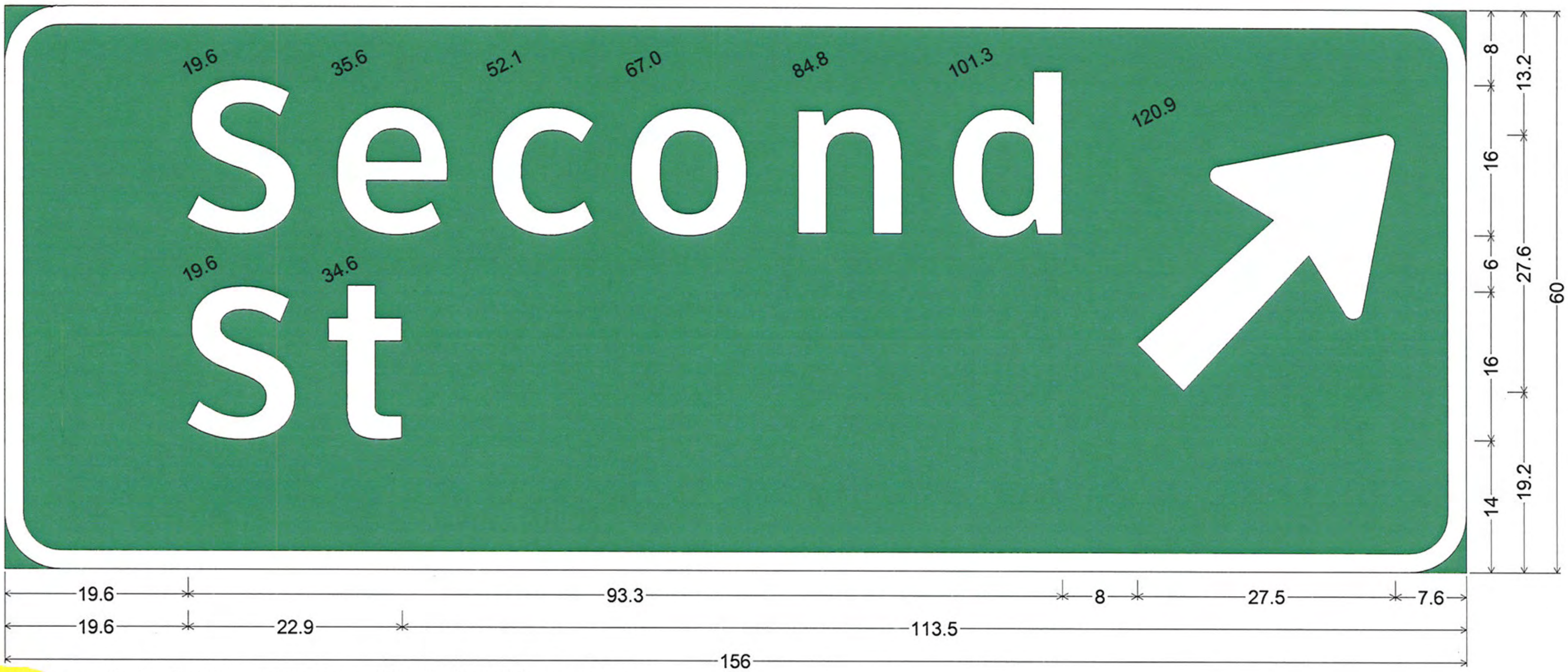


58 US50WB Gore Exit Only; 9.0" Radius, 2.0" Border, White on Green;
Arrow A-1 - 35.0" 135°; US 50 M1-4; "West" ClearviewHwy-5-W; "River Rd" ClearviewHwy-5-W;

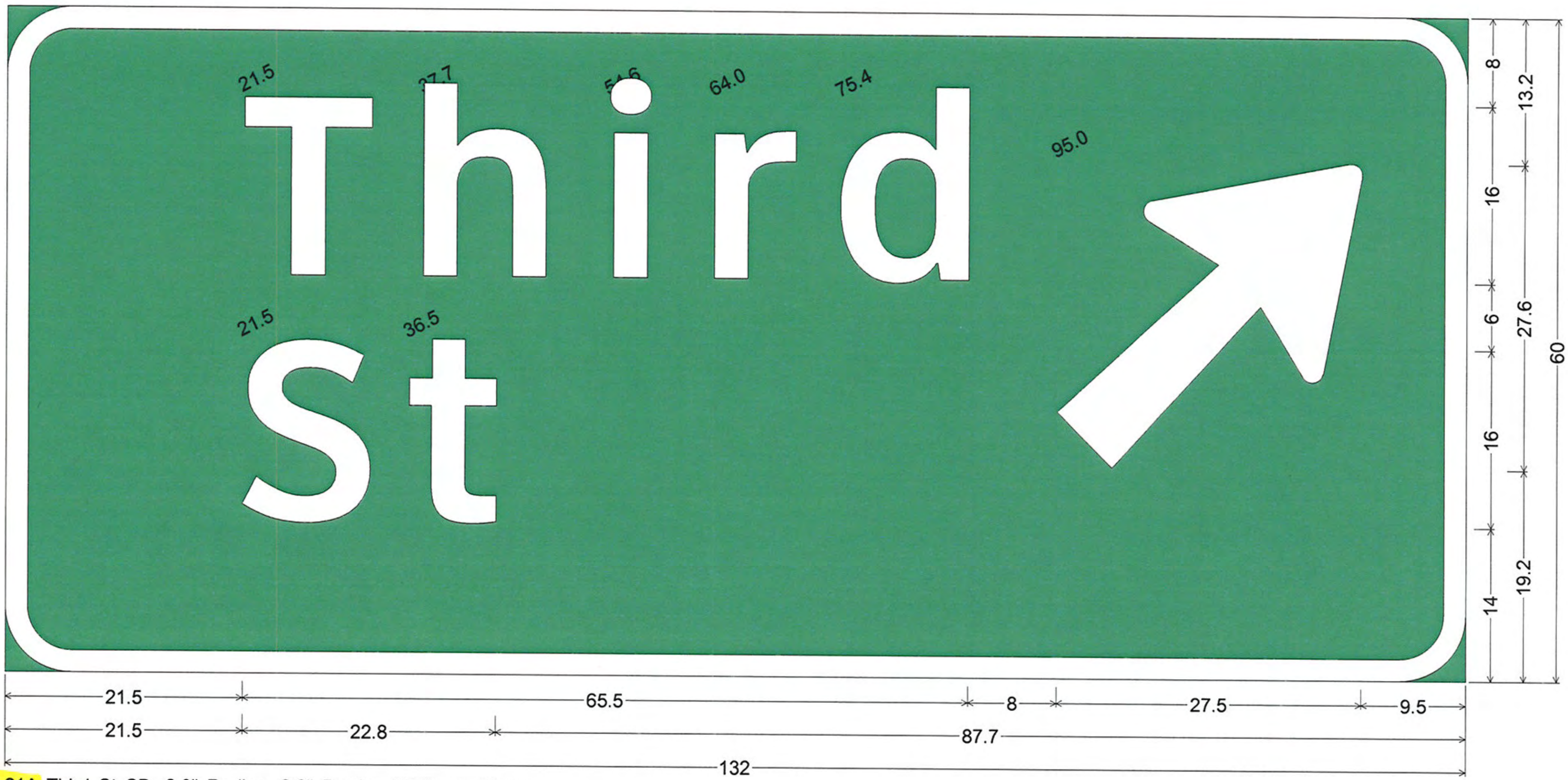
59 71NB 50EB Second St; 12.0" Radius, 2.0" Border, White on Green;
Interstate 75 M1-1; "North" ClearviewHwy-5-W; "Dayton" ClearviewHwy-5-W; Down Arrow C-1 - 22.0" 270°;



60 Winchell Ave 3 QTR Mile; 9.0" Radius, 2.0" Border, White on Green;
"Winchell Ave" ClearviewHwy-5-W; "Ezzard Charles Dr" ClearviewHwy-5-W; "3/4" ClearviewHwy-5-W; "MILE" ClearviewHwy-5-W;

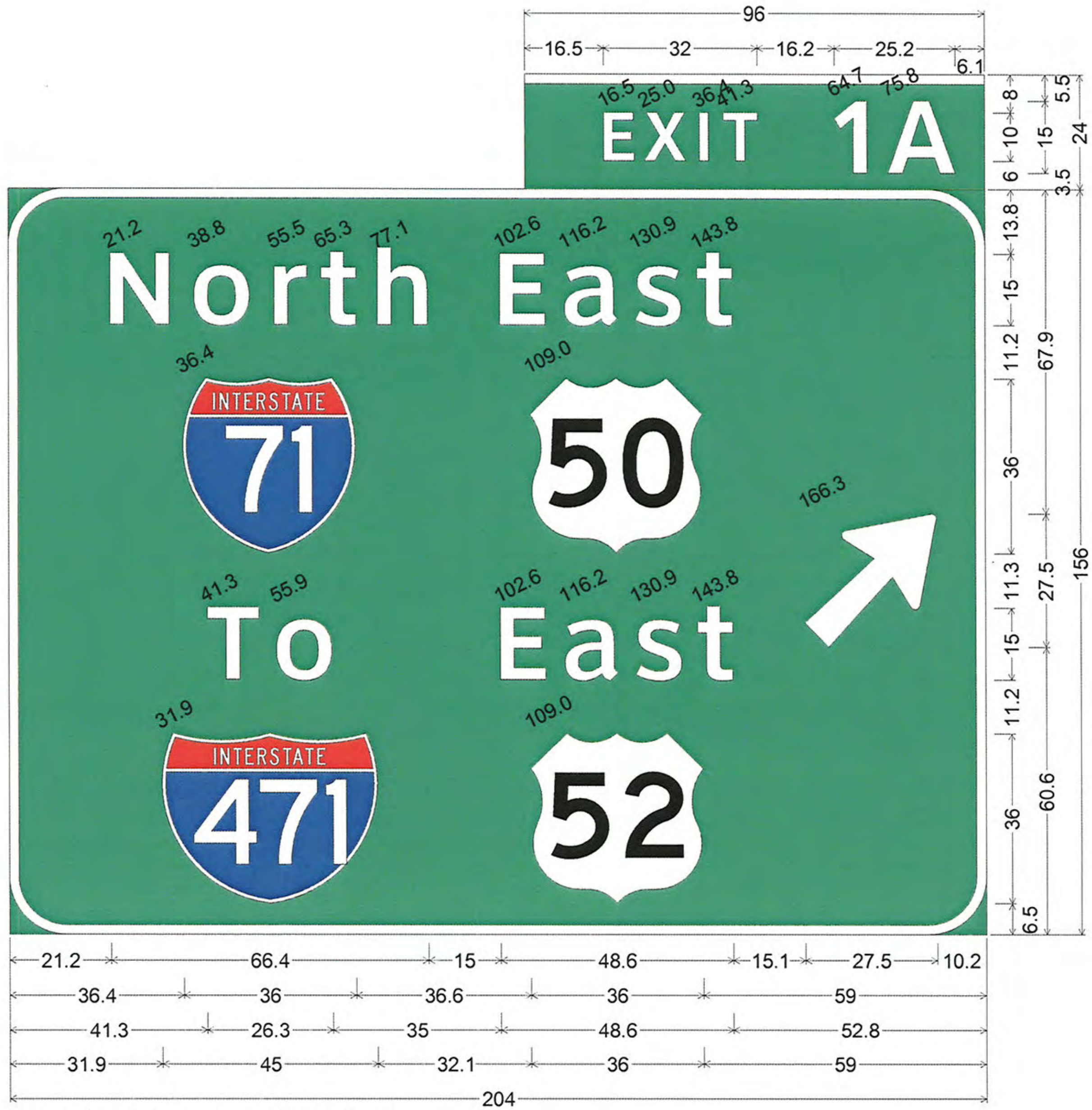


61 Second St SB Exit Only; 6.0" Radius, 2.0" Border, White on Green;
"Second" ClearviewHwy-5-W; "St" ClearviewHwy-5-W; Arrow A-1 - 35.0" 45°;

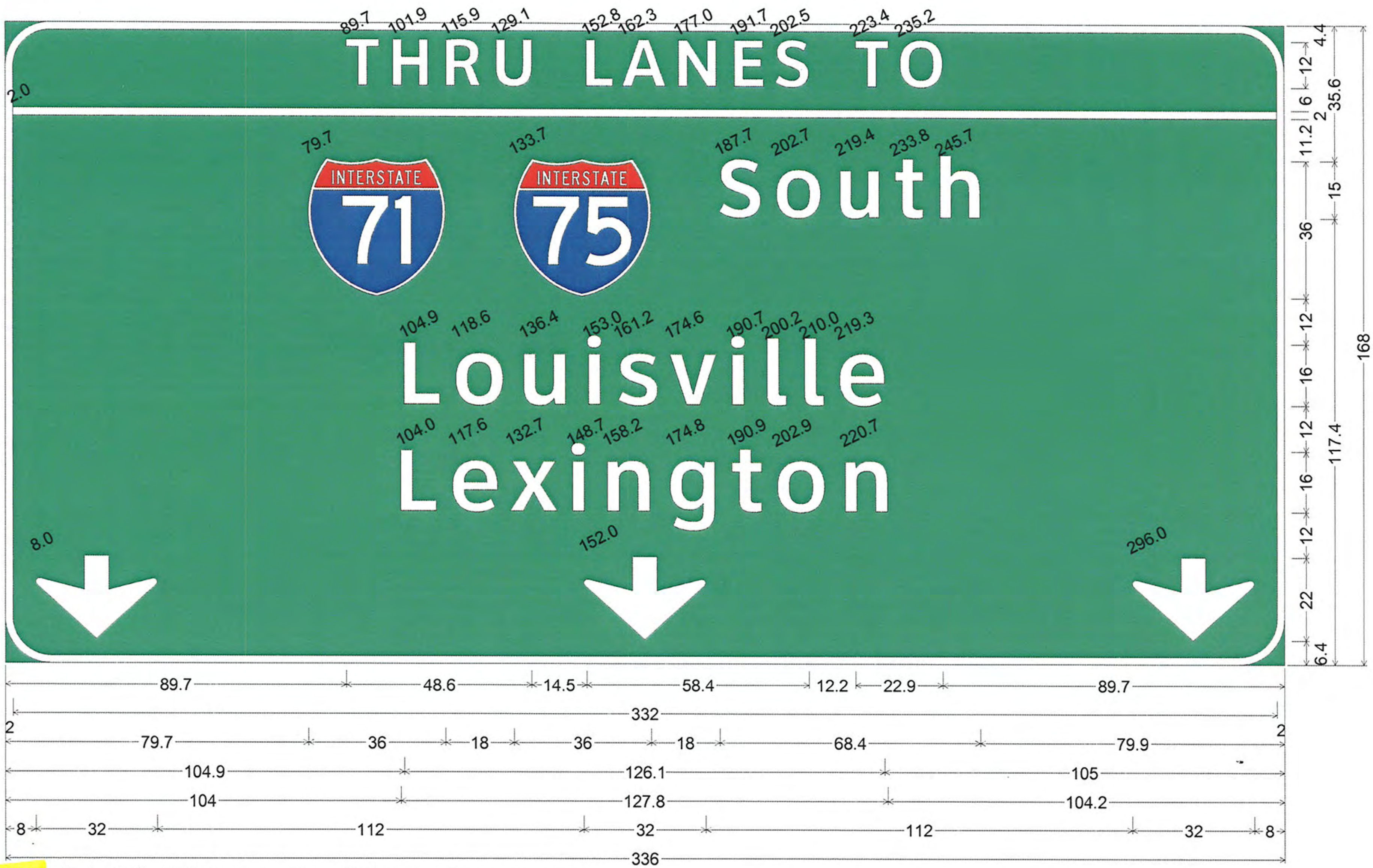


61A Third St SB; 6.0" Radius, 2.0" Border, White on Green;
"Third" ClearviewHwy-5-W; "St" ClearviewHwy-5-W; Arrow A-1 - 35.0" 45°;

62 71NB_50EB_Columbus; 12.0" Radius, 2.0" Border, White on Green; "North" ClearviewHwy-5-W; Interstate 75 M1-1; "To" ClearviewHwy-5-W; Interstate 471 M1-1; "East" ClearviewHwy-5-W; US 50 M1-4; "East" ClearviewHwy-5-W; US 52 M1-4; Down Arrow C-1 - 22.0" 270°;

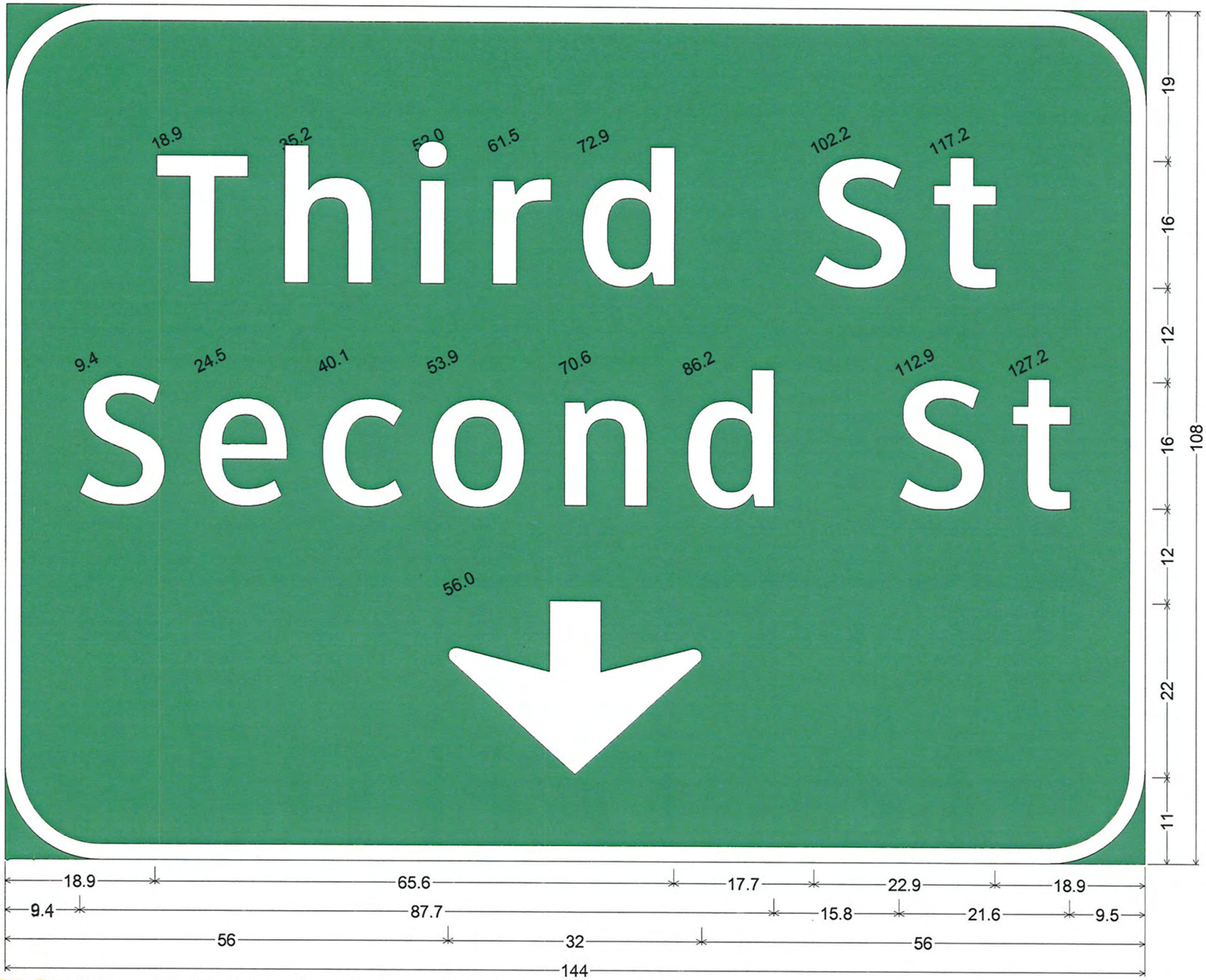


3.0" Radius, 2.0" Border, White on Green;
"EXIT" ClearviewHwy-5-W; "1A" ClearviewHwy-5-W;
63 71NB 50EB Gore; 12.0" Radius, 2.0" Border, White on Green;
"North" ClearviewHwy-5-W; Interstate 71 M1-1; "To" ClearviewHwy-5-W; Interstate 471 M1-1;
"East" ClearviewHwy-5-W; US 50 M1-4; "East" ClearviewHwy-5-W; US 52 M1-4; Arrow A-0 - 35.0" 45°;



64 71 SB Louisville 75SB Lexington Thru; 12.0" Radius, 2.0" Border, White on Green;
"THRU LANES TO" ClearviewHwy-5-W; Interstate 71 M1-1; Interstate 75 M1-1; "South" ClearviewHwy-5-W; "Louisville" ClearviewHwy-5-W;
"Lexington" ClearviewHwy-5-W; Down Arrow C-1 - 22.0" 270°; Down Arrow C-1 - 22.0" 270°; Down Arrow C-1 - 22.0" 270°;

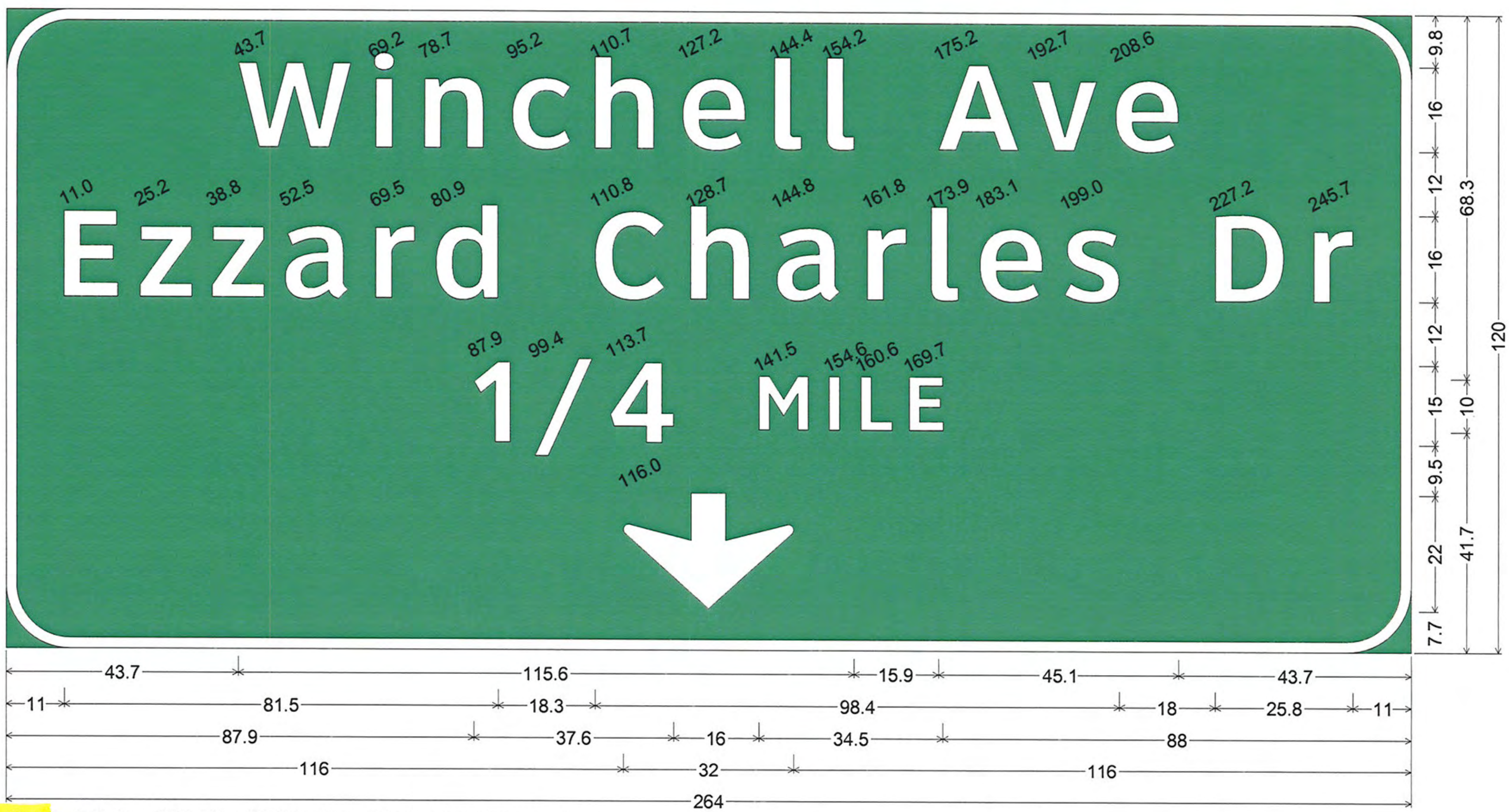
65 Downtown Exits Covington; 12.0" Radius, 2.0" Border, White on Green;
"DOWNTOWN" ClearviewHwy-5-W; "EXITS" ClearviewHwy-5-W; "Covington" ClearviewHwy-4-W;
Down Arrow C-1 - 22.0" 270°;



66 Third St Second St SB; 12.0" Radius, 2.0" Border, White on Green;
"Third St" ClearviewHwy-5-W; "Second St" ClearviewHwy-4-W; Down Arrow C-1 - 22.0" 270°;

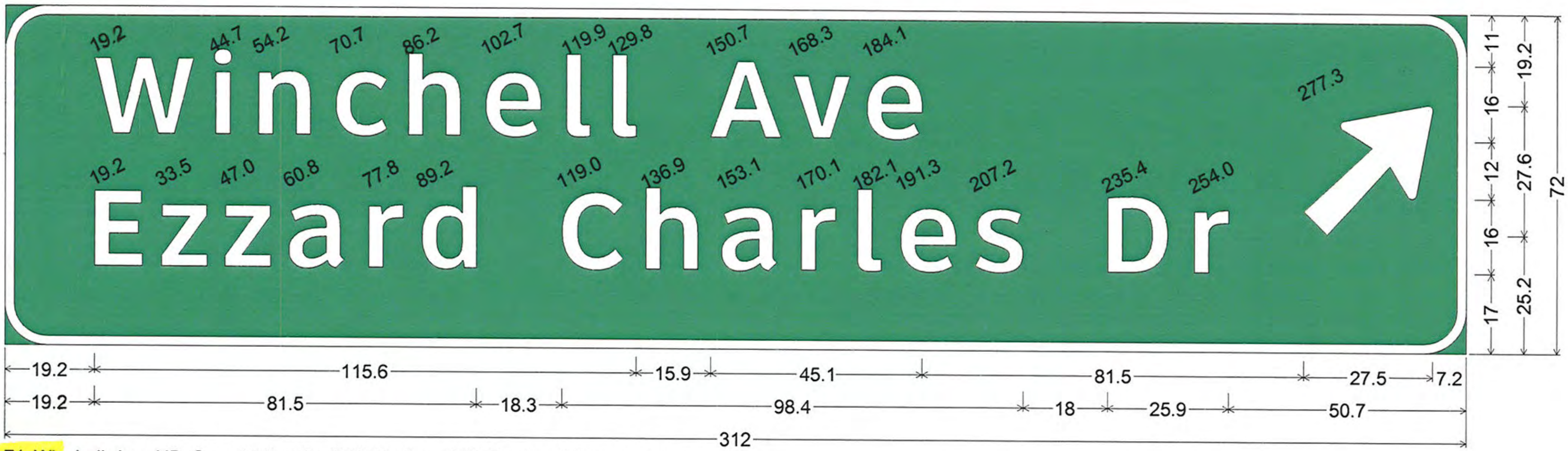
67 Fifth St SB Exit Only; 9.0" Radius, 2.0" Border, White on Green;
Arrow A-1 - 35.0" 135°; "Fifth" ClearviewHwy-5-W; "St" ClearviewHwy-5-W;

68 71NB_Dayton_Dual Down Arrow; 12.0" Radius, 2.0" Border, White on Green;
Interstate 75 M1-1; "North" ClearviewHwy-5-W; "Dayton" ClearviewHwy-5-W; Down Arrow C-1 - 22.0" 270°; Down Arrow C-1 - 22.0" 270°;



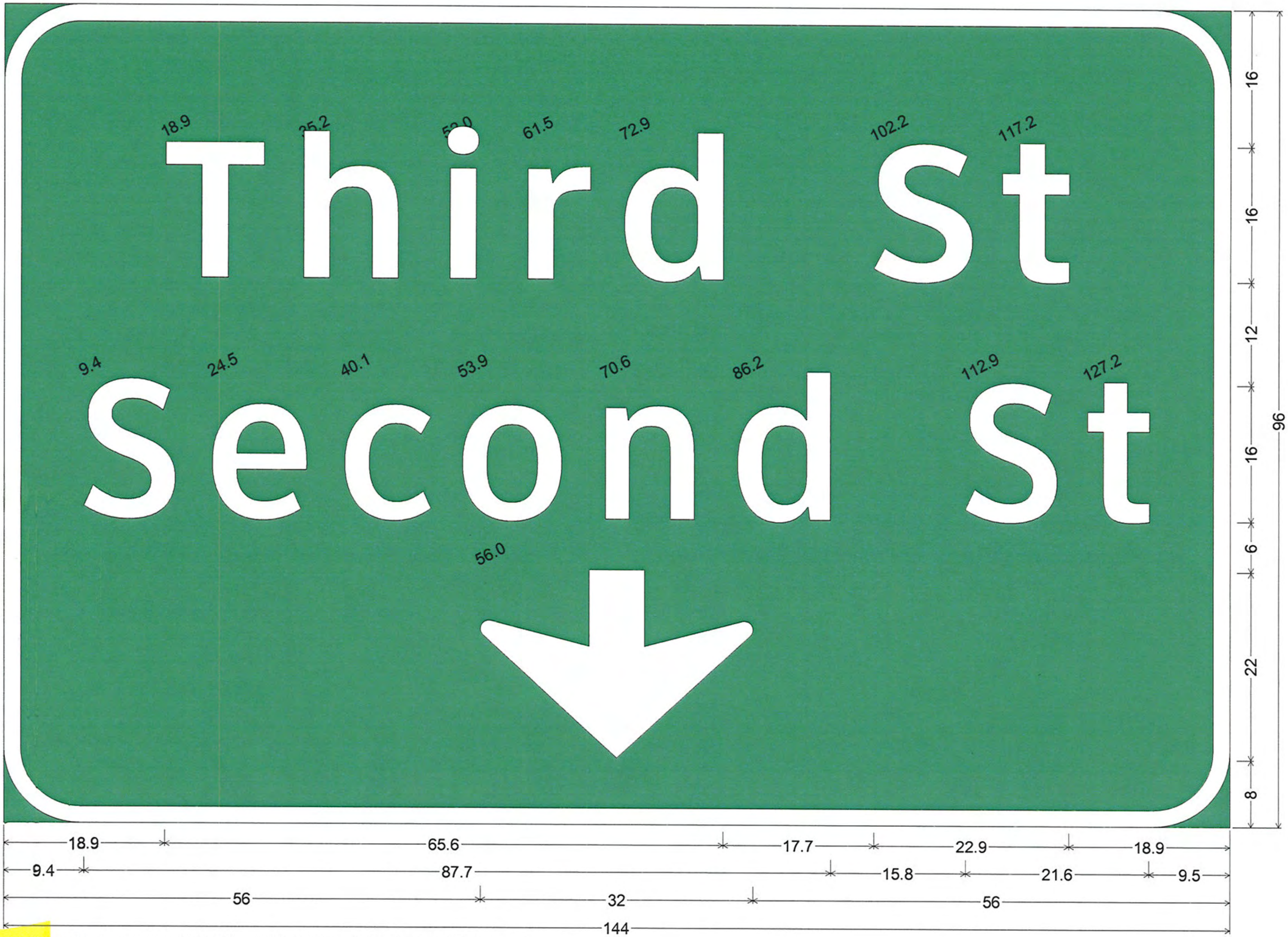
69 Winchell Ave QTR Mile; 12.0" Radius, 2.0" Border, White on Green;
"Winchell Ave" ClearviewHwy-5-W; "Ezzard Charles Dr" ClearviewHwy-5-W; "1/4" ClearviewHwy-5-W; "MILE" ClearviewHwy-5-W; Down Arrow C-1 - 22.0" 270°;

70 71NB_Dayton_Dual Down Arrow; 12.0" Radius, 2.0" Border, White on Green;
Interstate 75 M1-1; “North” ClearviewHwy-5-W; “Dayton” ClearviewHwy-5-W; Down Arrow C-1 - 22.0" 270°; Down Arrow C-1 - 22.0" 270°;



71 Winchell Ave NB Gore Exit only; 9.0" Radius, 2.0" Border, White on Green;
"Winchell Ave" ClearviewHwy-5-W; "Ezzard Charles Dr" ClearviewHwy-5-W; Arrow A-1 - 35.0" 45°;

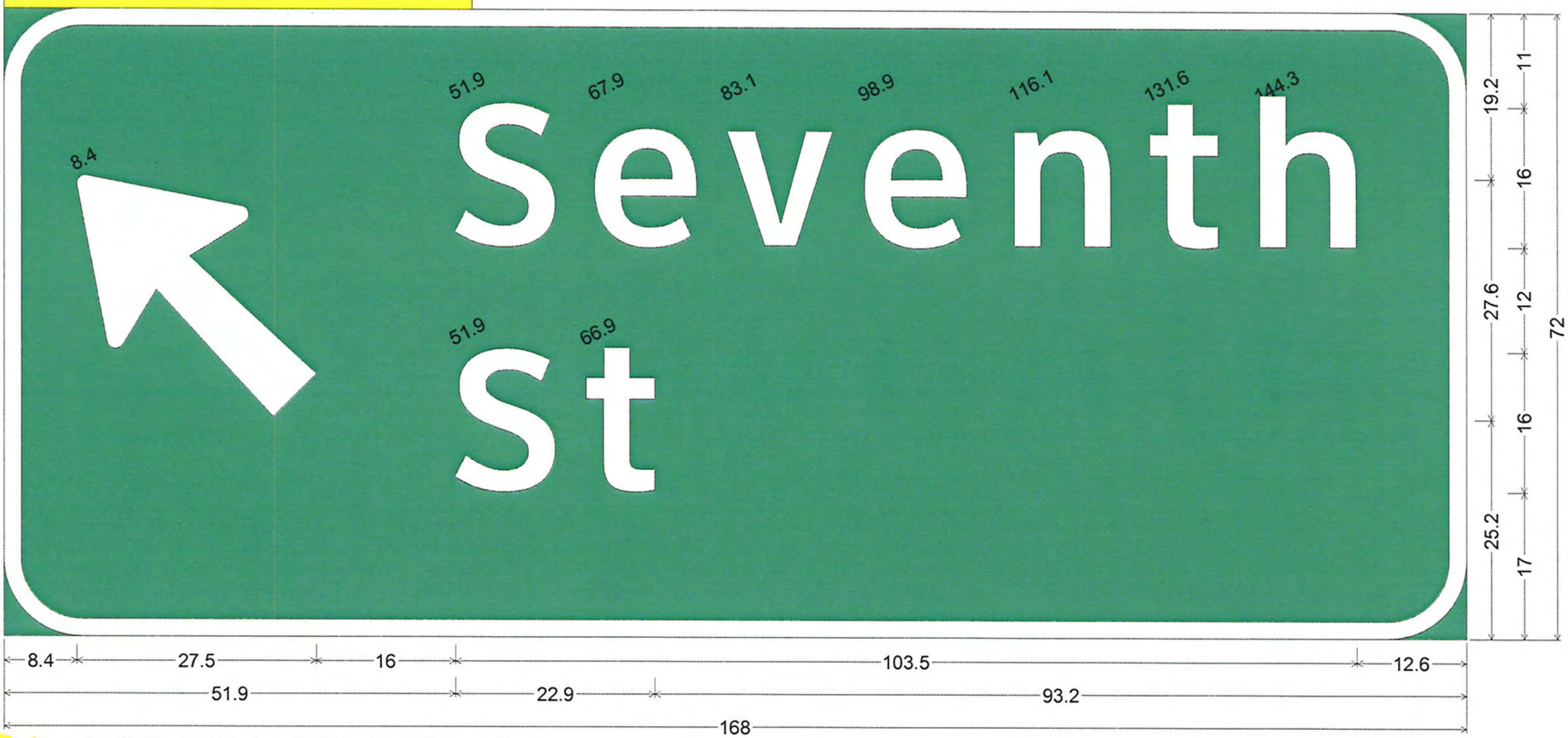
72 Cinci DowntownExits Gore; 12.0" Radius, 2.0" Border, White on Green;
"DOWNTOWN" ClearviewHwy-5-W; "EXITS" ClearviewHwy-5-W; "Covington" ClearviewHwy-4-W;
Down Arrow C-1 - 22.0" 270°;



73 Third St Second St Half Mile; 9.0" Radius, 2.0" Border, White on Green;
"Third St" ClearviewHwy-5-W; "Second St" ClearviewHwy-4-W; Down Arrow C-1 - 22.0" 270°;

74 Fifth St QTR Mile; 6.0" Radius, 2.0" Border, White on Green;
"Fifth St" ClearviewHwy-5-W; Down Arrow C-1 - 22.0" 270°;

LEFT

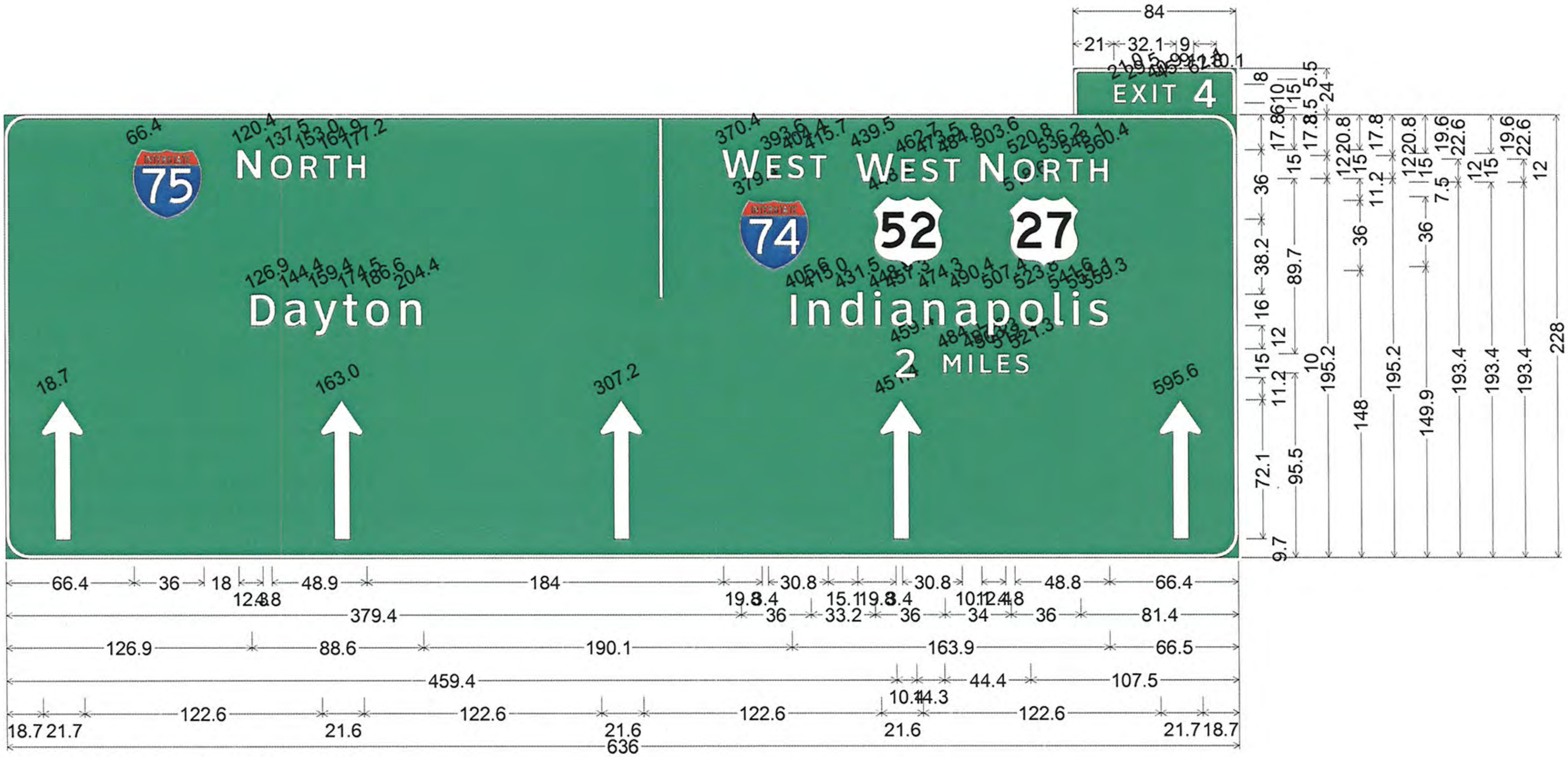


75 Seventh St SB; 9.0" Radius, 2.0" Border, White on Green;
Arrow A-1 - 35.0" 135°; "Seventh" ClearviewHwy-5-W; "St" ClearviewHwy-5-W;

3.0" Radius, 2.0" Border, White on Green;
"EXIT" ClearviewHwy-5-W; "1A" ClearviewHwy-5-W;
76 71NB 50EB Columbus Half Mile;
12.0" Radius, 2.0" Border, White on Green;
"North" ClearviewHwy-5-W; Interstate 71 M1-1;
"To" ClearviewHwy-5-W; Interstate 471 M1-1;
"East" ClearviewHwy-5-W; US 50 M1-4; "East" ClearviewHwy-5-W;
US 52 M1-4; "1/2 MILE" ClearviewHwy-5-W;

3.0" Radius, 2.0" Border, White on Green;
“EXIT” ClearviewHwy-5-W; “2” ClearviewHwy-5-W;
77 Harrison Ave 1 Mile; 9.0" Radius, 2.0" Border, White on Green;
“Harrison” ClearviewHwy-5-W; “Ave” ClearviewHwy-5-W; “1 MILE” ClearviewHwy-5-W;

3.0" Radius, 2.0" Border, White on Green;
“EXIT” ClearviewHwy-5-W; “3” ClearviewHwy-5-W;
77A Hopple St 2 Mile; 9.0" Radius, 2.0" Border, White on Green;
“Hopple” ClearviewHwy-5-W; “St” ClearviewHwy-5-W; “2 ” ClearviewHwy-5-W;
“MILES” ClearviewHwy-5-W;



3.0" Radius, 2.0" Border, White on Green;
"EXIT 4" ClearviewHwy-5-W;
78 75N Dayton 74N Indy 2 Miles; 12.0" Radius, 2.0" Border, White on Green;
Interstate 75 M1-1; "N ORTH" ClearviewHwy-5-W; "W EST" ClearviewHwy-5-W; Interstate 74 M1-1; "W EST" ClearviewHwy-5-W;
US 52 M1-4; "N ORTH" ClearviewHwy-5-W; US 27 M1-4; "Dayton" ClearviewHwy-5-W; "Indianapolis" ClearviewHwy-5-W;
" " ClearviewHwy-5-W; "2 MILES" ClearviewHwy-5-W; Standard Arrow Custom 72.0" X 21.6" 90°;
Standard Arrow Custom 72.0" X 21.6" 90°; Standard Arrow Custom 72.0" X 21.6" 90°; Standard Arrow Custom 72.0" X 21.6" 90°;
Standard Arrow Custom 72.0" X 21.6" 90°;

3.0" Radius, 2.0" Border, White on Green;
"EXIT" ClearviewHwy-5-W; "1B" ClearviewHwy-5-W;
80 Covington 5th St 12th St; 12.0" Radius, 2.0" Border, White on Green;
"Covington" ClearviewHwy-5-W; "EXITS" ClearviewHwy-5-W;
"5th St" ClearviewHwy-4-W; "12th St" ClearviewHwy-4-W;
6.0" Radius, 2.0" Border, Black on Yellow;
"EXIT" ClearviewHwy-5-W; Down Arrow C-1 - 22.0" 270°;
"ONLY" ClearviewHwy-5-W;

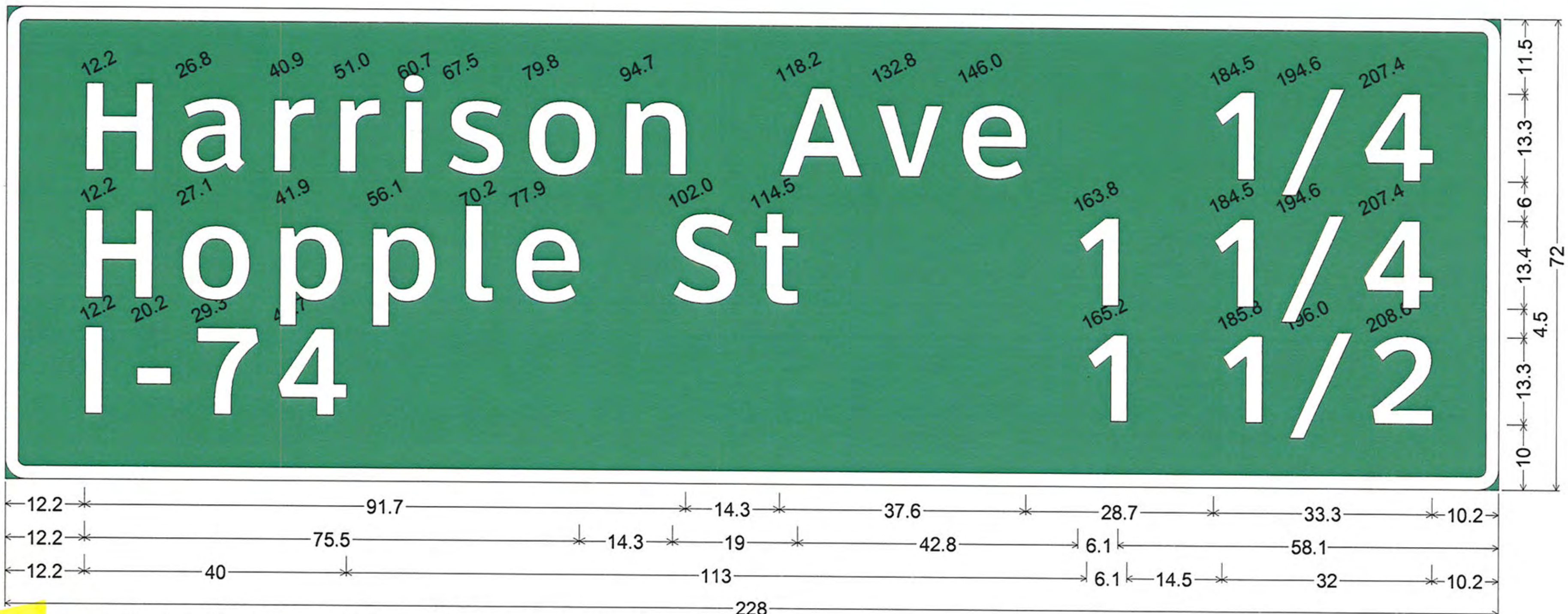
3.0" Radius, 2.0" Border, White on Green;
“EXIT” ClearviewHwy-5-W; “1B” ClearviewHwy-5-W;
81 Cincinnati Second St; 12.0" Radius, 2.0" Border, White on Green;
“Cincinnati” ClearviewHwy-5-W; “EXITS” ClearviewHwy-5-W;
“Third St” ClearviewHwy-4-W; “Second St” ClearviewHwy-4-W;
6.0" Radius, 2.0" Border, Black on Yellow;
“EXIT” ClearviewHwy-5-W; Down Arrow C-1 - 22.0" 270°;
“ONLY” ClearviewHwy-5-W;

3.0" Radius, 2.0" Border, White on Green;
"EXIT" ClearviewHwy-5-W; "1B" ClearviewHwy-5-W;
82 Cincinnati Fifth St; 9.0" Radius, 2.0" Border, White on Green;
"Cincinnati" ClearviewHwy-5-W; "EXITS" ClearviewHwy-5-W; "Fifth St" ClearviewHwy-4-W;
6.0" Radius, 2.0" Border, Black on Yellow;
"EXIT" ClearviewHwy-5-W; Down Arrow C-1 - 22.0" 270°; "ONLY" ClearviewHwy-5-W;

3.0" Radius, 2.0" Border, White on Green;
"EXIT 1B" ClearviewHwy-5-W;
83 75SB Lexington Seventh St; 12.0" Radius, 2.0" Border, White on Green;
"THRU LANES TO" ClearviewHwy-5-W; Interstate 71 M1-1; "South" ClearviewHwy-5-W; Interstate 75 M1-1; "South" ClearviewHwy-5-W;
"Louisville" ClearviewHwy-5-W; "Lexington" ClearviewHwy-5-W; "Cincinnati EXITS" ClearviewHwy-5-W; "Seventh St" ClearviewHwy-5-W;
Standard Arrow Custom 72.0" X 21.6" 90°; Standard Arrow Custom 72.0" X 21.6" 90°; through Turn arrow;

3.0" Radius, 2.0" Border, White on Green;
"EXIT" ClearviewHwy-5-W; "1C" ClearviewHwy-5-W;
84 To 50 West Freeman Ave Gore; 9.0" Radius, 2.0" Border, White on Green;
"To" ClearviewHwy-5-W; US 50 M1-4; "West" ClearviewHwy-5-W; "Freeman Ave" ClearviewHwy-5-W; Arrow A-1 - 35.0" 45°;

3.0" Radius, 2.0" Border, White on Green;
"EXIT" ClearviewHwy-5-W; "2" ClearviewHwy-5-W;
84A Harrison Ave Half Mile; 9.0" Radius, 2.0" Border, White on Green;
"Harrison" ClearviewHwy-5-W; "Ave" ClearviewHwy-5-W; "1/2 MILE" ClearviewHwy-5-W;

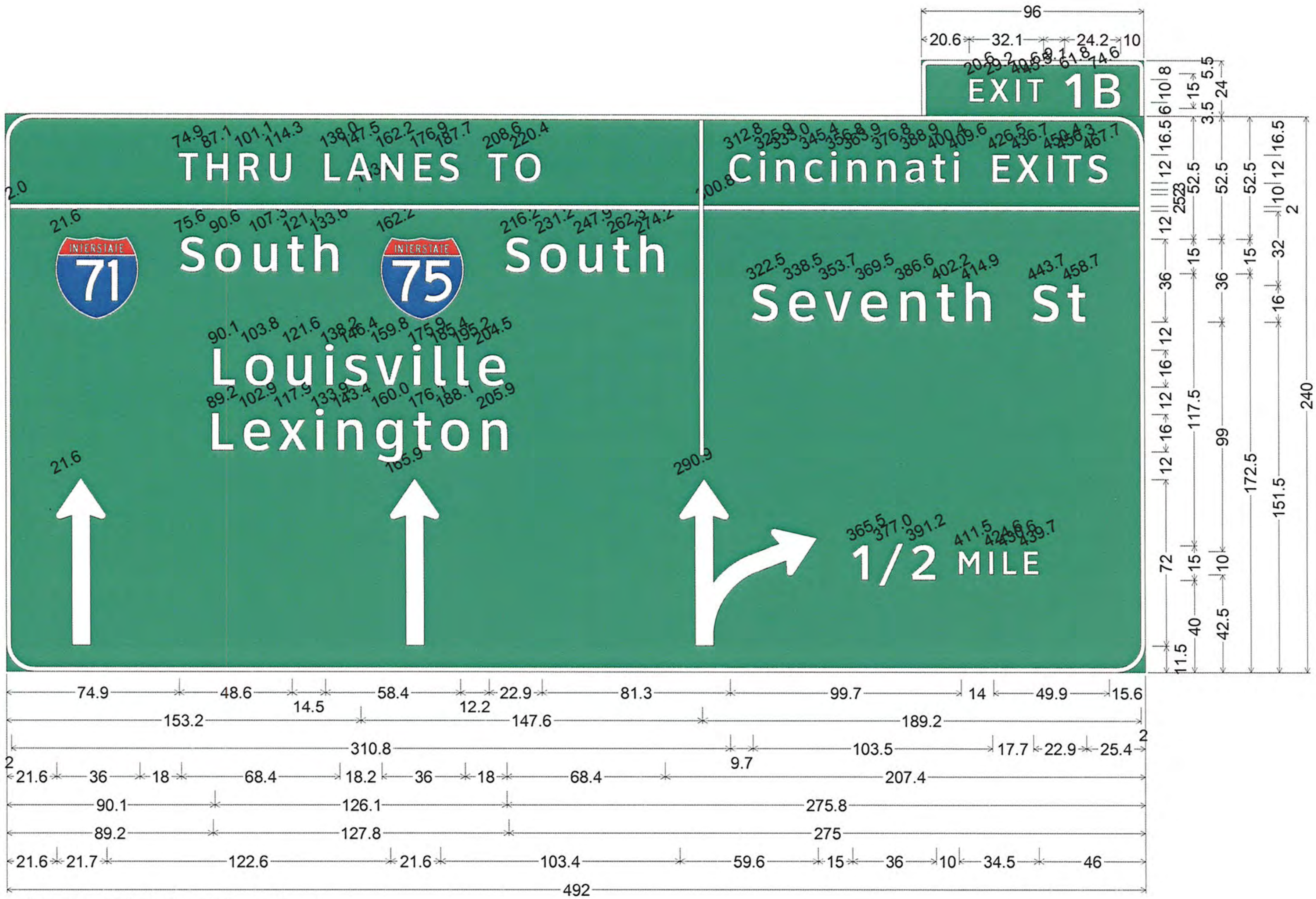


85 Sequence Harrison Hopple I-74; 3.0" Radius, 2.0" Border, White on Green;
"Harrison Ave" ClearviewHwy-5-W; "1/4" ClearviewHwy-5-W; "Hopple St" ClearviewHwy-5-W; "1 1/4" ClearviewHwy-5-W; "I-74" ClearviewHwy-5-W; "1 1/2" ClearviewHwy-5-W;

3.0" Radius, 2.0" Border, White on Green;
"EXIT" ClearviewHwy-5-W; "1B" ClearviewHwy-5-W;
86 Covington 5th St 12th Half Mile;
12.0" Radius, 2.0" Border, White on Green;
"Covington" ClearviewHwy-5-W; "EXITS" ClearviewHwy-5-W;
"5th St" ClearviewHwy-4-W; "12th St" ClearviewHwy-4-W;
"1/2 MILE" ClearviewHwy-5-W;
6.0" Radius, 2.0" Border, Black on Yellow;
"EXIT" ClearviewHwy-5-W; Down Arrow C-1 - 22.0" 270°;
"ONLY" ClearviewHwy-5-W;

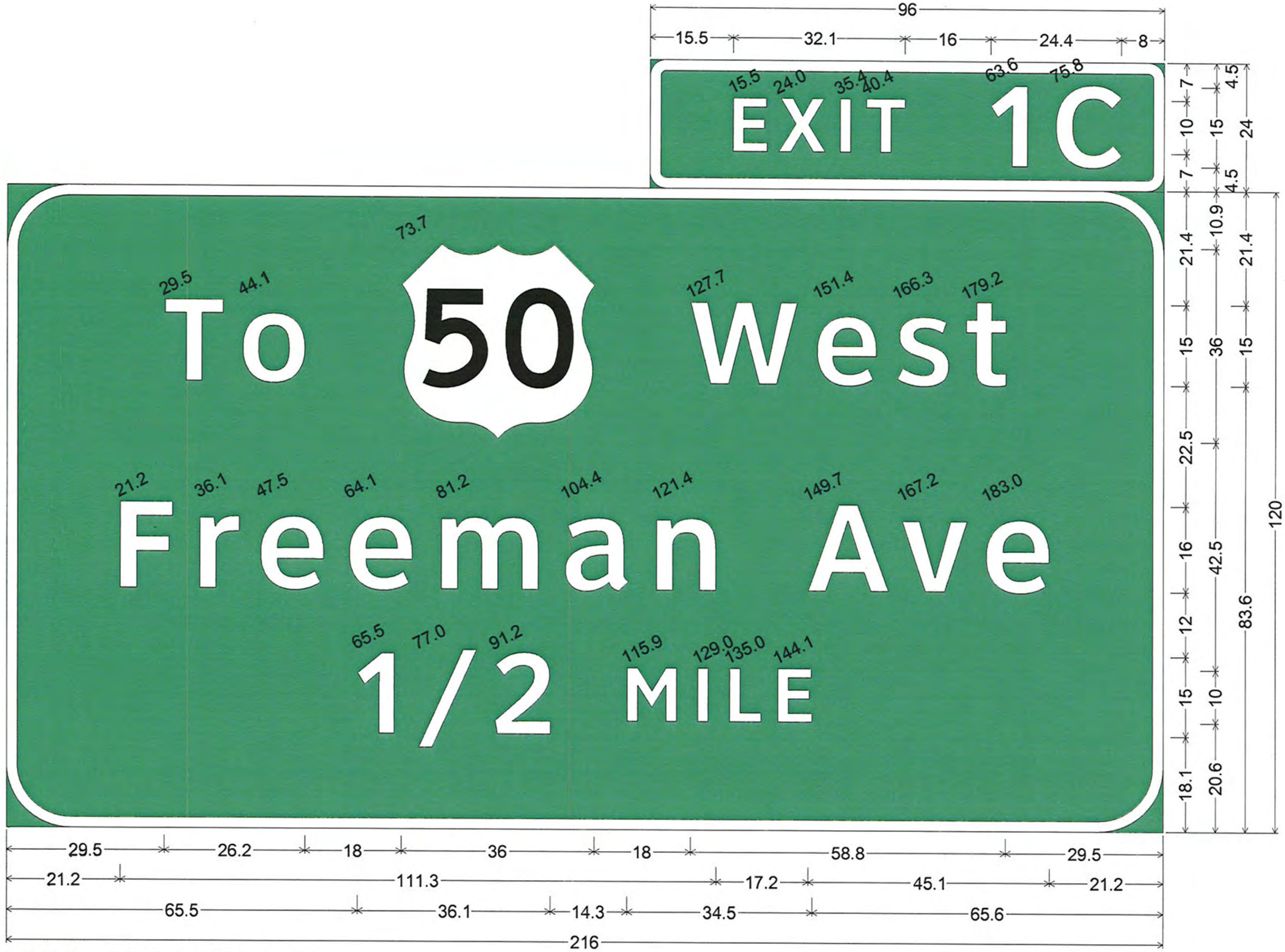
3.0" Radius, 2.0" Border, White on Green;
"EXIT" ClearviewHwy-5-W; "1B" ClearviewHwy-5-W;
87 Cincinnati Third St Second St;
12.0" Radius, 2.0" Border, White on Green;
"Cincinnati" ClearviewHwy-5-W; "EXITS" ClearviewHwy-5-W;
"Third St" ClearviewHwy-4-W;
"Second St" ClearviewHwy-4-W;
"1/2 MILE" ClearviewHwy-5-W;
6.0" Radius, 2.0" Border, Black on Yellow;
"EXIT" ClearviewHwy-5-W; Down Arrow C-1 - 22.0" 270°;
"ONLY" ClearviewHwy-5-W;

3.0" Radius, 2.0" Border, White on Green;
"EXIT" ClearviewHwy-5-W; "1B" ClearviewHwy-5-W;
88 Cincinnati Fifth St; 12.0" Radius, 2.0" Border, White on Green;
"Cincinnati" ClearviewHwy-5-W; "EXITS" ClearviewHwy-5-W;
"Fifth St" ClearviewHwy-4-W; "1/2 MILE" ClearviewHwy-5-W;
6.0" Radius, 2.0" Border, Black on Yellow;
"EXIT" ClearviewHwy-5-W; Down Arrow C-1 - 22.0" 270°;
"ONLY" ClearviewHwy-5-W;



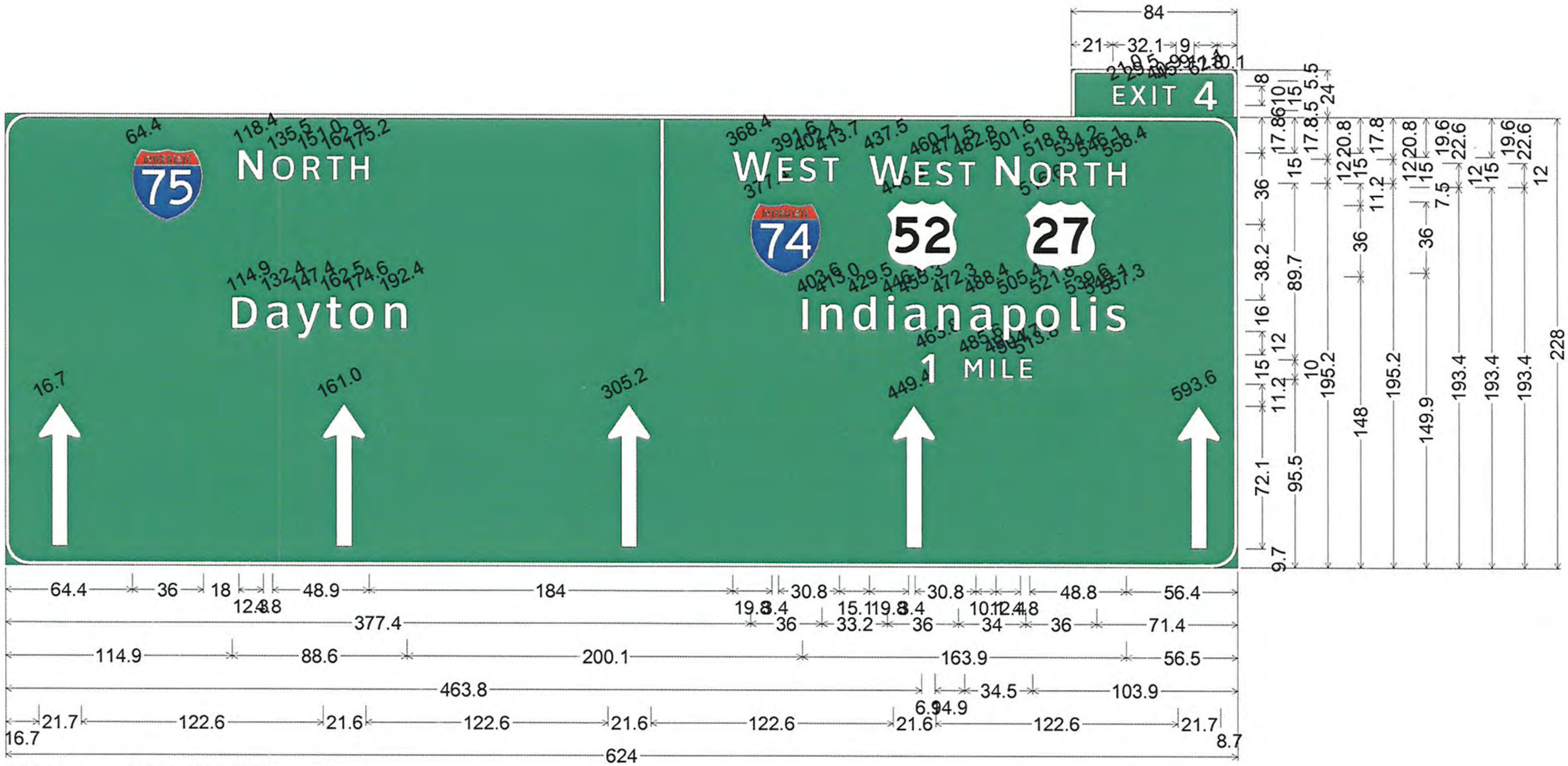
3.0" Radius, 2.0" Border, White on Green;
"EXIT 1B" ClearviewHwy-5-W;
89 71 SB Louisville 75SB Lexington Seventh St; 12.0" Radius, 2.0" Border, White on Green;
"THRU LANES TO" ClearviewHwy-5-W; Interstate 71 M1-1; "South" ClearviewHwy-5-W; Interstate 75 M1-1; "South" ClearviewHwy-5-W;
"Louisville" ClearviewHwy-5-W; "Lexington" ClearviewHwy-5-W; "Cincinnati EXITS" ClearviewHwy-5-W; "Seventh St" ClearviewHwy-5-W;
Standard Arrow Custom 72.0" X 21.6" 90°; Standard Arrow Custom 72.0" X 21.6" 90°; through Turn arrow; "1/2 MILE" ClearviewHwy-5-W;

3.0" Radius, 2.0" Border, White on Green;
"EXIT" ClearviewHwy-5-W; "1A" ClearviewHwy-5-W;
90 71NB 50EB 1 Mile;
12.0" Radius, 2.0" Border, White on Green;
"North" ClearviewHwy-5-W; Interstate 71 M1-1;
"To" ClearviewHwy-5-W; Interstate 471 M1-1;
"East" ClearviewHwy-5-W; US 50 M1-4;
"East" ClearviewHwy-5-W; US 52 M1-4;
"1 MILE" ClearviewHwy-5-W;
Down Arrow C-1 - 22.0" 270°;



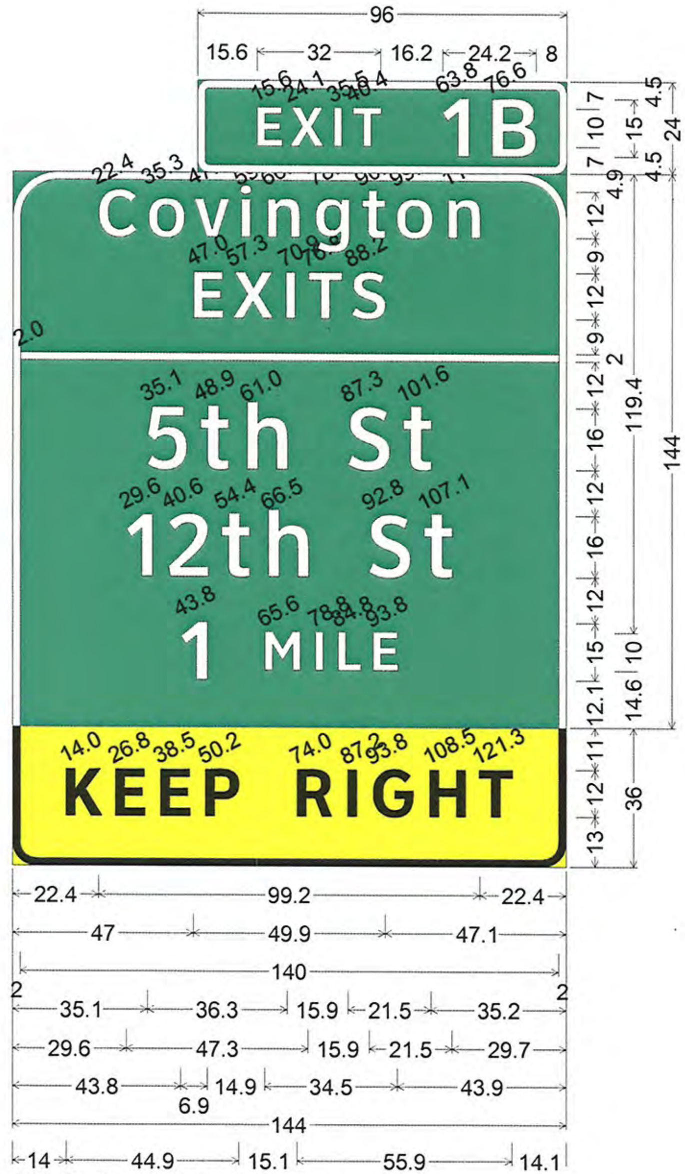
3.0" Radius, 2.0" Border, White on Green;
"EXIT" ClearviewHwy-5-W; "1C" ClearviewHwy-5-W;
90A To 50 West Freeman Ave Half Mile; 12.0" Radius, 2.0" Border, White on Green;
"To" ClearviewHwy-5-W; US 50 M1-4; "West" ClearviewHwy-5-W; "Freeman Ave" ClearviewHwy-5-W; "1/2 MILE" ClearviewHwy-5-W;

3.0" Radius, 2.0" Border, White on Green;
"EXIT" ClearviewHwy-5-W; "2" ClearviewHwy-5-W;
91 Harrison Ave Gore; 9.0" Radius, 2.0" Border, White on Green;
"Harrison" ClearviewHwy-5-W; "Ave" ClearviewHwy-5-W; Arrow A-0 - 35.0" 45°;



3.0" Radius, 2.0" Border, White on Green;
"EXIT 4" ClearviewHwy-5-W;
92 75N Dayton 74N Indy 1 Mile; 12.0" Radius, 2.0" Border, White on Green;
Interstate 75 M1-1; "N ORTH" ClearviewHwy-5-W; "W EST" ClearviewHwy-5-W; Interstate 74 M1-1; "W EST" ClearviewHwy-5-W;
US 52 M1-4; "N ORTH" ClearviewHwy-5-W; US 27 M1-4; "Dayton" ClearviewHwy-5-W; "Indianapolis" ClearviewHwy-5-W;
" " ClearviewHwy-5-W; "1 MILE" ClearviewHwy-5-W; Standard Arrow Custom 72.0" X 21.6" 90°;
Standard Arrow Custom 72.0" X 21.6" 90°; Standard Arrow Custom 72.0" X 21.6" 90°; Standard Arrow Custom 72.0" X 21.6" 90°;
Standard Arrow Custom 72.0" X 21.6" 90°;

3.0" Radius, 2.0" Border, White on Green;
"EXIT" ClearviewHwy-5-W; "3" ClearviewHwy-5-W;
93 Hopple St 1 Mile; 9.0" Radius, 2.0" Border, White on Green;
"Hopple" ClearviewHwy-5-W; "St" ClearviewHwy-5-W; "1 " ClearviewHwy-5-W;
"MILE" ClearviewHwy-5-W;



3.0" Radius, 2.0" Border, White on Green;
"EXIT" ClearviewHwy-5-W; "1B" ClearviewHwy-5-W;
94 Covington 5th St 12th St 1 Mile;
12.0" Radius, 2.0" Border, White on Green;
"Covington" ClearviewHwy-5-W;
"EXITS" ClearviewHwy-5-W;
"5th St" ClearviewHwy-4-W;
"12th St" ClearviewHwy-4-W;
"1 MILE" ClearviewHwy-5-W;
6.0" Radius, 2.0" Border, Black on Yellow;
"KEEP" ClearviewHwy-5-W;
"RIGHT" ClearviewHwy-5-W;

3.0" Radius, 2.0" Border, White on Green;
"EXIT" ClearviewHwy-5-W; "1B" ClearviewHwy-5-W;
95 Cincinnati Third St Second St 1 Mile;
12.0" Radius, 2.0" Border, White on Green;
"Cincinnati" ClearviewHwy-5-W; "EXITS" ClearviewHwy-5-W;
"Third St" ClearviewHwy-4-W;
"Second St" ClearviewHwy-4-W; "1 MILE" ClearviewHwy-5-W;
6.0" Radius, 2.0" Border, Black on Yellow;
"EXIT" ClearviewHwy-5-W; Down Arrow C-1 - 22.0" 270°;
"ONLY" ClearviewHwy-5-W;

3.0" Radius, 2.0" Border, White on Green;
"EXIT" ClearviewHwy-5-W; "1B" ClearviewHwy-5-W;
96 Cincinnati Fifth St 1 Mile; 12.0" Radius, 2.0" Border, White on Green;
"Cincinnati" ClearviewHwy-5-W; "EXITS" ClearviewHwy-5-W;
"Fifth St" ClearviewHwy-4-W; "1 MILE" ClearviewHwy-5-W;
6.0" Radius, 2.0" Border, Black on Yellow;
"EXIT" ClearviewHwy-5-W; Down Arrow C-1 - 22.0" 270°;
"ONLY" ClearviewHwy-5-W;

3.0" Radius, 2.0" Border, White on Green;
"EXIT 1B" ClearviewHwy-5-W;
97 71 SB Louisville 75SB Lexington Seventh St 1 mile; 12.0" Radius, 2.0" Border, White on Green;
"THRU LANES TO" ClearviewHwy-5-W; Interstate 71 M1-1; "South" ClearviewHwy-5-W; Interstate 75 M1-1; "South" ClearviewHwy-5-W;
"Louisville" ClearviewHwy-5-W; "Lexington" ClearviewHwy-5-W; "Cincinnati EXITS" ClearviewHwy-5-W; "Seventh St" ClearviewHwy-5-W;
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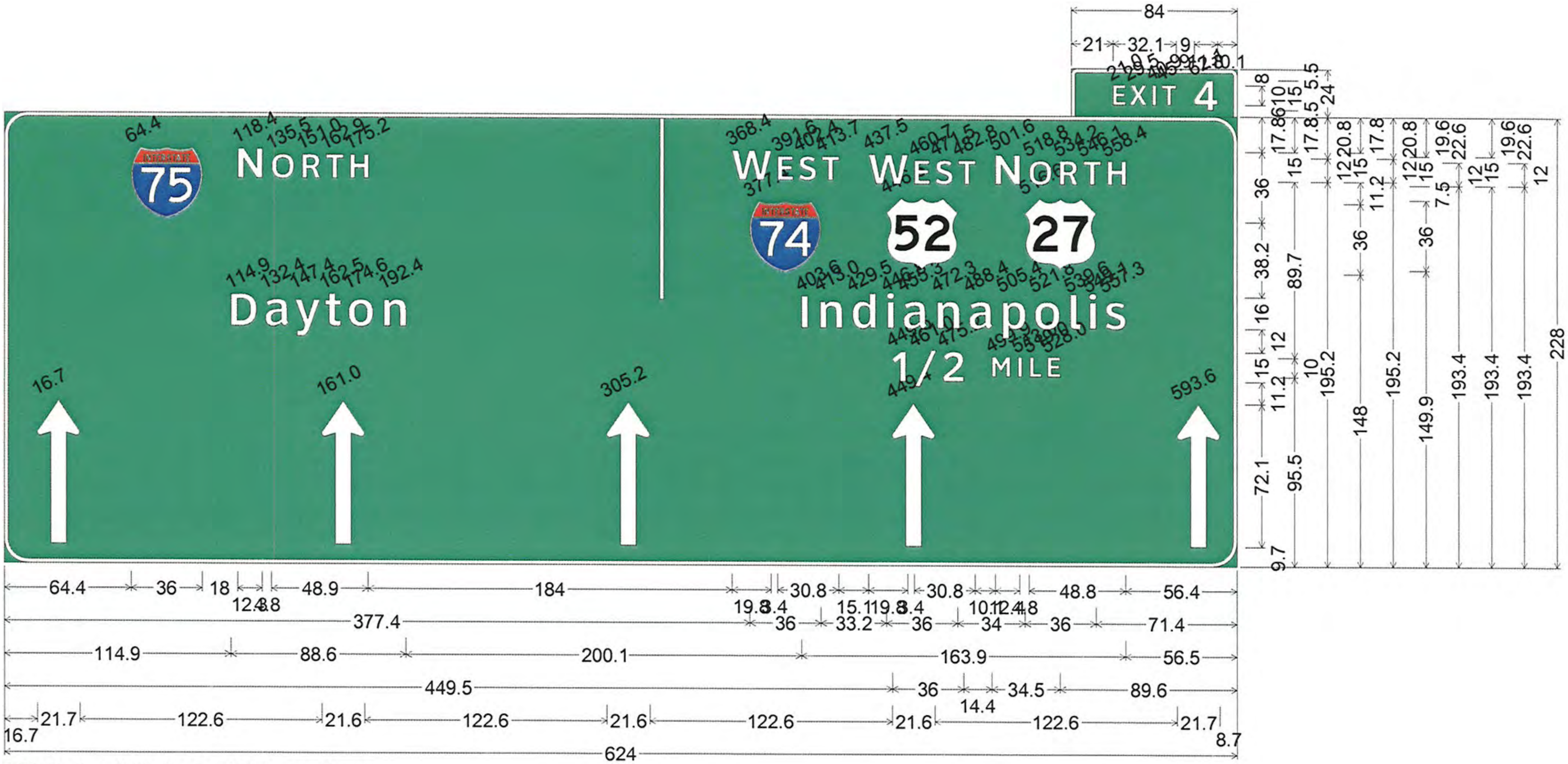

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US 52 M1-4; "N ORTH" ClearviewHwy-5-W; US 27 M1-4; "Dayton" ClearviewHwy-5-W; "Indianapolis" ClearviewHwy-5-W;
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Standard Arrow Custom 72.0" X 21.6" 90°;

3.0" Radius, 2.0" Border, White on Green;
"EXIT" ClearviewHwy-5-W; "2A" ClearviewHwy-5-W;
99 Western Ave SB Gore; 9.0" Radius, 2.0" Border, White on Green;
"Western" ClearviewHwy-5-W; "Ave" ClearviewHwy-5-W; Arrow A-0 - 35.0" 45°;

3.0" Radius, 2.0" Border, White on Green;
"EXIT" ClearviewHwy-5-W; "2B" ClearviewHwy-5-W;
99A Harrison Ave SB Thru; 12.0" Radius, 2.0" Border, White on Green;
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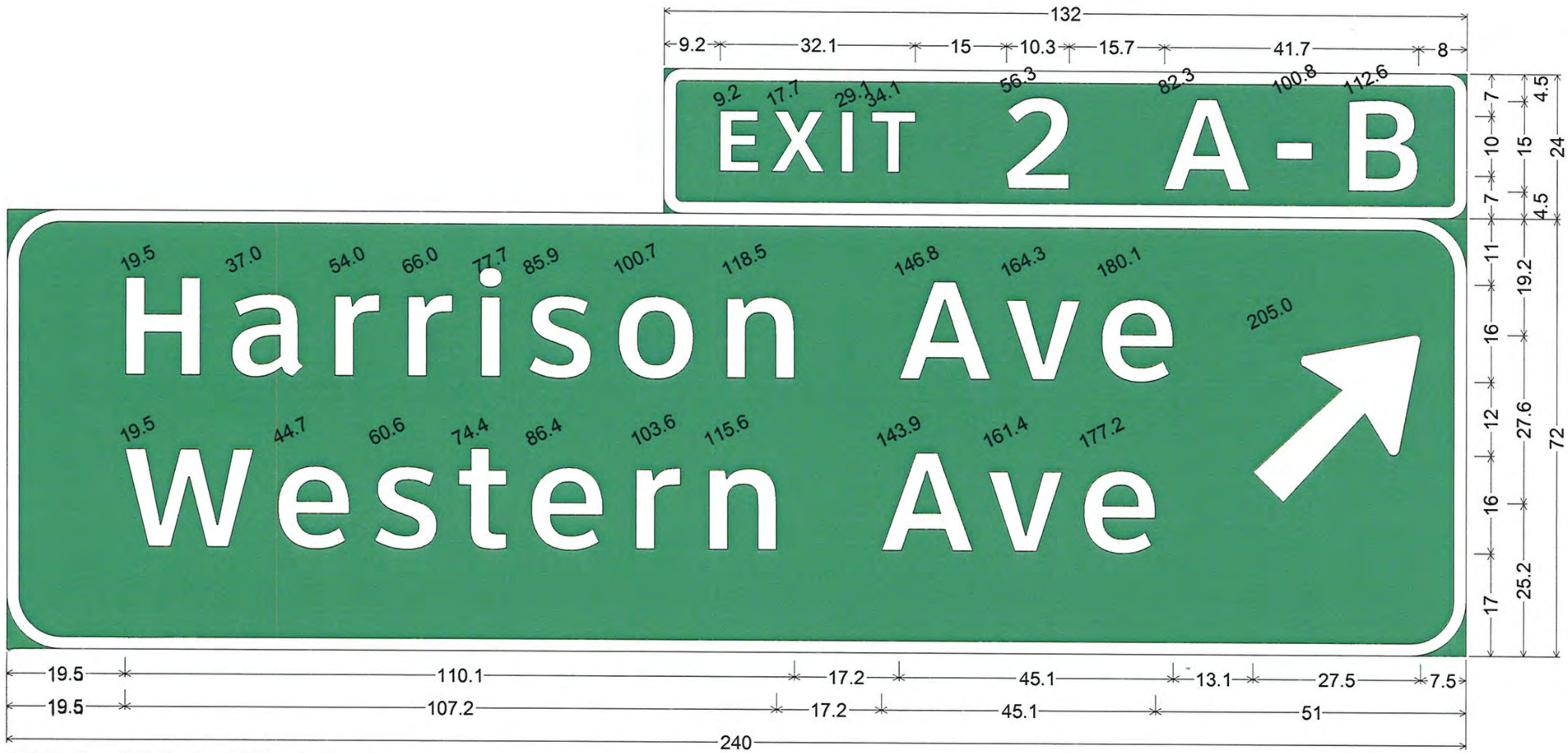

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3.0" Radius, 2.0" Border, White on Green;

"EXIT" ClearviewHwy-5-W; "1C" ClearviewHwy-5-W;

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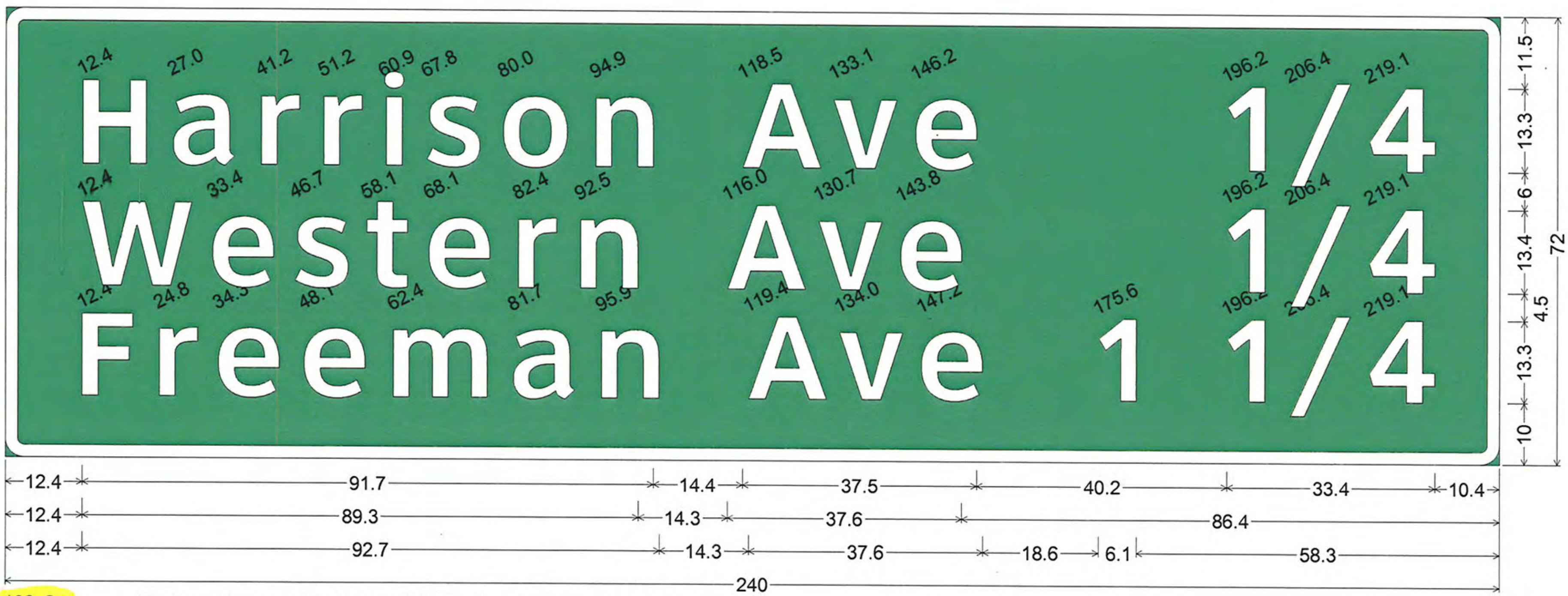

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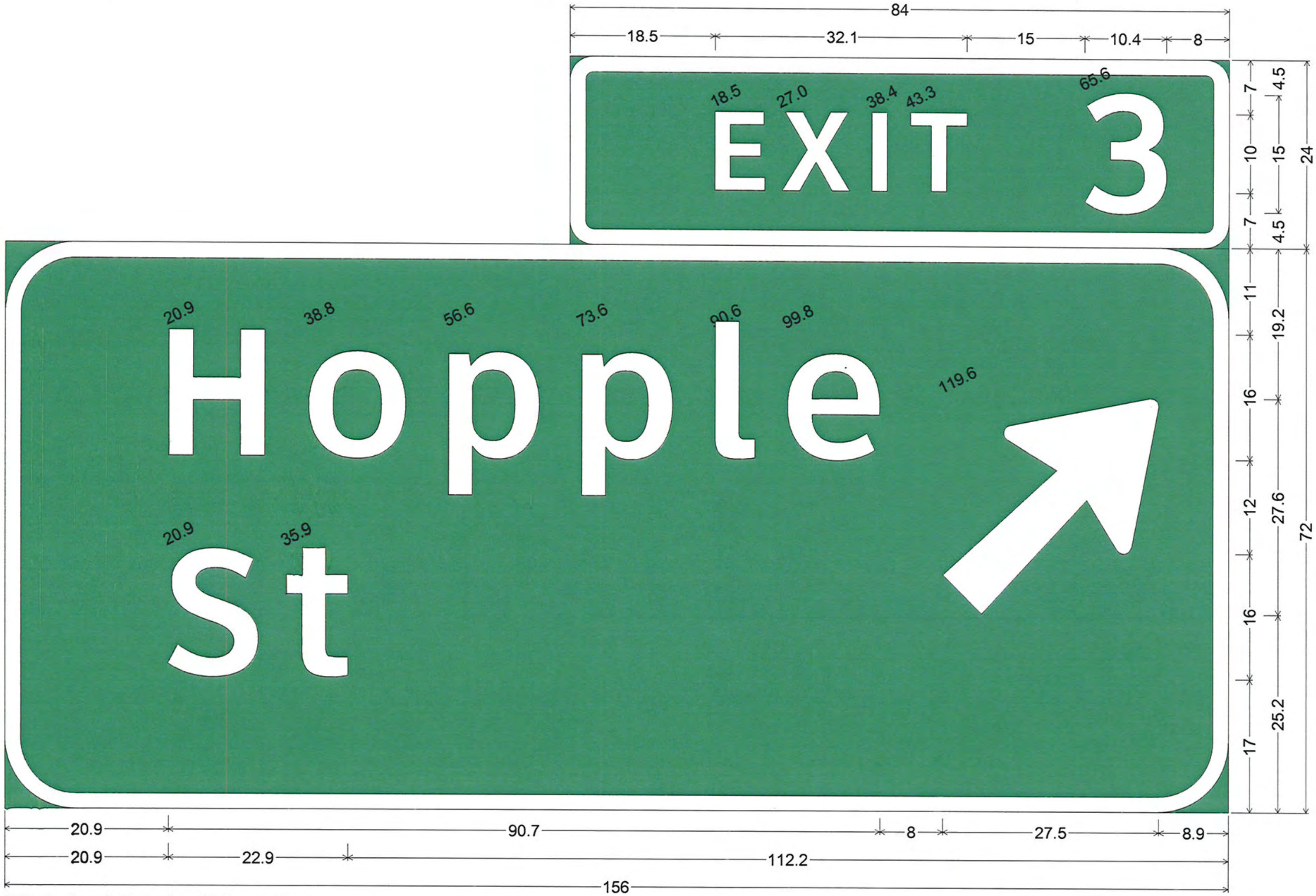

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103 Hopple St Gore; 9.0" Radius, 2.0" Border, White on Green;
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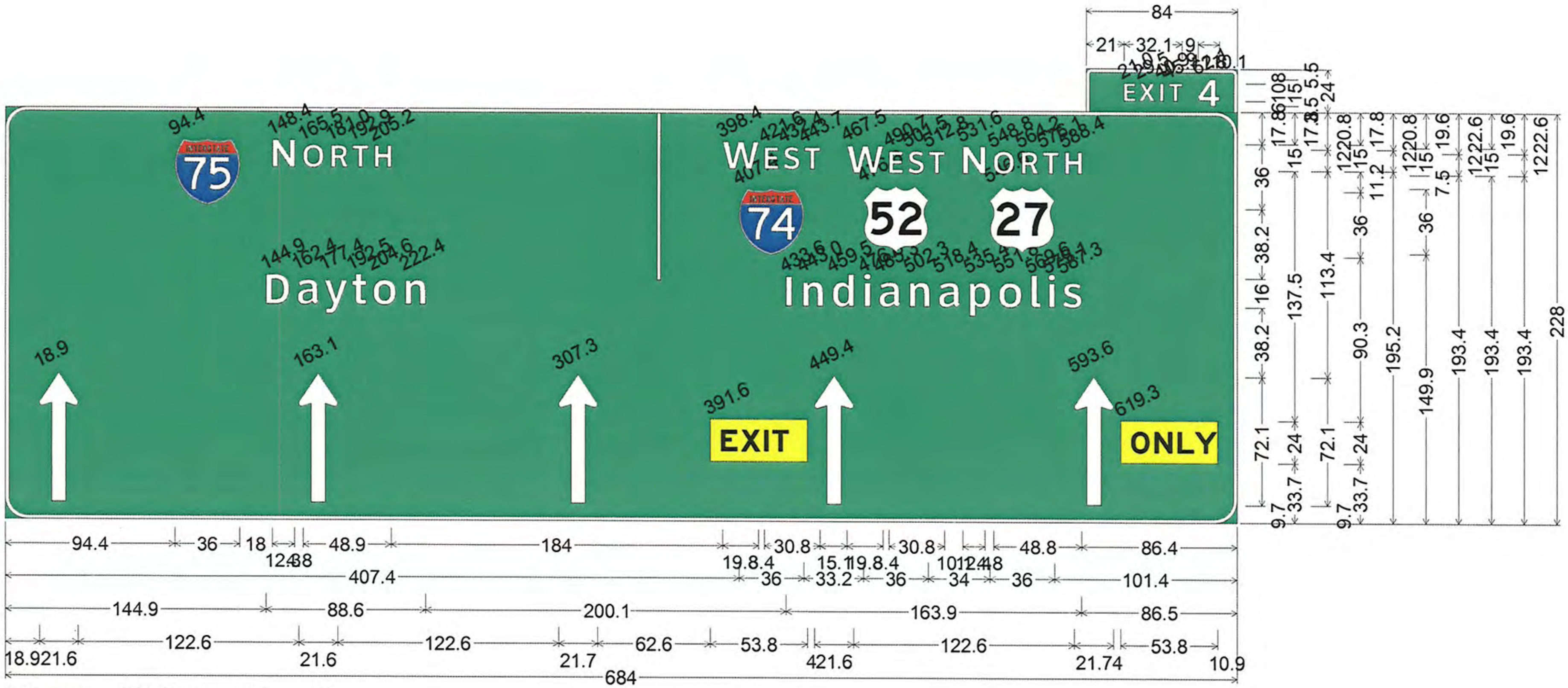

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US 52 M1-4; "N ORTH" ClearviewHwy-5-W; US 27 M1-4; "Dayton" ClearviewHwy-5-W; "Indianapolis" ClearviewHwy-5-W;
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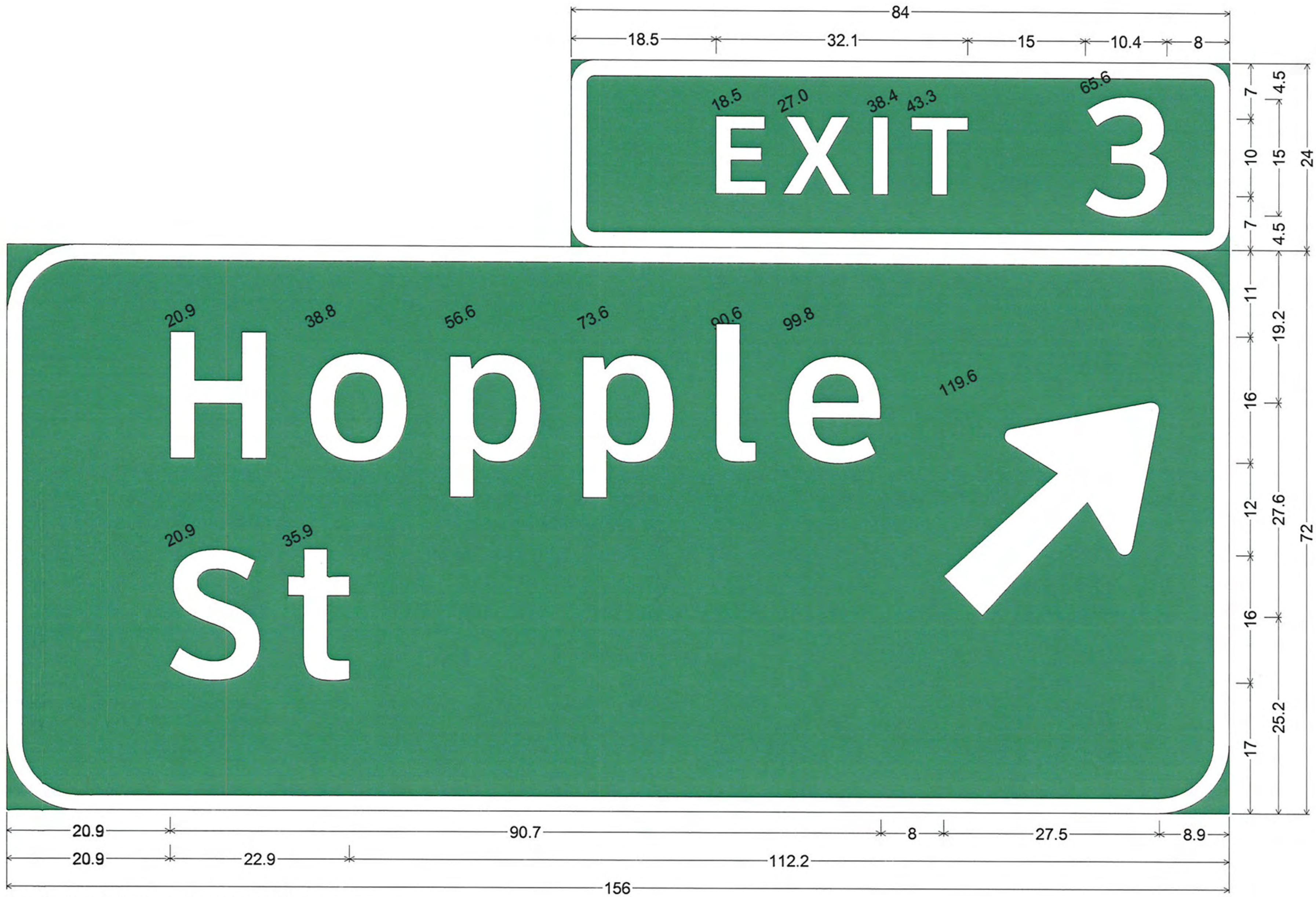

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"Hopple" ClearviewHwy-5-W; "St" ClearviewHwy-5-W; Arrow A-1 - 35.0" 45°;

106 71NB 50EB 471; 12.0" Radius, 2.0" Border, White on Green;
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"Riverfront" ClearviewHwy-4-W; Down Arrow C-1 - 22.0" 270°;

108 Cincinnati Fifth St Downtown; 12.0" Radius, 2.0" Border, White on Green;
“Cincinnati” ClearviewHwy-5-W; “EXITS” ClearviewHwy-5-W; “Fifth St” ClearviewHwy-4-W;
“Downtown” ClearviewHwy-4-W;
6.0" Radius, 2.0" Border, Black on Yellow;
“EXIT” ClearviewHwy-5-W; Down Arrow C-1 - 22.0" 270°; “ONLY” ClearviewHwy-5-W;

109 71 75 Covington 5th St 12th St; 12.0" Radius, 2.0" Border, White on Green;
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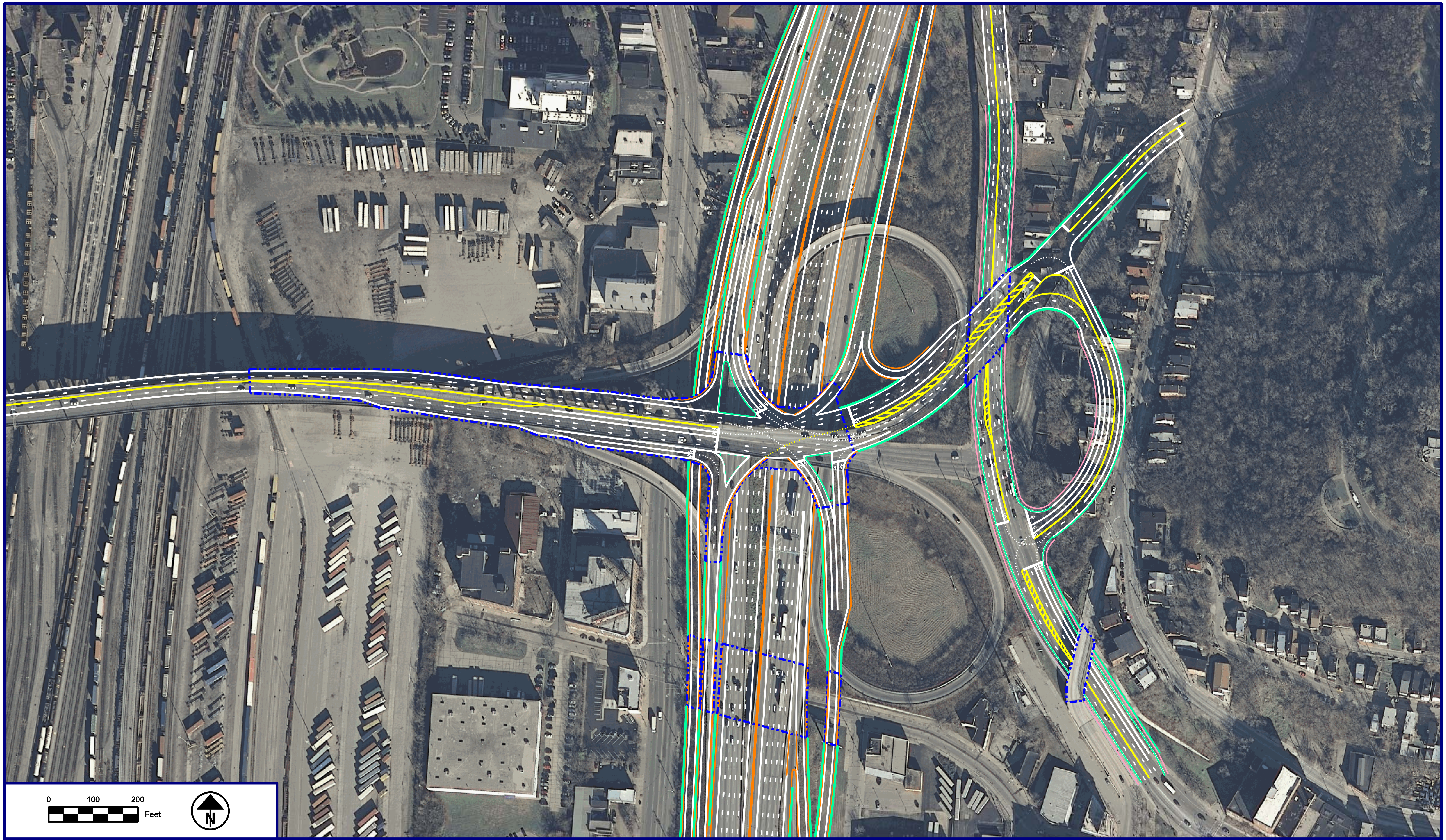
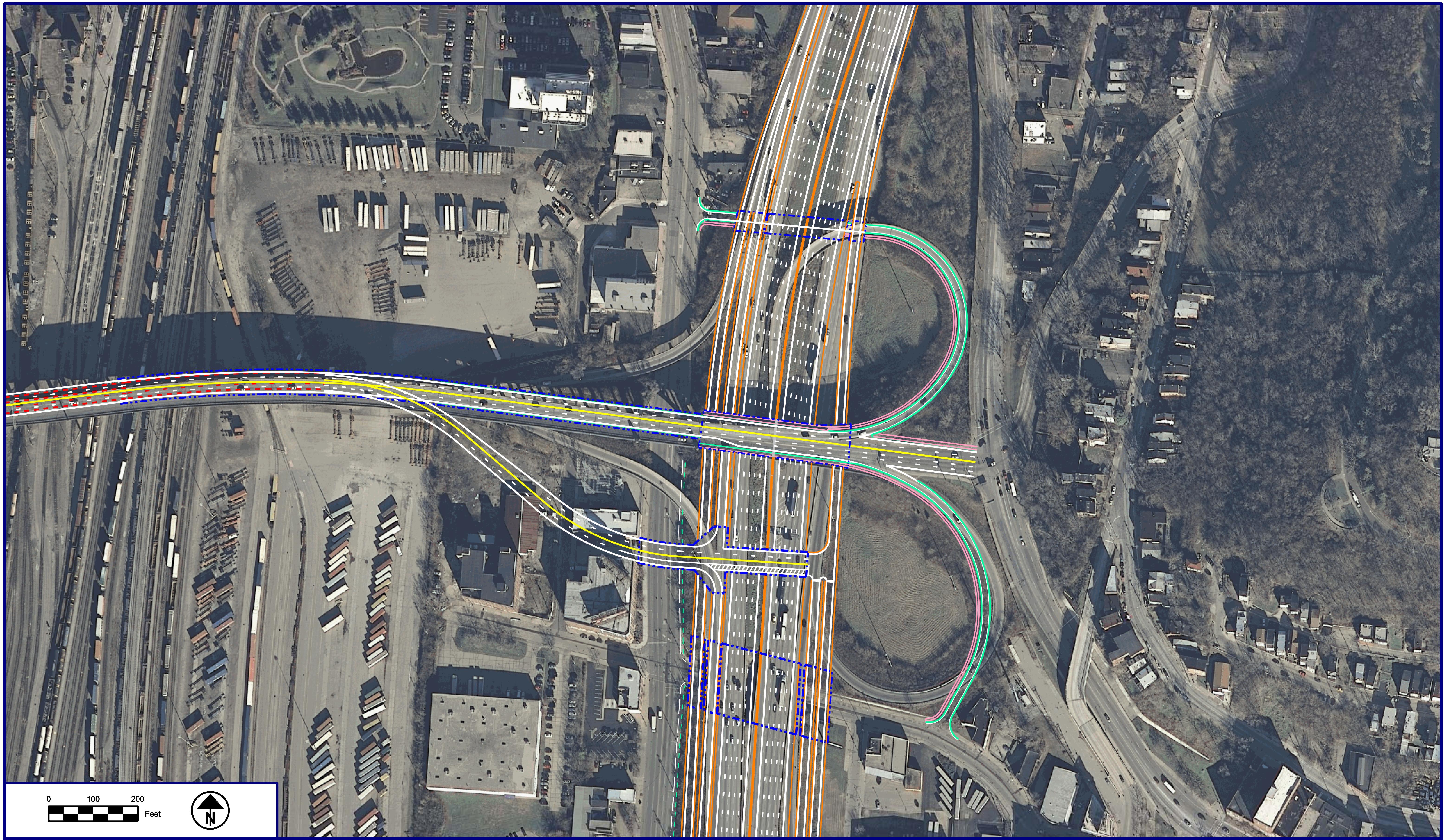


U.S. Department of Transportation
Federal Highway Administration

WESTERN HILLS VIADUCT
SINGLE POINT URBAN INTERCHANGE

EXHIBIT
7

Prepared by:
PARSONS BRINCKERHOFF



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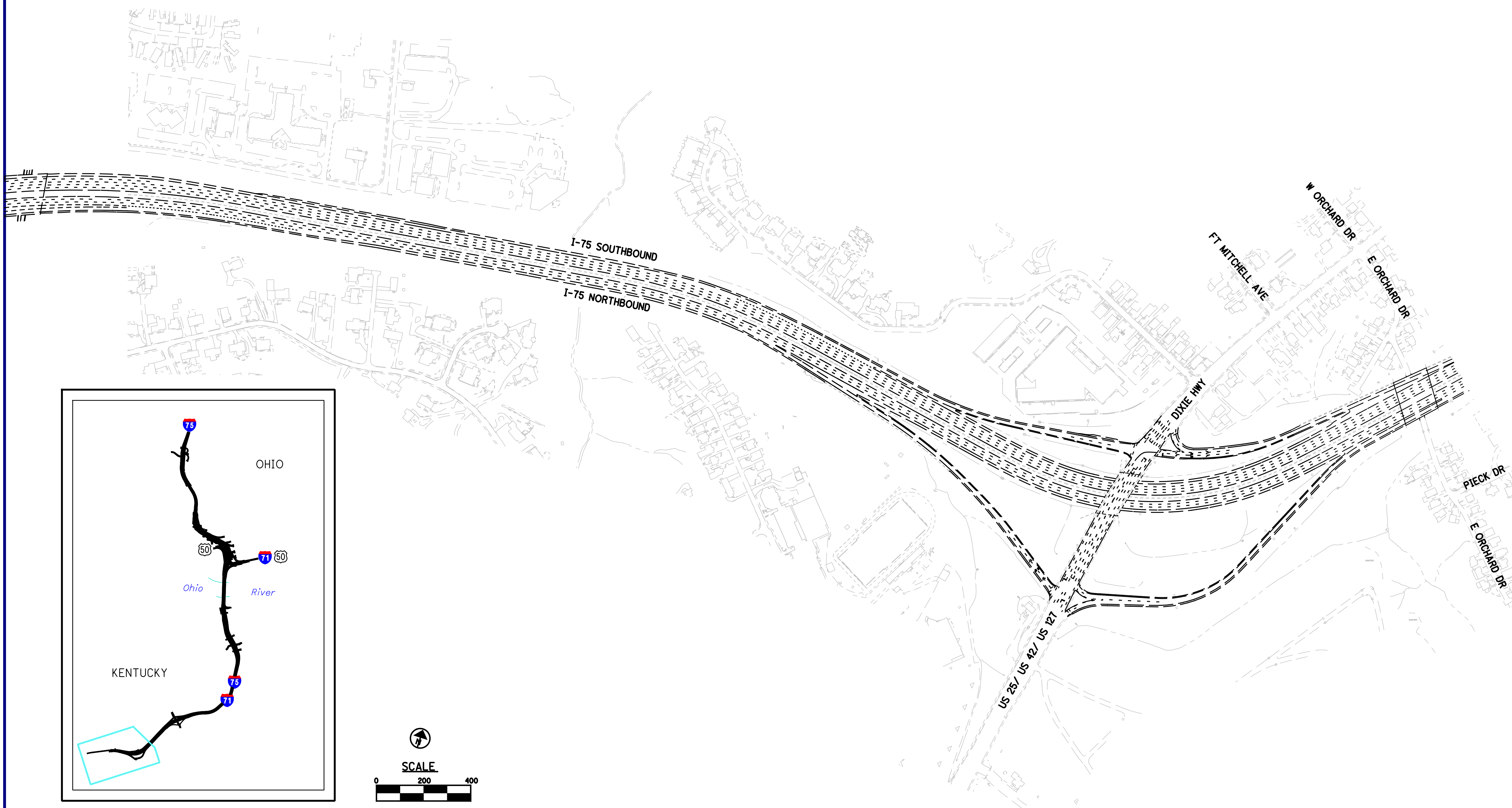
Federal Highway Administration

WESTERN HILLS VIADUCT
TIGHT DIAMOND INTERCHANGE OPTION 1

EXHIBIT
8

Prepared by:
PARSONS BRINCKERHOFF

Appendix A
Plan Set



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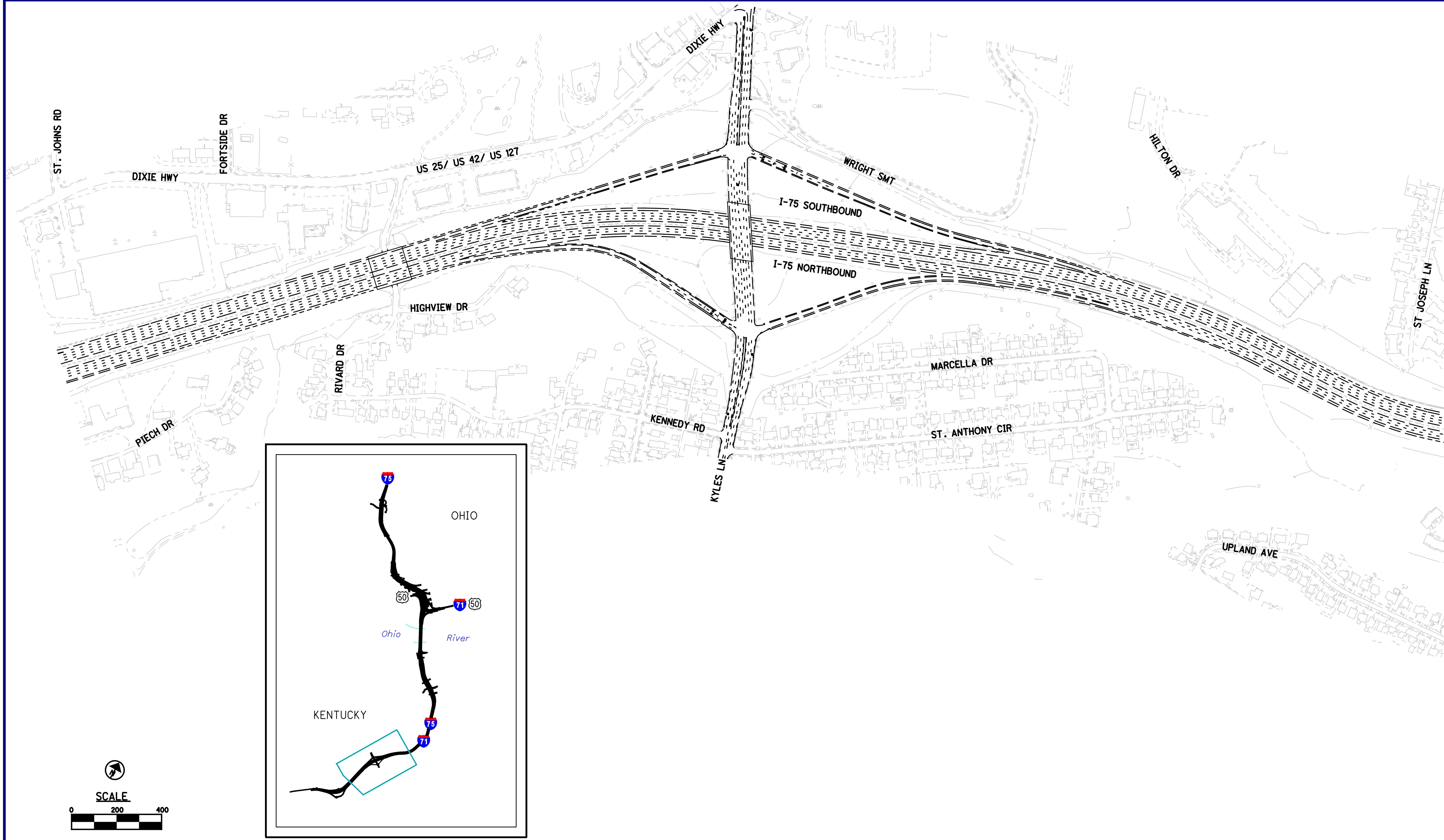
NO BUILD ALTERNATIVE

EXHIBIT
1 of 7

Prepared by:
PARSONS BRINCKERHOFF



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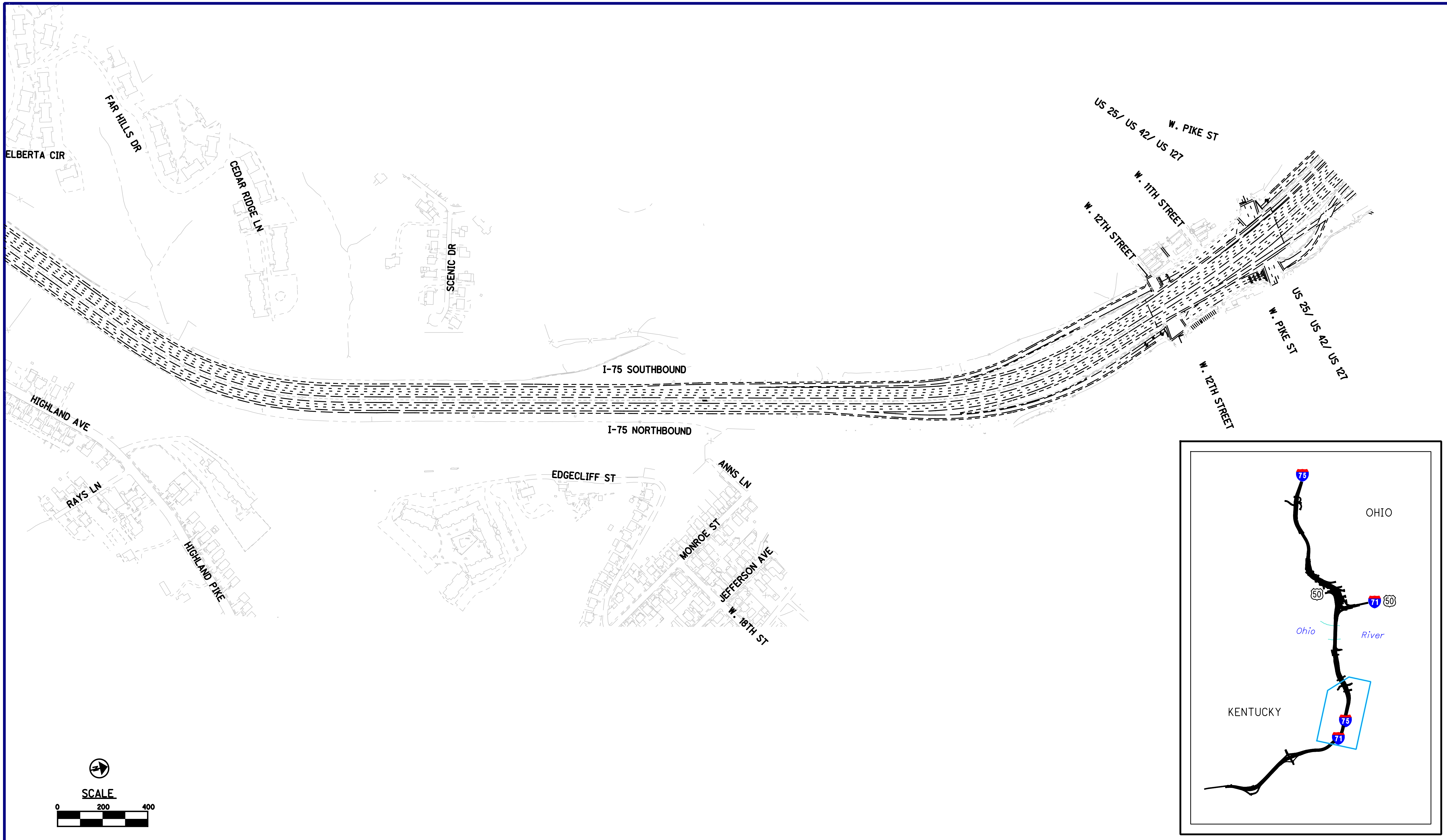
NO BUILD ALTERNATIVE

EXHIBIT
2 of 7

Prepared by:
PARSONS BRINCKERHOFF



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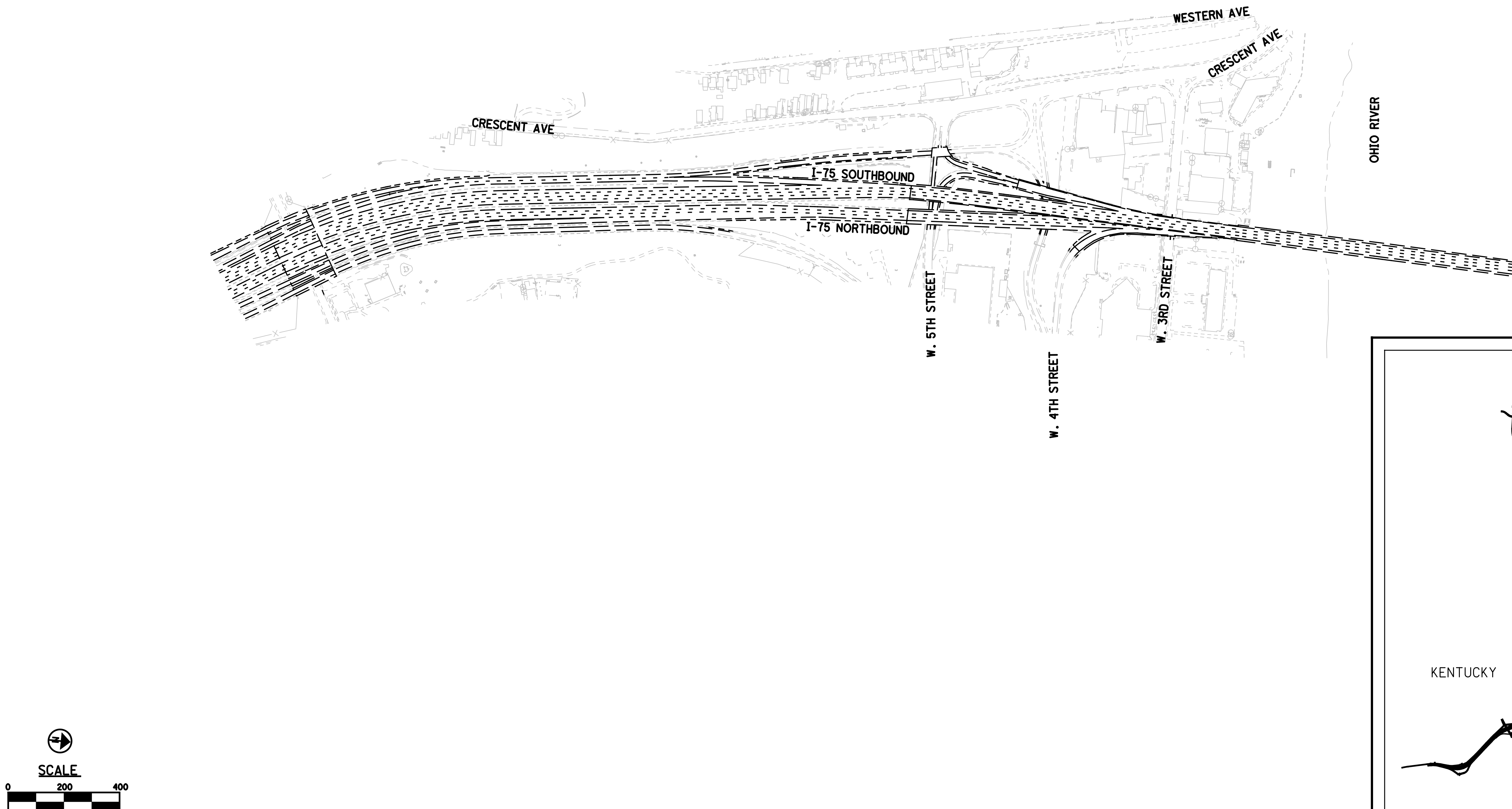
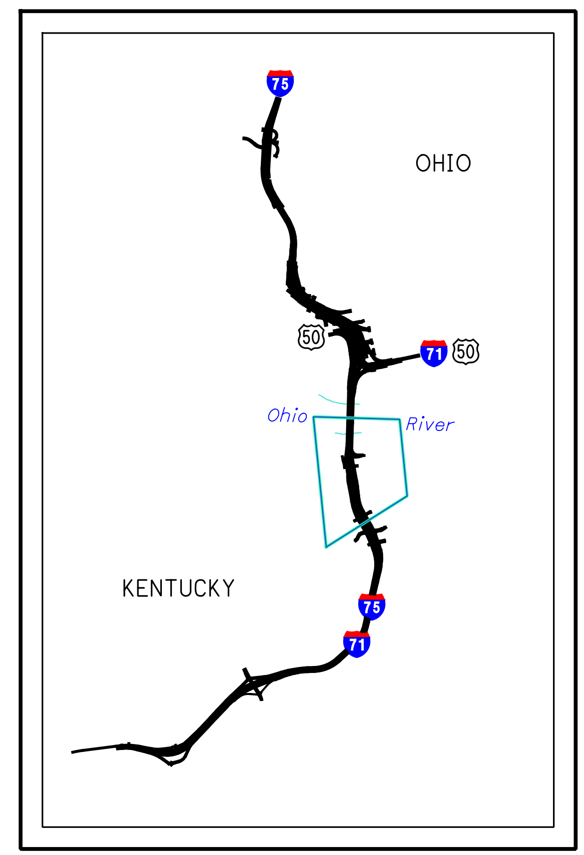
NO BUILD ALTERNATIVE

EXHIBIT
3 of 7

Prepared by:
PARSONS BRINCKERHOFF





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NO BUILD ALTERNATIVE

EXHIBIT

4 of 7

Prepared by:
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NO BUILD ALTERNATIVE

EXHIBIT
5 of 7

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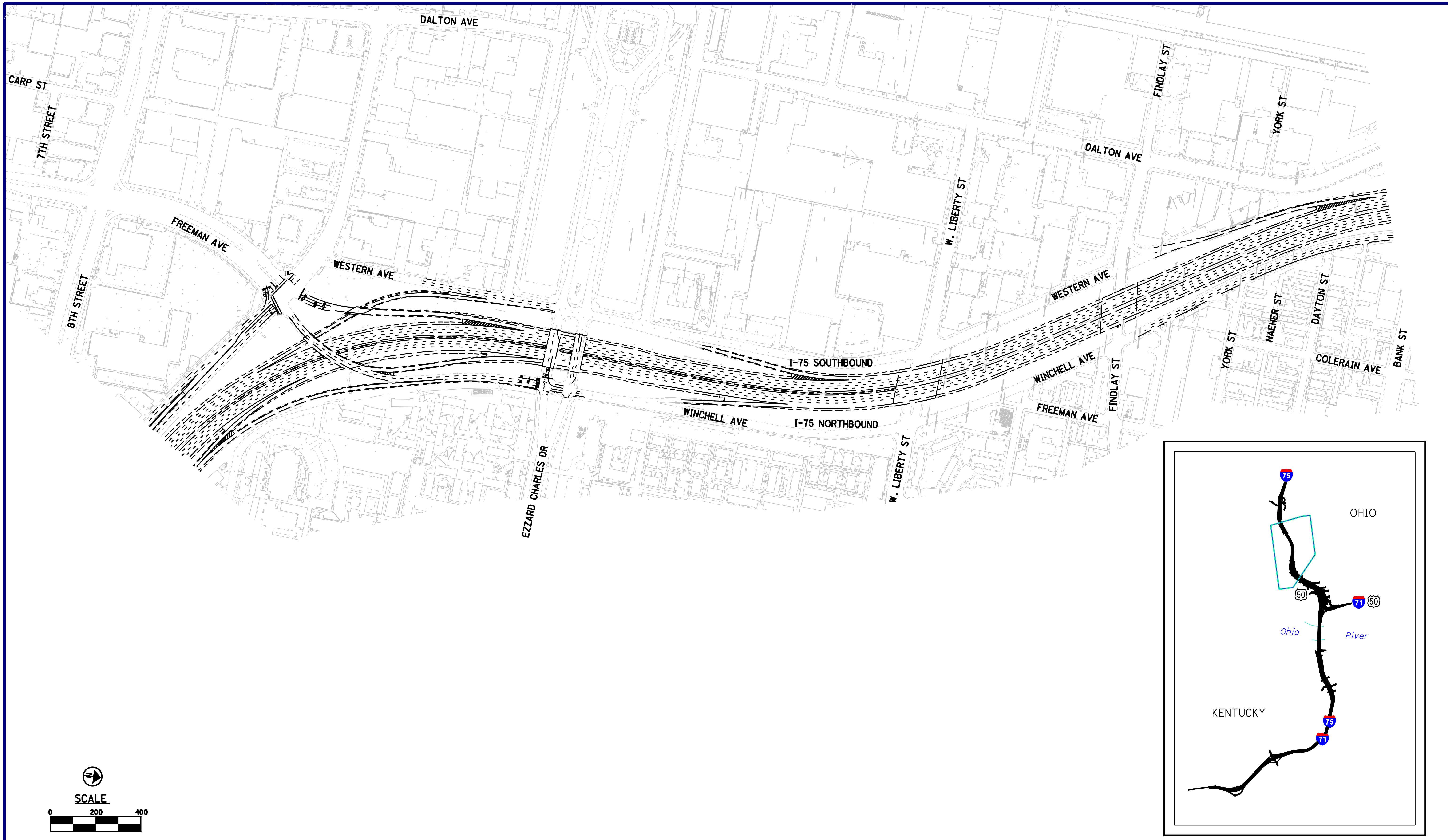
PARSONS BRINCKERHOFF



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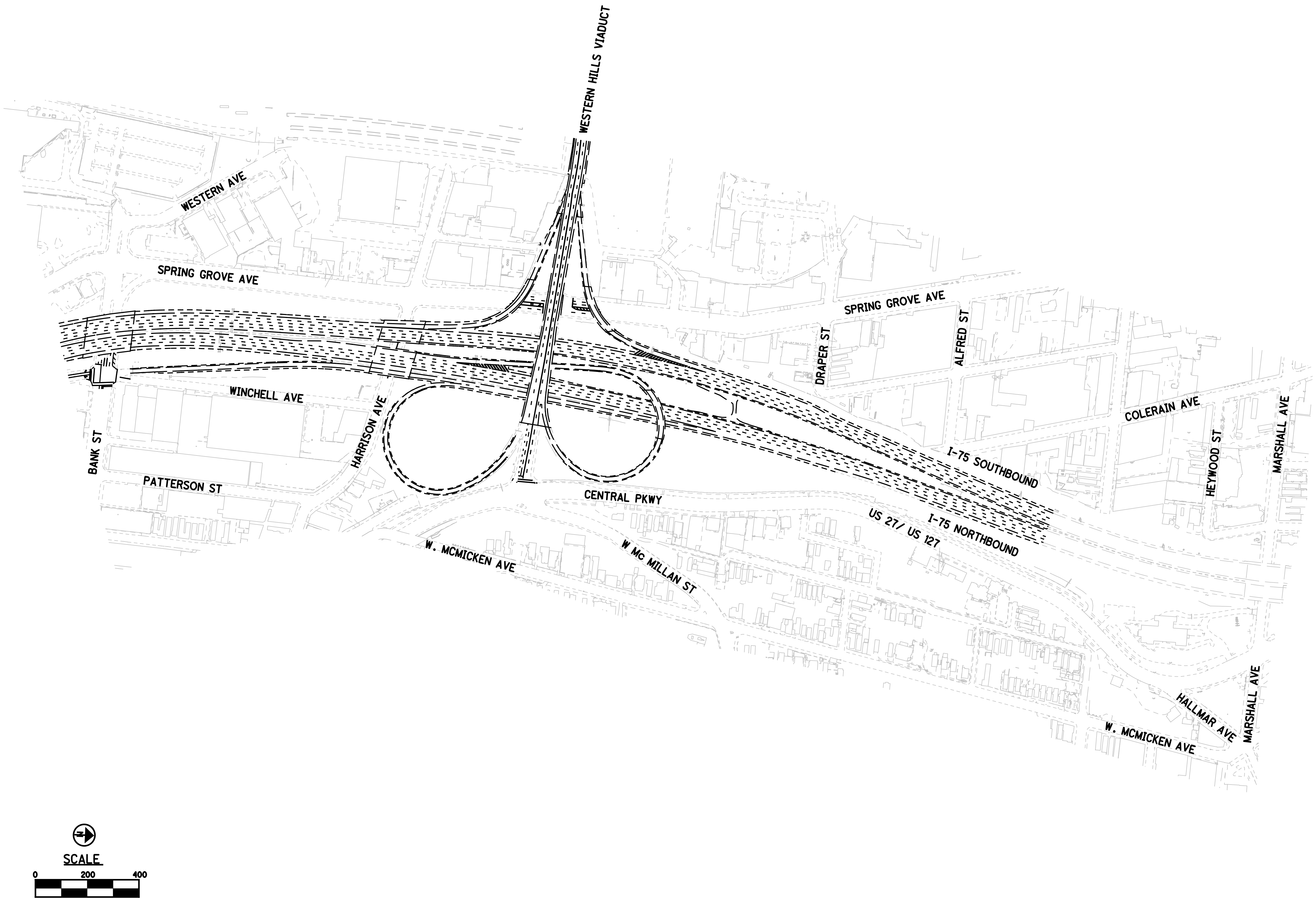
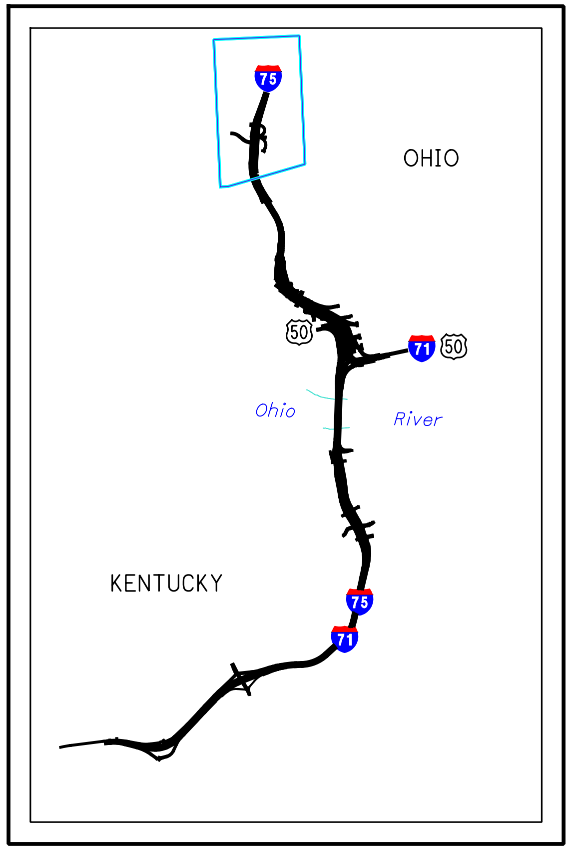
NO BUILD ALTERNATIVE

EXHIBIT
6 of 7

Prepared by:
PB PARSONS BRINCKERHOFF





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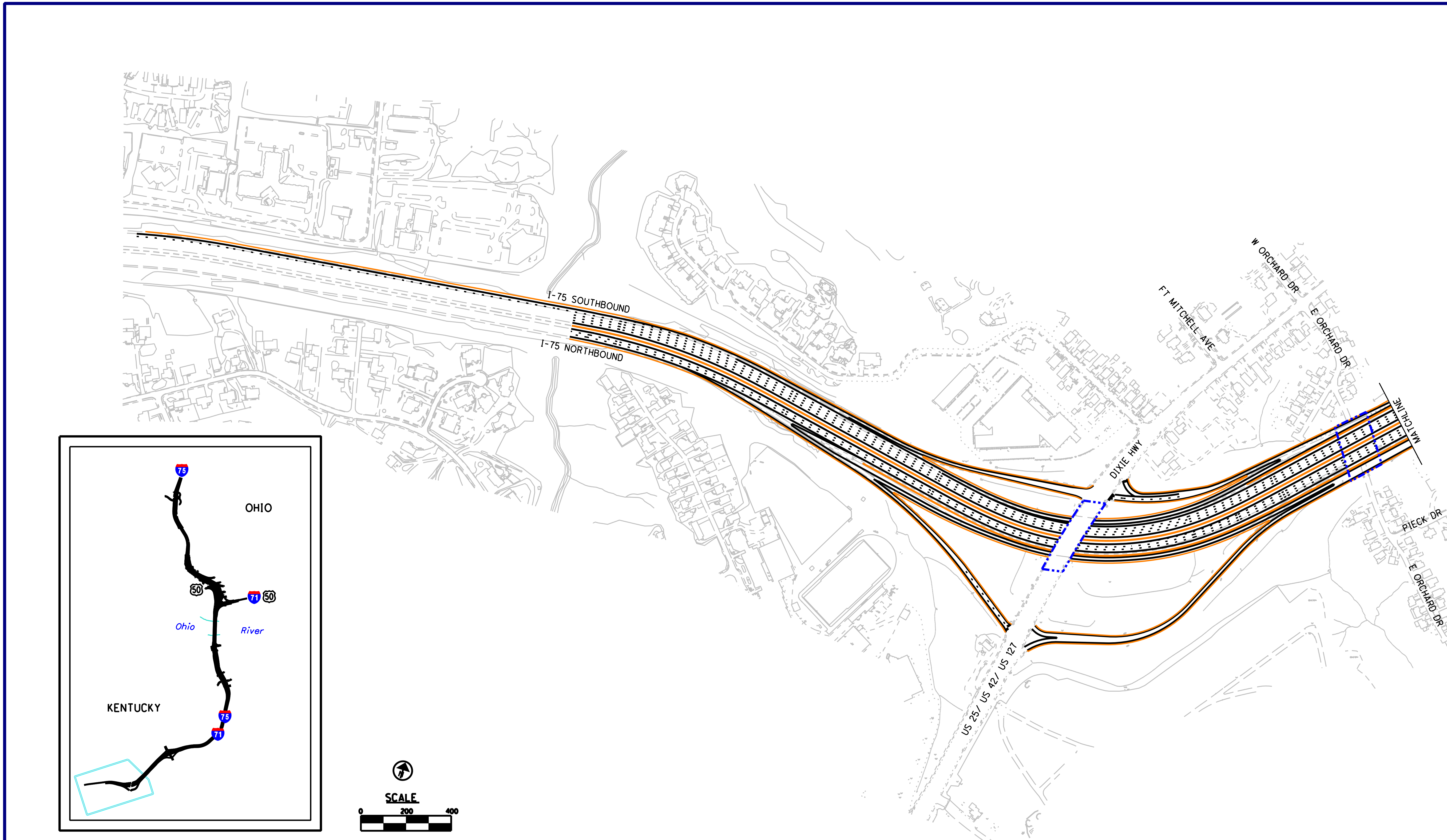
NO BUILD ALTERNATIVE

EXHIBIT
7 of 7

Prepared by:
PARSONS BRINCKERHOFF



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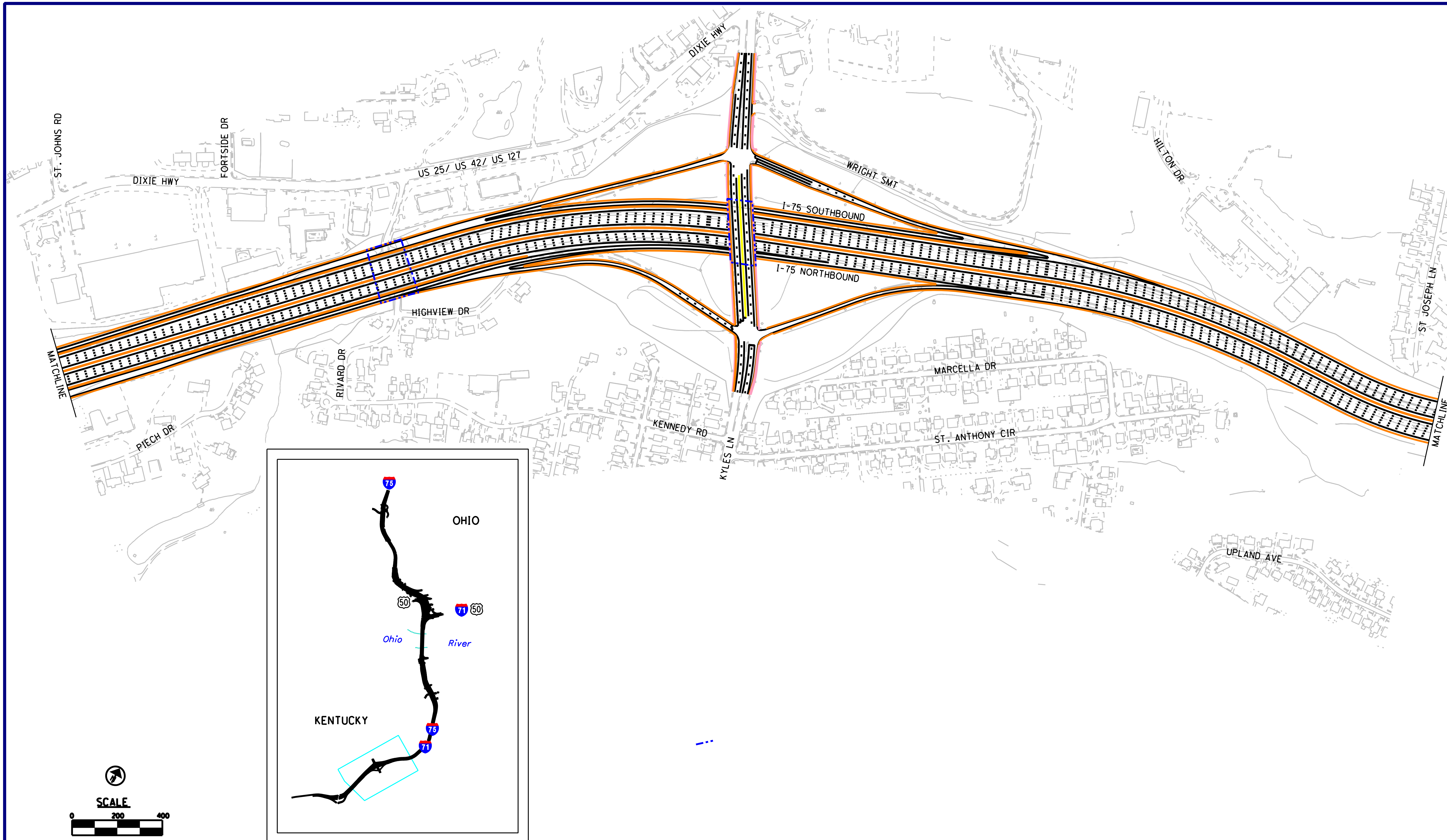
RECOMMENDED PREFERRED ALTERNATIVE
(ALTERNATIVE I)

EXHIBIT
1 of 7

Prepared by
PARSONS BRINCKERHOFF



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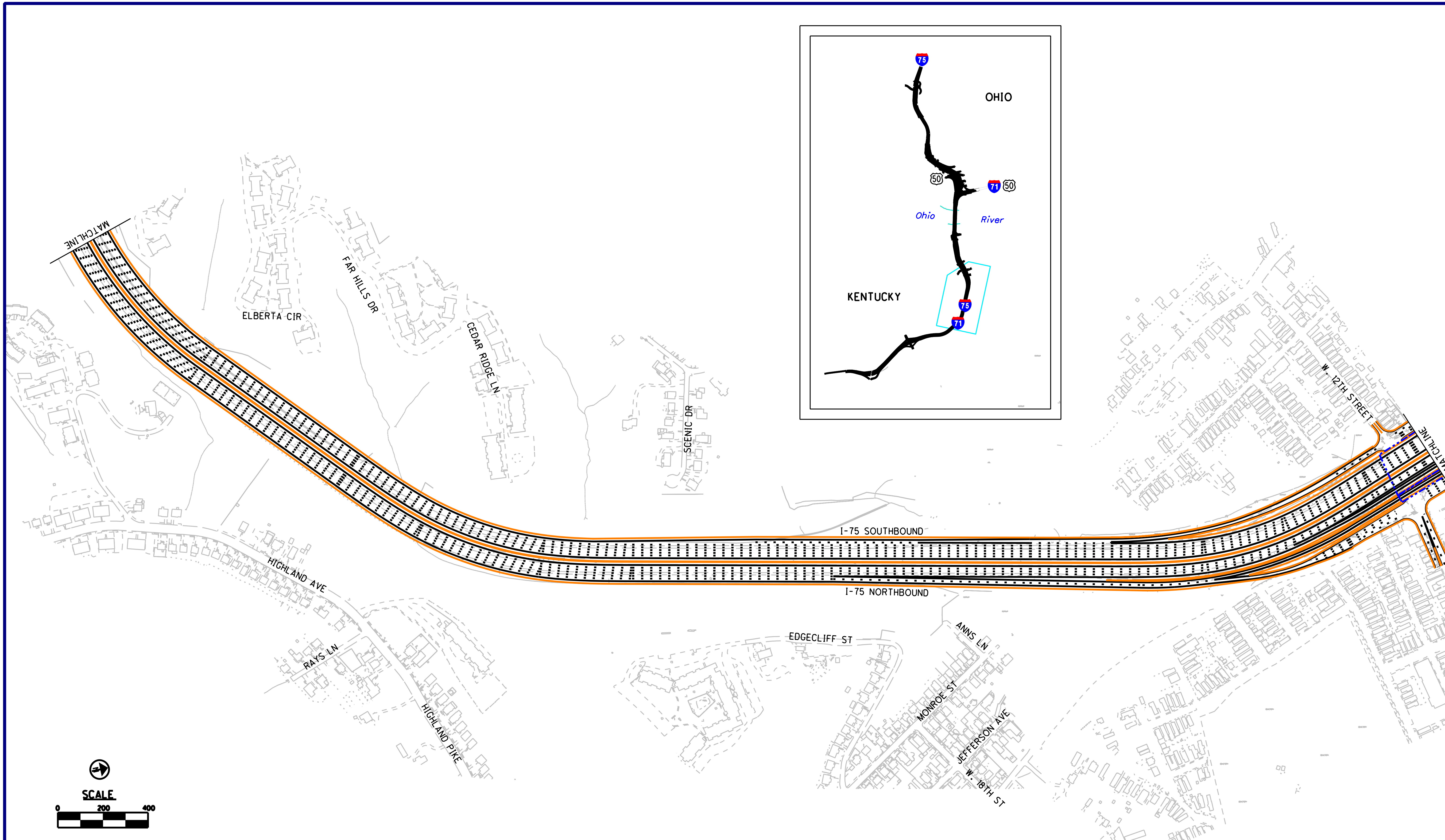
RECOMMENDED PREFERRED ALTERNATIVE (ALTERNATIVE I)

EXHIBIT
2 of 7

Prepared by
PARSONS BRINCKERHOFF



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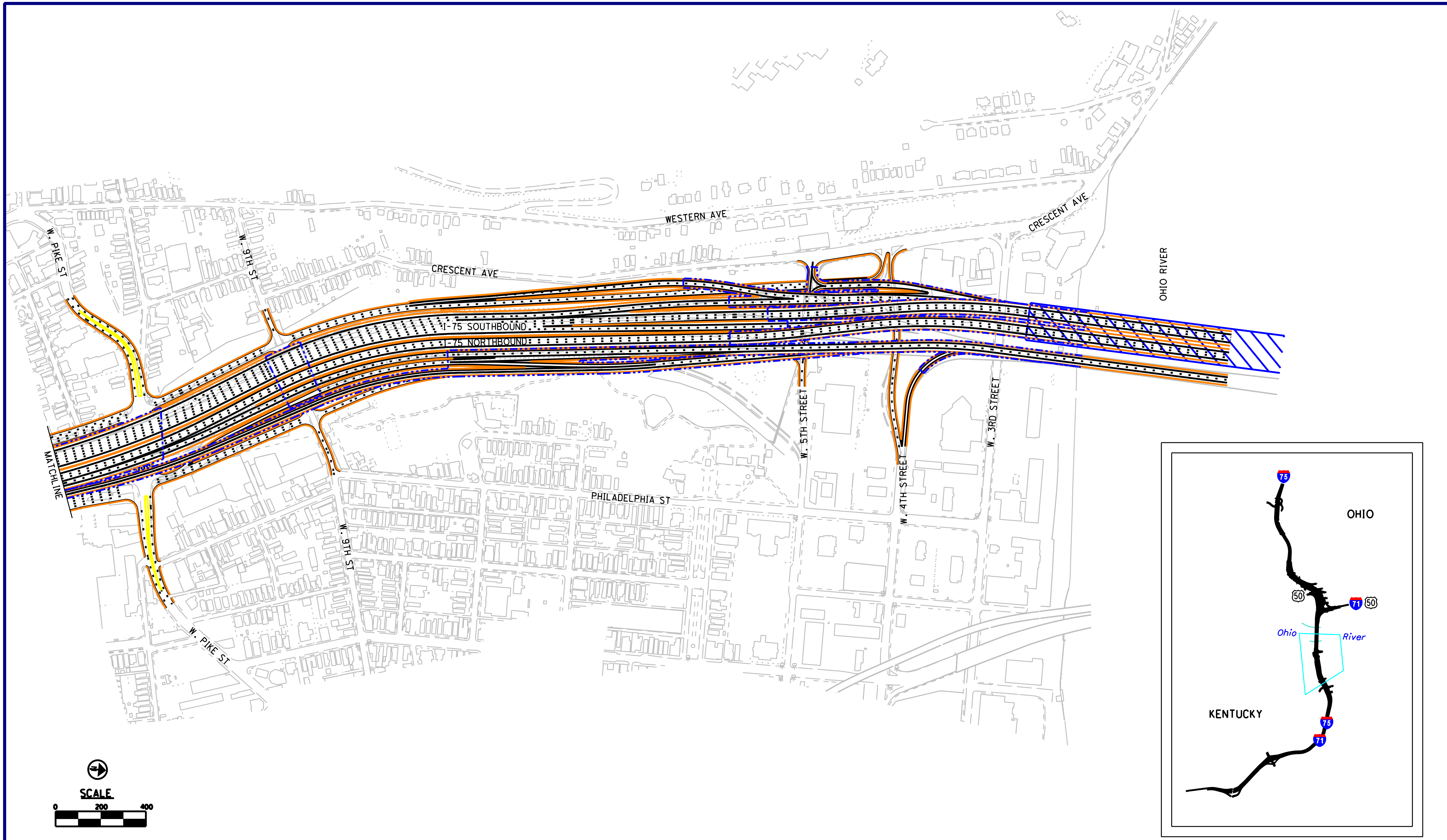
RECOMMENDED PREFERRED ALTERNATIVE (ALTERNATIVE I)

EXHIBIT

3 of 7

Prepared by:
PARSONS BRINCKERHOFF



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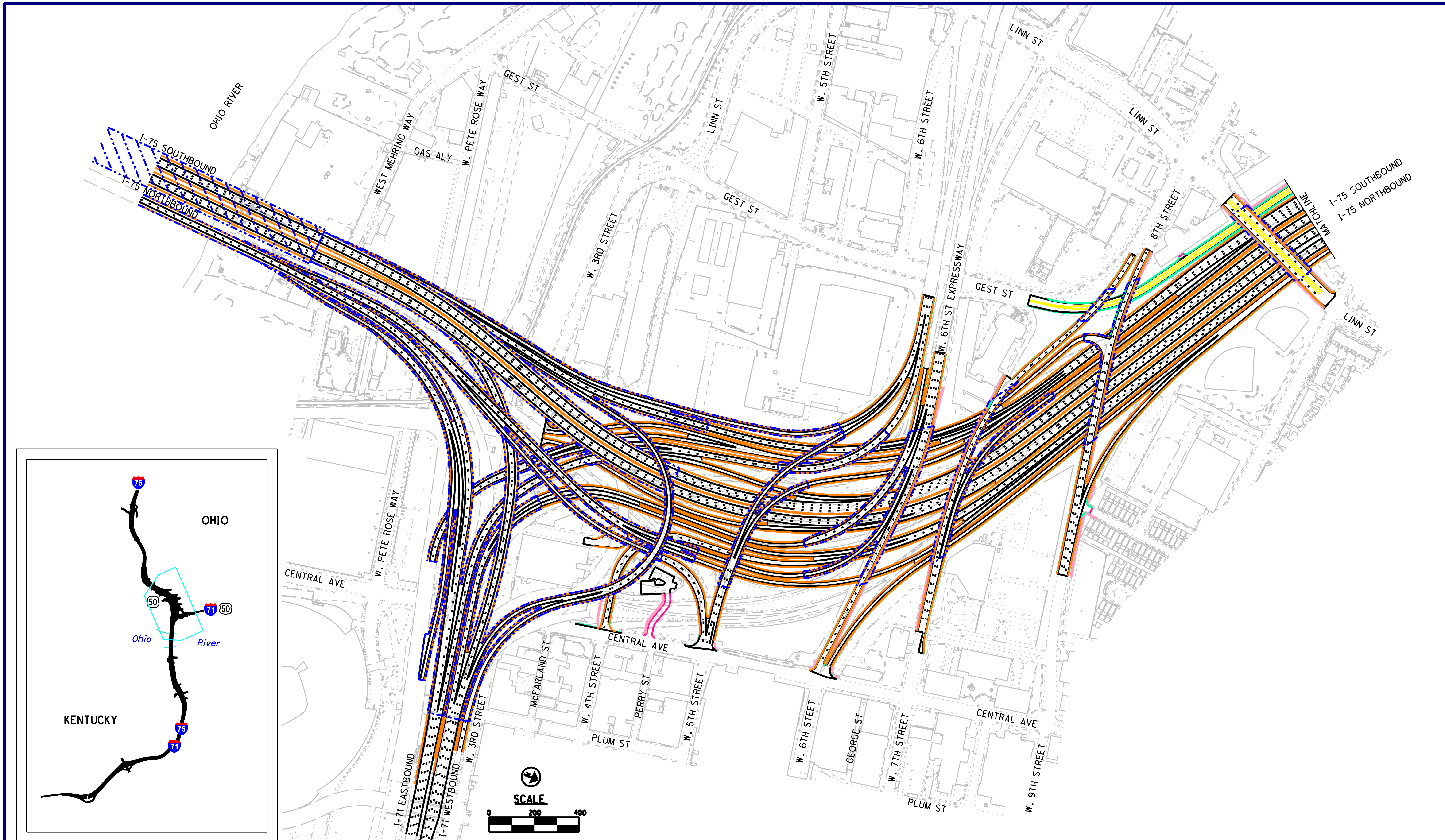
RECOMMENDED PREFERRED ALTERNATIVE (ALTERNATIVE I)

EXHIBIT
4 of 7

Prepared by
PARSONS BRINCKERHOFF



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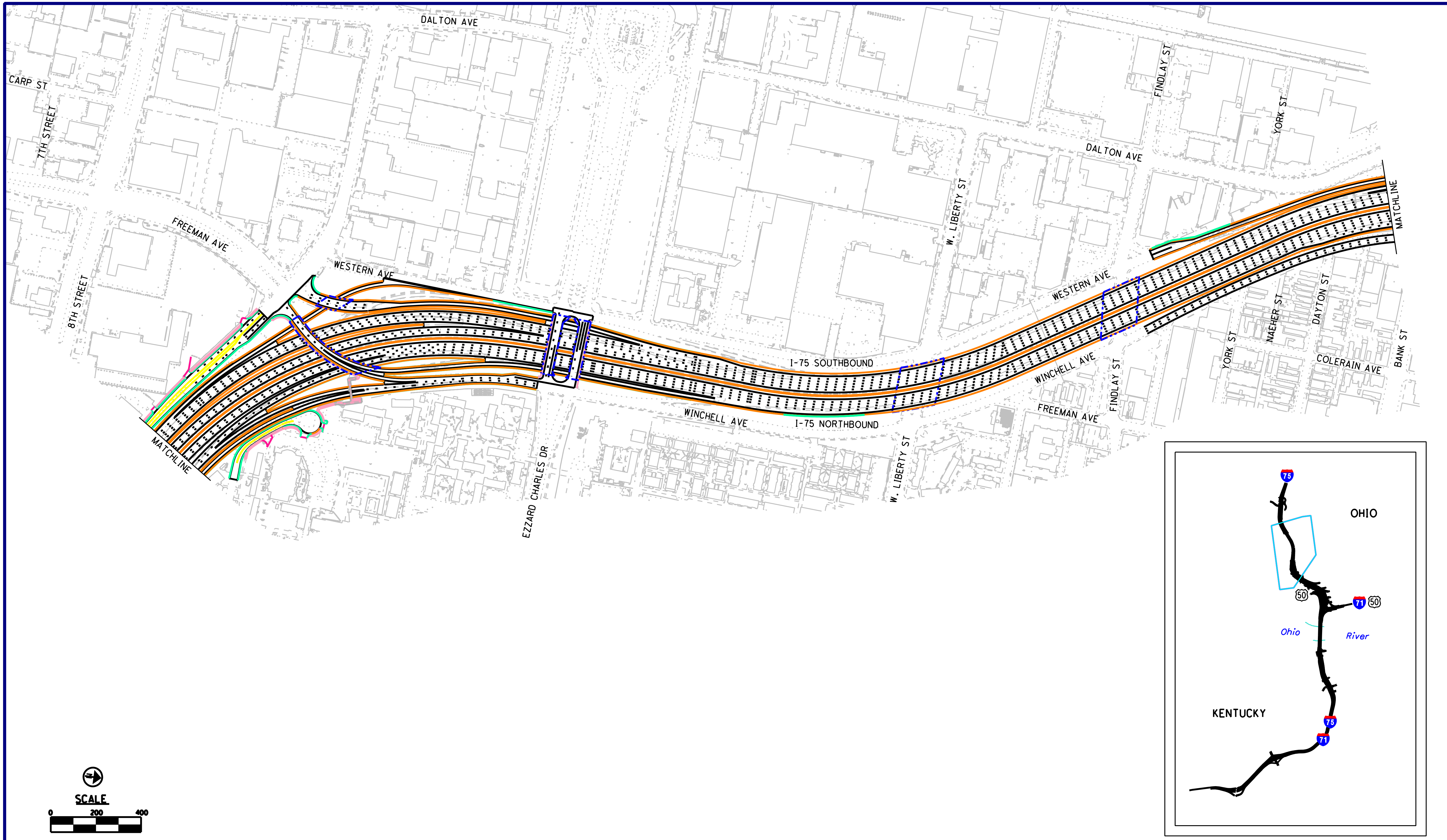
RECOMMENDED PREFERRED ALTERNATIVE
(ALTERNATIVE I)

EXHIBIT
5 of 7

Prepared by:
PARSONS BRINCKERHOFF



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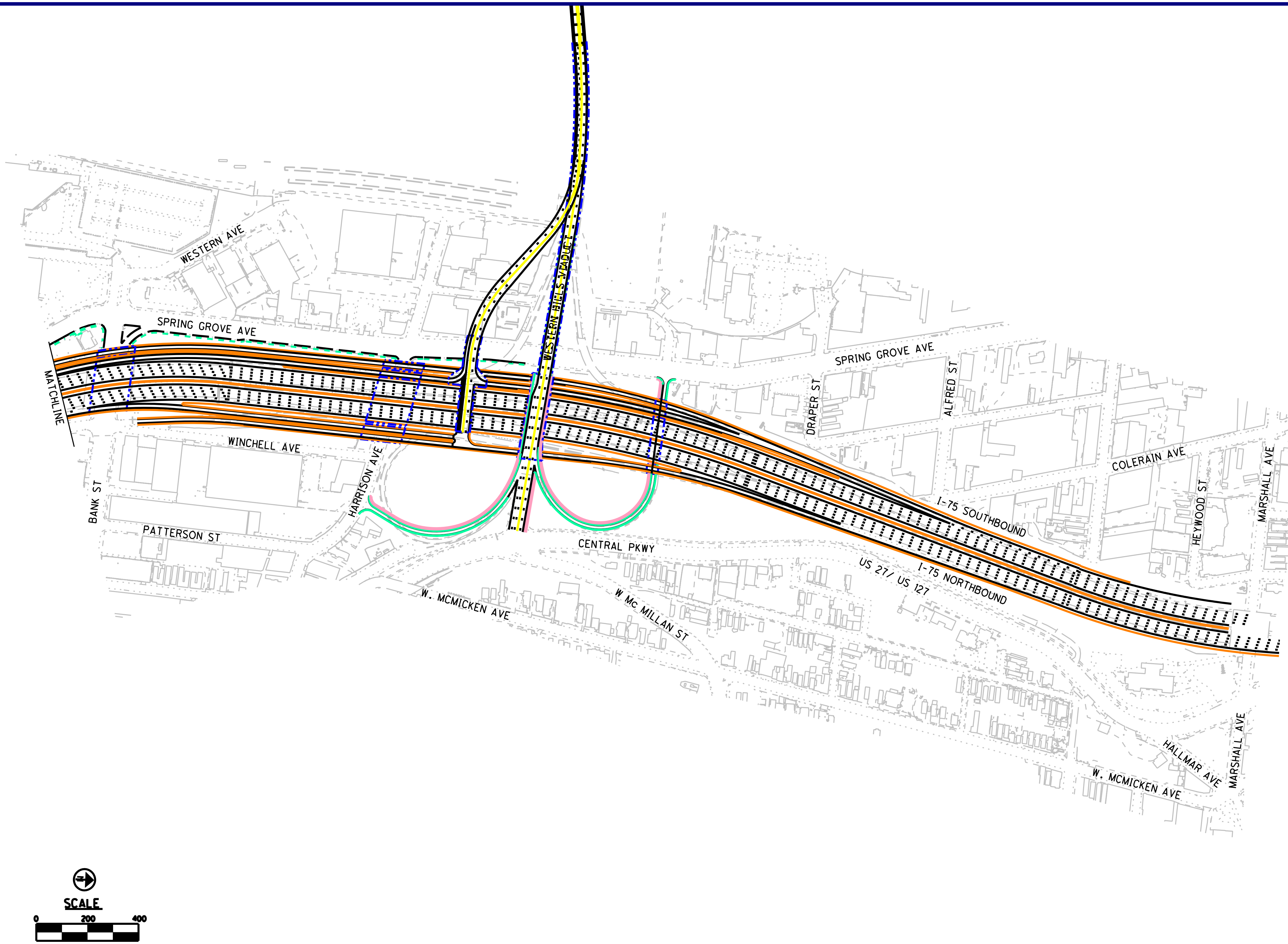
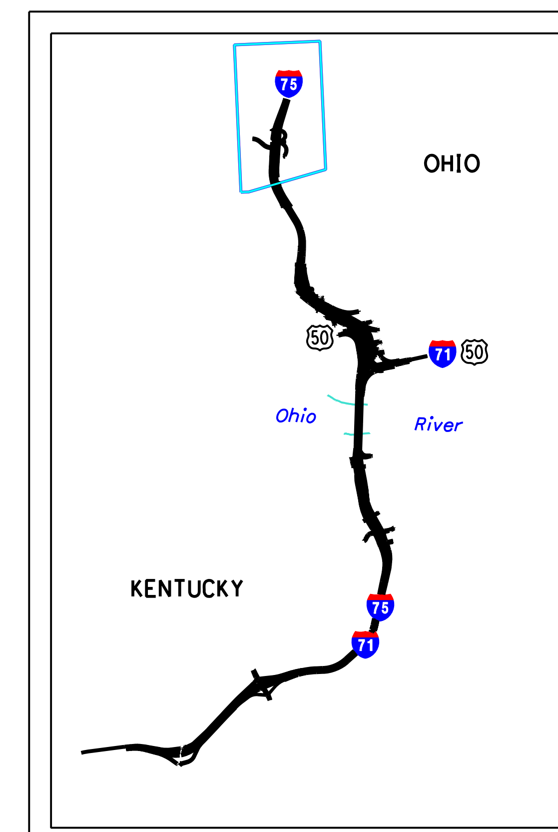
Federal Highway Administration

RECOMMENDED PREFERRED ALTERNATIVE (ALTERNATIVE I)

EXHIBIT
6 of 7

Prepared by
PARSONS BRINCKERHOFF





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Federal Highway Administration

RECOMMENDED PREFERRED ALTERNATIVE (ALTERNATIVE I)

EXHIBIT
7 of 7

Prepared by
PARSONS BRINCKERHOFF

Appendix C
Certified Traffic

MEMORANDUM

TO: **Mark Byram, PE**
Ohio Department of Transportation

Susan Swartz, PE, AICP
TranSystems Corporation

FROM: **Randy Kill, PE, PTOE**
Paul Dorothy, PhD, PE, AICP

SUBJECT: **30th Highest Hour Adjustment Factor**

January 6, 2005

The purpose of this memo is to develop a single factor that can be applied to traffic counts to estimate the 30th highest hour volume. This factor will be used for the HAM-75-10.10, HAM 75-2.30 and the Brent Spence Bridge Studies located on Interstate 75 in Hamilton County, Ohio and Kenton County, Kentucky. The purpose of this factor is to tie all three projects together traffic wise and provide results for all three that are based on the same assumptions.

<u>Basic Assumption</u>
When developing the procedure to determine the 30th highest hour volume, the following assumption was used: in a major urban area like Cincinnati, the weekday (Monday-Friday) peak hour volume will remain fairly constant regardless of the day of the week or month of the year. With this assumption as a basis, it is reasonable to assume that the typical weekday peak hour volume will be pretty close to the 30th highest hour volume. With that in mind, the procedure was developed.

<u>Procedure</u>
The 30th highest hour factor was developed using the following procedure. Automatic traffic recorders (ATR) were identified in the study area and hourly counts were obtained for each ATR for an entire year. From the counts, the peak hour volume for each weekday, excluding holidays, was identified and the average weekday peak hour volume for the entire year was calculated for each location. The count data was also used to determine the 30th highest hour volume for each location. Next, a 30th highest hour adjustment factor was calculated for each ATR. This factor is simply the 30th highest hour volume divided by the average weekday volume. Finally, the 30th highest hour adjustment factors were averaged for all the locations to arrive at the final 30th highest hour adjustment factor that will be used for the fore mentioned projects.

<u>ATR Locations</u>
The following ATR were identified and used in this analysis. All are bi-directional unless noted.

- ATR 528 South – This ATR is located on I-75 around milepost 6, just south of the Mitchell Avenue interchange. This counter in the southbound direction only, and 2003 data was used.
- ATR 524 – This ATR is located on I-75 at approximately milepost 15, which is south of the Sharonville Road interchange. The 2003 calendar year was used for this location.
- ATR 157 – This ATR is located on I-275, approximately one mile east of I-75. The count data was from 2003.
- ATR 93 (KY) – This ATR is located on I-71/75 in Kentucky. It is around milepost 189, which is between the Kyles Lane and 12th Street interchanges. Because incomplete data was available for 2003, 2002 data was used.

Calculations

Table 1 shows the average weekday peak hour volume, 30th highest hour volume, and 30th highest hour adjustment factors for the ATR locations.

TABLE 1

ATR	Average Weekday Peak Hour Volume	30th Highest Hour Volume	30th Highest Hour Adjustment Factor
528 South	5642	5940	1.053
524	9724	10350	1.064
157	9846	10300	1.046
93 KY	11583	12226	1.059

Averaging the 30th highest hour adjustment factors from Table 1 gives a factor of 1.056**.**

Conclusions

Because the 30th highest hour adjustment factors for the four ATR locations are very close to 1.00, the assumption that the typical weekday peak hour volume is close to the 30th highest hour volume is supported. This in turn validates the procedure used to determine the adjustment factor. Therefore, the factor that will be used on the three projects to develop 30th highest hour volumes is **1.056**. This factor will be applied to all AM and PM peak hour counts. The counts should not be seasonally adjusted.

MEMORANDUM

TO: **Susan Swartz, PE, AICP**
TranSystems Corporation

FROM: **Randy Kill, PE, PTOE**
Paul Dorothy, PhD, PE, AICP

SUBJECT: **Coordination of Traffic Projections for the Three HAM-75 Projects**

March 9, 2005

The purpose of this memo is to outline the procedure used to generate and coordinate the traffic projections for the HAM-71-0.00 Brent Spence Bridge, HAM-75-2.30 Mill Creek Expressway and the HAM-75-10.10 Thru the Valley projects. The projections will be used for planning level analysis on the above projects and the procedure is designed to provide a consistent set of traffic data between the three projects. The goal is that the preferred alternatives coming out of the separate projects will fit together nicely since the traffic projections were all generated in the same manner. These projections do not represent Certified Traffic forecasts, simply reasonable forecasts that will allow the selection of a preferred alternative.

Adjustment Procedures for Raw Travel Demand Results

30th Highest Hour

To develop 30th highest hour volumes, the raw AM and PM traffic counts are multiplied by the 30th highest hour adjustment factor of 1.056. This generates the volumes that will be used as the existing conditions. Development of the 30th highest hour adjustment factor is outlined in the January 6, 2005 "30th Highest Hour Adjustment Factor" memorandum by Burgess & Niple, Inc.

Refined 2030 Baseline Projections

The Baseline is defined as the 2030 No-Build condition. For this procedure, 2004 and 2030 Baseline OKI regional travel demand model assignments for the AM and PM peak hours are used to calculate the refined 2030 Baseline projections using a hybrid mix of the ratio and additive methods. These methods are applied on a link-by-link basis.

<u>Ratio Method</u>

$$\text{Refined 2030 Baseline Projection} = \frac{\text{2030 TRANPLAN Baseline}}{\text{2004 TRANPLAN Existing}} \times 30^{th} \text{ Highest Hour Volume}$$

<u>Additive Method</u>

$$\text{Refined 2030 Baseline Projection} = (\text{2030 TRANPLAN Baseline} - \text{2004 TRANPLAN Existing}) + 30^{th} \text{ Highest Hour Volume}$$

Application of the Methods

The purpose of this procedure is to provide a single, relatively simple procedure to develop consistent future traffic projections for all three I-75 studies. This procedure is for planning level purposes only, and is not intended to replace the various methods and engineering judgment used to create Certified Traffic.

For mainline and ramp volumes, the ratio method is applied to all 30th highest hour volumes less than 500 vph, and the additive method is applied to all 30th highest hour volumes 500 vph or greater.

At intersections, the additive method is used for all in and out 30th highest hour link volumes to make the balancing process easier.

Balancing Mainline

Because two different methods are applied to calculate refined 2030 Baseline projections, there will be areas where the applied methodologies overlap causing an imbalance in projections between these adjacent links. To create a balanced network, the following method is used.

- Hold the refined 2030 Baseline projections for all the ramps in the network constant.
- Use the 2030 Baseline projections for the master mainline section.
- Add and subtract the on and off-ramp projections to the mainline projection to create balanced mainline projections.

Balancing Intersections

The intersections are balanced so that the total inbound link projection is equal to the total outbound link projection. Because the additive method is used for all intersection links, most intersections will already be balanced. Due to discrepancies in the travel demand model network, some intersections will not balance. These discrepancies include missing approaches at intersections, missing intersections and movements either prohibited or allowed in the travel demand model that do not correspond to the real conditions. The following process is used when intersections do not balance:

- Make sure as much information is being used from the travel demand model as possible, even if this means using the same assignment as an inbound and outbound volume for intersections that are not coded in the network.
- For intersections that have ramps entering or exiting, make sure the intersection projection matches the ramp projection from the balanced mainline projection.
- Use engineering judgment to adjust the remaining inbound and outbound projections to balance the intersection.

Turning Movement Projections

Once the intersection inbound and outbound link projections are balanced, the turning movements are generated. To accomplish this, a spreadsheet is used that was obtained from ODOT Technical Services. The inputs for the spreadsheet are the existing turning movements and the 2030 Baseline inbound and outbound link projections. The spreadsheet then uses the National Cooperative Highway Research Program Report 255, *Highway Traffic Data for Urbanized Area Project Planning and Design* procedures to generate 2030 Baseline turning movement projections.

Operational Modeling

It should be noted that the procedure used for 2030 Baseline projections does not always produce intersections that are balanced along the corridor, meaning the projection leaving one intersection is not the same that arrives at the next intersection. These variations are caused by centroids in the travel demand model. The centroids represent things like parking lots, shopping centers, residential units, etc. To account for these in the operational model, midbolck source and sink nodes need to be inserted to add and remove the traffic.

Project Coordination

HAM-71-0.00 (Brent Spence Bridge)

Add the following raw ramp count to the existing traffic count program:

I-75 SB off-ramp to Findlay
AM Peak = 592 vph
PM Peak = 347 vph

Inclusion of this ramp will tie the HAM-71-0.00 traffic projections in with the HAM-75-2.30 project to the north.

Existing AM and PM Peak hour counts will be used for all ramps and intersections. The mainline volumes will be calculated by adding and subtracting the ramp volumes from the master mainline location. The master location for this project is the segment south of the Western Hills Viaduct. Table 1 shows the existing raw counts and 2030 Baseline traffic projections for the master mainline section.

Table 1 – HAM-71-0.00 Master Mainline Projections

Location	Existing Raw		2030 Baseline	
	AM Peak	PM Peak	AM Peak	PM Peak
SB I-75, North of Findlay off-ramp	8530	5343	9985	7662
NB I-75, North of Ezzard Charles on-ramp	4440	7151	6700	8779

Follow the Adjustment Procedures for Raw Travel Demand Results, outlined above, to calculate the 30th highest hour and 2030 Baseline traffic projections.

HAM-75-10.10 (Thru the Valley)

To coordinate the traffic counts and 2030 projections of this project with the process used for HAM-75-2.30 and HAM-71-0.00, the raw AM and PM peak hour volumes from each individual ramp count should be used. These volumes will replace the existing volumes previously calculated using AADT, k and d factors. The mainline volumes will then be calculated by adding and subtracting the ramp counts from the master mainline location. The master location for this project is the segment just north of the Paddock Road interchange. Table 2 shows the existing raw counts and 2030 Baseline traffic projections for the master mainline section.

Table 2 – HAM-75-10.10 Master Mainline Projections

Location	Existing Raw		2030 Baseline	
	AM Peak	PM Peak	AM Peak	PM Peak
SB I-75, North of Paddock Rd off-ramp	6875	6569	8495	8113
NB I-75, North of Paddock Rd on-ramp	6214	6322	7710	7842

Follow the Adjustment Procedures for Raw Travel Demand Results, outlined above, to calculate the 30th highest hour and 2030 Baseline traffic projections.

Alternatives Analysis

2030 Baseline OKI regional travel demand model assignments and 2030 Alternative OKI regional travel demand model assignments for the AM and PM peak hours are used to calculate the refined 2030 Alternative projections using a hybrid mix of the ratio and additive methods. These methods are applied on a link-by-link basis.

Ratio Method

$$\text{Refined 2030 Alternative Projection} = \frac{\text{2030 TRANPLAN Alternative}}{\text{2030 TRANPLAN Baseline}} \times \text{Balanced Refined 2030 Baseline Projections}$$

Additive Method

Refined 2030 Alternative Projections = (2030 TRANPLAN Alternative – 2030 TRANPLAN Baseline) + Balanced Refined 2030 Baseline Projections

Application of the Methods
For mainline and ramp volumes, the ratio method is applied to all Balanced Refined 2030 Baseline projections less than 500 vph, and the additive method is applied to all Balanced Refined 2030 Baseline projections 500 vph or greater.

At intersections, the additive method is used for all in and out Balanced Refined 2030 Baseline projections to make the balancing process easier

Balancing Mainline
Because two different methods are applied to calculate refined 2030 Alternative projections, there will be areas where the applied methodologies overlap causing an imbalance in projections between these adjacent links. To create a balanced network, the following method is used.

- Hold the refined 2030 Alternative projections for all the ramps in the network constant.
- Hold the refined 2030 Alternative projections for the master mainline section constant.
- Add and subtract the on and off-ramp projections to the mainline projections to create balanced mainline projections.

Intersections will be balanced and turning movements generated using the Adjustment Procedures for Raw Travel Demand Results outlined earlier.

Special Considerations
Alternatives that do not include any change of access (e.g. widening) will follow the above procedure.

For alternatives that modify access but do not add or eliminate access points (e.g. braiding existing ramps) special care must be taken so that the roadway network of the Balanced Refined 2030 Baseline projections matches the roadway network of the alternative. It will be necessary to recalculate the Balanced Refined 2030 Baseline mainline projections based on the new ramp configurations.

Alternatives that add or eliminate existing access points will require additional consideration. As much information as possible needs to be used from the 2030 Alternative travel demand network. Finally, engineering judgment will be required at to generate balanced projections for locations where the access has changed.

MEMORANDUM

TO: **Jay Hamilton, PE**
ODOT District 8

FROM: **Randy Kill, PE, PTOE**
Paul Dorothy, PhD, PE, AICP

SUBJECT: **Coordination of Mainline Traffic Projections for the Three HAM-75 Projects**

March 30, 2005

The purpose of this memo is to discuss the thought process used to generate the raw mainline traffic volumes and provide an explanation for the discrepancies between the new volumes and those previously used. This memo will focus on the mainline discrepancies at the Sharonville Road interchange.

Determination of Master Mainline Volume

To tie the mainline traffic volumes of the three projects together, it was necessary to find one location within any of the three study areas that represented a good average day count. From this count, all the ramp volumes were added and subtracted through all three study areas to create uniform traffic volumes. Three potential locations were identified:

- ATR 528 South, just south of the Mitchell Avenue interchange
- ATR 524, just south of the Sharonville Road interchange
- Brent Spence Bridge

ATR 528 South was removed because it only counts in the southbound direction and both north and southbound volumes were needed.

ATR 524 was not chosen because the flow appears to be counterintuitive; with the northbound being the peak direction in both the AM and PM peaks. Engineering judgment says that the peak AM direction should be southbound into the CBD. Also, ME's Existing and Future Conditions report shows an LOS F in the southbound direction just south of ATR 524, it is possible that the flow is queued or metered on the ATR, and capacity is being counted instead of demand.

The Brent Spence Bridge volumes were counted as part of the Brent Spence Bridge Feasibility and Constructability Study. They were counted once by Burgess & Niple, and then verified in a separate count by KYTC. After these two separate counts, ODOT, KYTC and OKI all agreed that the counts represented the average day peak hour traffic volumes.

Because of the separate counts for the Brent Spence Bridge and the concerns with the ATR data, the bridge volumes were chosen as the master mainline volumes. Table 1 shows the AM and PM volumes for ATR 528 South, ATR 524 and the Brent Spence Bridge. The ATR data represents the Tuesday, Wednesday and Thursday peak hours for all of 2003, with holidays removed.

Table 1 – Mainline Counts

Location	Northbound		Southbound	
	AM Peak	PM Peak	AM Peak	PM Peak
ATR 528 South	-	-	4800	5670
ATR 524	5200	5280	4390	4140
Brent Spence Bridge	6620	5560	4480	7280

The HAM 75-10.10 Existing and Future Conditions report used data for ATR 524 during April and May 2004. This data was then used to create K and D factors. Using these K and D factors, the following peak hour volumes were generated: 4480/4750 in the northbound direction during the AM and PM peaks, and 4920/3550 in the southbound direction during the AM and PM peaks respectively. A comparison with the 2003 data shows some significant differences. First, with the exception of the southbound AM, all the 2004 data is around 600 vehicles lower than the 2003 volumes. Also, the 2004 AM volumes shows that the southbound direction is clearly the peak direction, while the 2003 data shows a distinct bias to the northbound direction in the AM peak.

With the master mainline location chosen, the raw AM and PM ramp counts for the Brent Spence Bridge and the HAM-75.230 projects, as well as the developed volumes for the HAM 75-10.10 were added and subtracted to balance the mainline through all three study areas. Once this was done, a comparison was made between the newly developed volumes south of Sharonville Road and the actual ATR data there. Table 2 shows this comparison along with the volume difference.

Table 2 – Volume Comparison South of Sharonville Road

Direction	Developed Volumes		ATR 524 Volumes		ATR 524 Difference	
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Northbound	6370	6350	5200	5280	-1170	-1070
Southbound	6210	5240	4390	4140	-1820	-1100

As shown in table 2, the developed volumes are higher than the ATR data. With the exception of the southbound AM volume, all differences are around 1100 vehicles. The larger difference in the southbound AM provided further evidence that something is not right with this counter, possibly metered flow in the AM. To double check the southbound direction, we compared the developed volumes with the actual ATR data for ATR 528 South, just south of the Mitchell Avenue interchange. Table 3 shows this comparison.

Table 3 – Volume Comparisons South of Mitchell Avenue

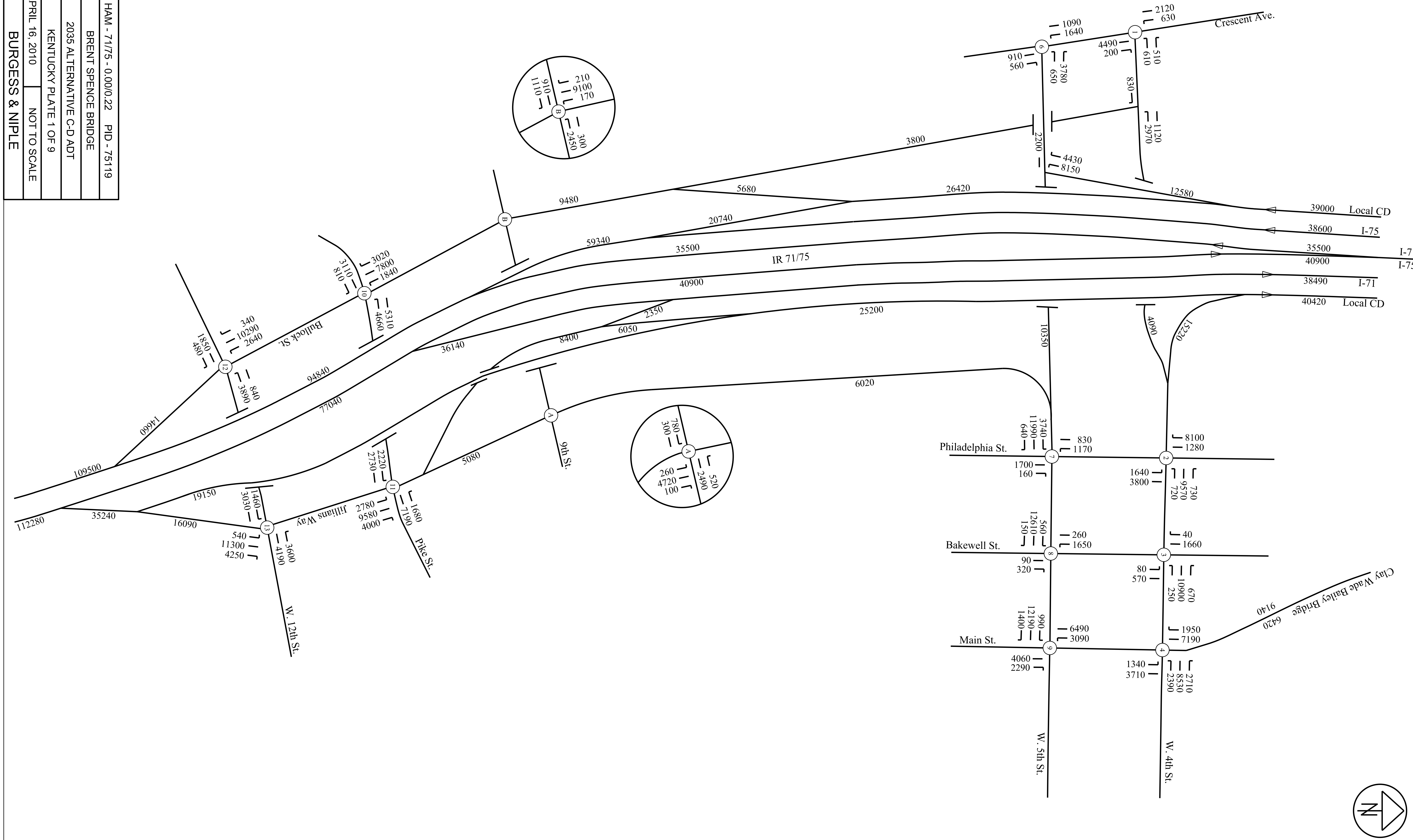
Direction	Developed Volumes		ATR 528 Volumes		ATR 528 Difference	
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Southbound	5410	6150	4800	5670	-610	-480

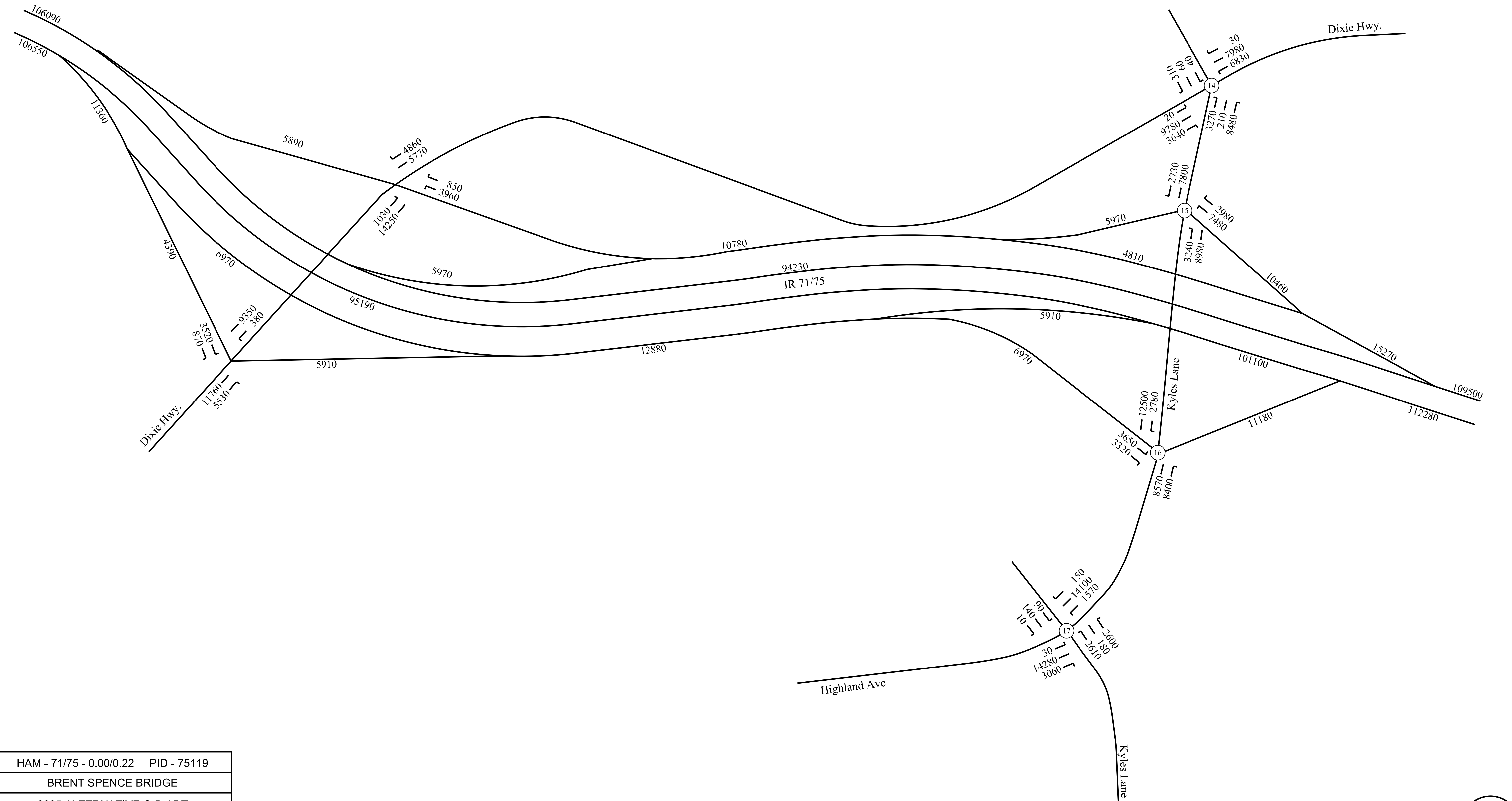
Table 3 shows that the volumes developed using the Brent Spence Bridge as a starting point are close to the ATR data at location 528 South. This provides further validation to the developed volumes at ATR 524.

Conclusions

Based on the data shown above, it appears that if you start with the Brent Spence Bridge mainline volume and add and subtract the ramps to Sharonville Road, the volume ends up around 1100 vehicles higher than the ATR located there. There are two possible explanations for this difference. First, several ramps need to be included in each direction. The counts for these ramps were not performed on the same day, introducing variability to the volumes. Second, the Brent Spence Bridge volumes and the HAM 75-2.30 volumes come from actual peak hour counts. The volumes for the HAM 75-10.10 were developed using K and D factors created from the ATR 524 data (which is suspect). It is possible that once the actual peak hour counts are used for the ramps, the overall difference will decrease. In general, the developed volumes are relatively close, within a half of lane, and on the high side. However, the volumes are based on the most defensible data available in the corridor and should be reliable.

HAM - 71/75 - 0.00/0.22 PID - 75119
BRENT SPENCE BRIDGE
2035 ALTERNATIVE C-D ADT
KENTUCKY PLATE 1 OF 9
APRIL 16, 2010
NOT TO SCALE
BURGESS & NIPLE





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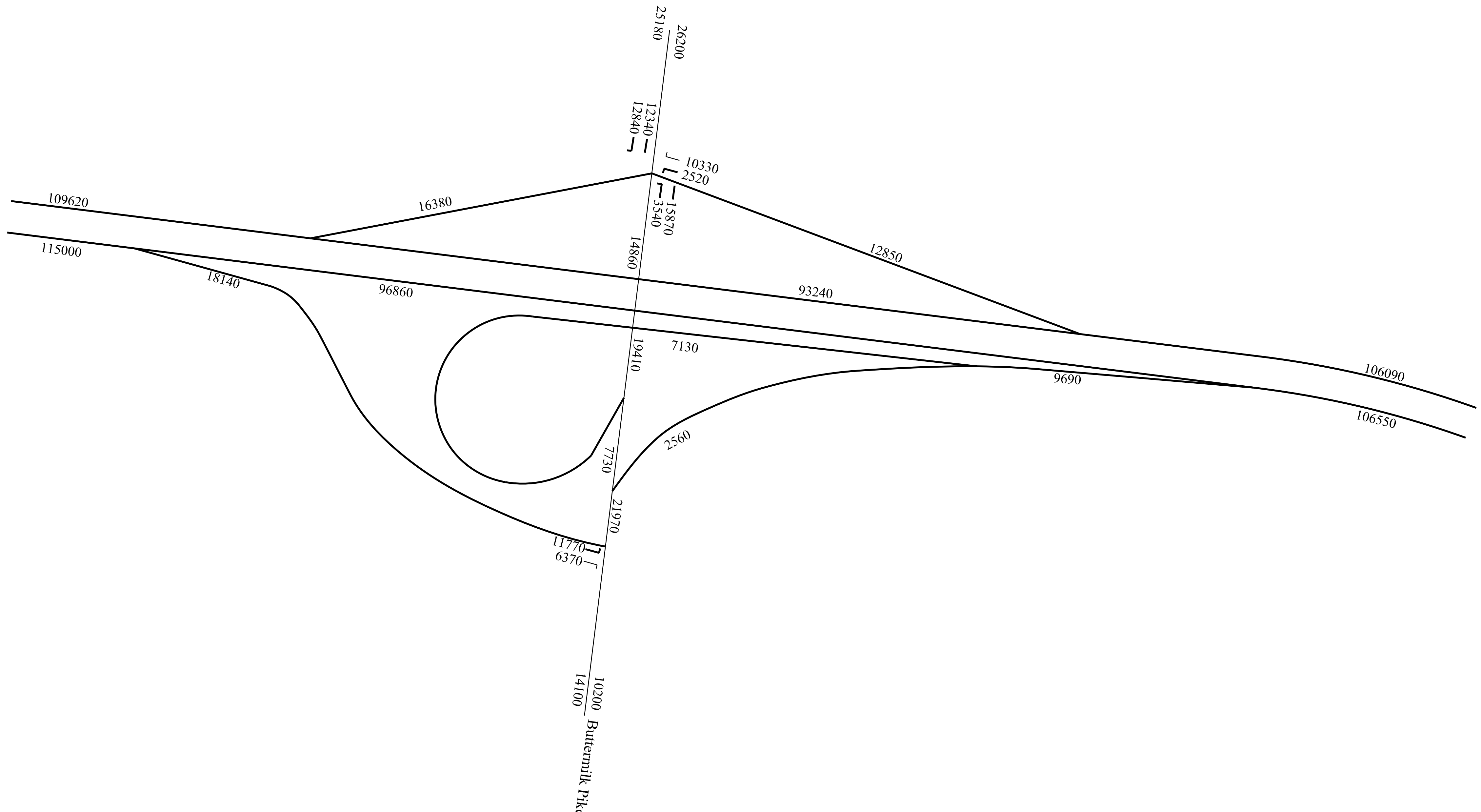
BURGESS & NIPLE	



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2035 ALTERNATIVE C-D ADT	
KENTUCKY PLATE 3 OF 9	
APRIL 16, 2010	NOT TO SCALE
BURGESS & NIPLE	

HAM - 71/75 - 0.00/0.22 PID - 75119

BRENT SPENCE BRIDGE

2035 ALTERNATIVE C-D AM

KENTUCKY PLATE 4 OF 9

JUNE 25, 2010

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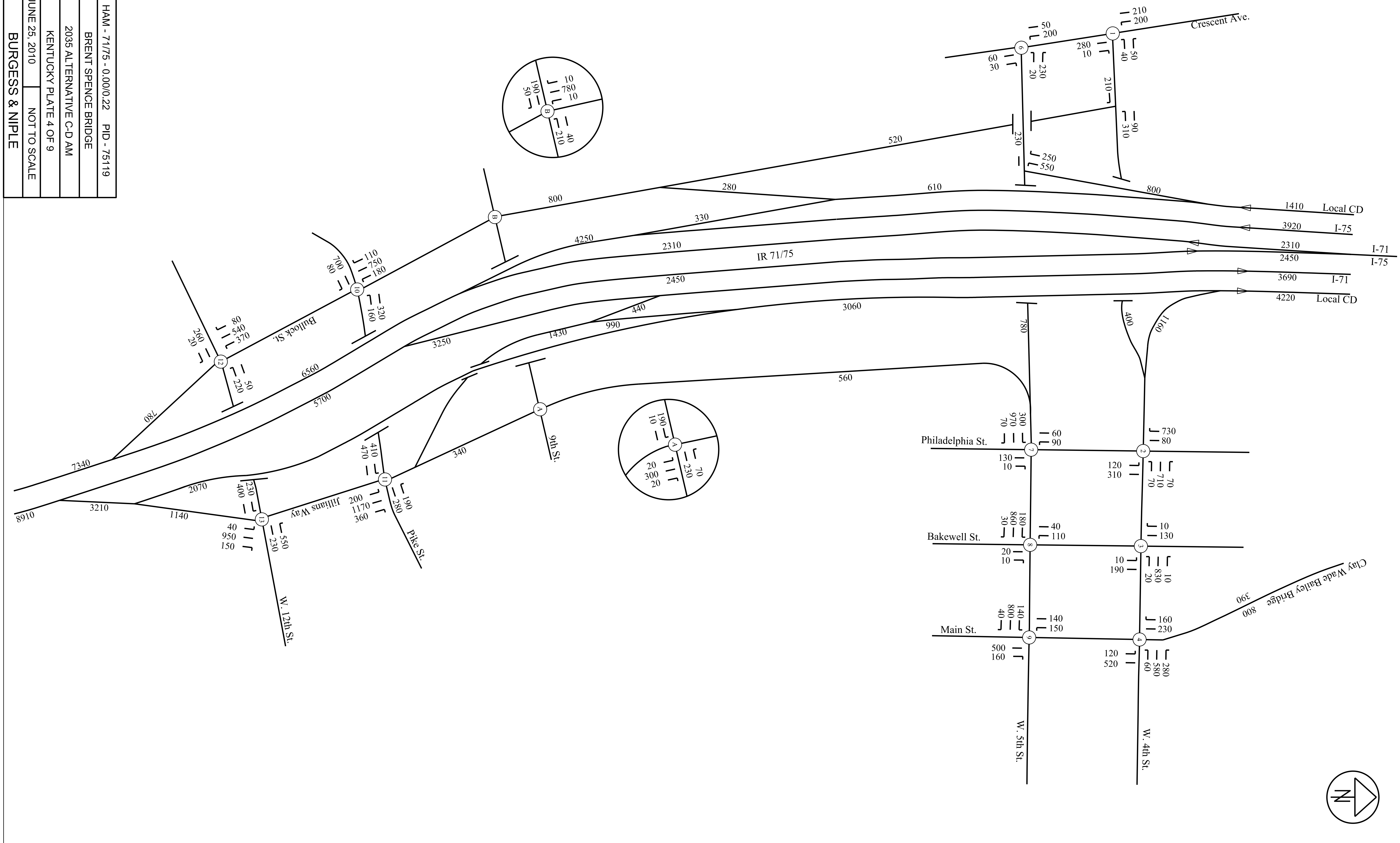

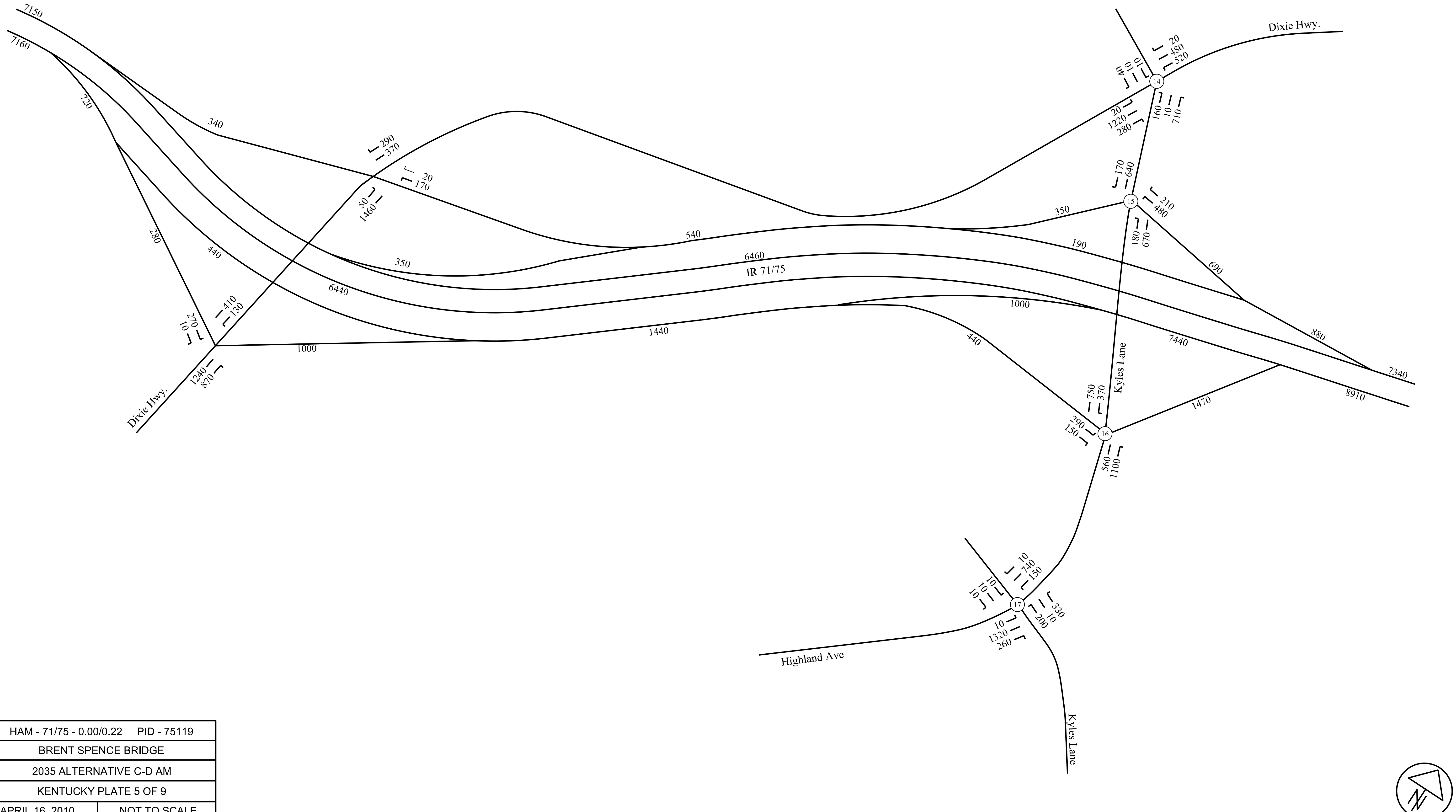

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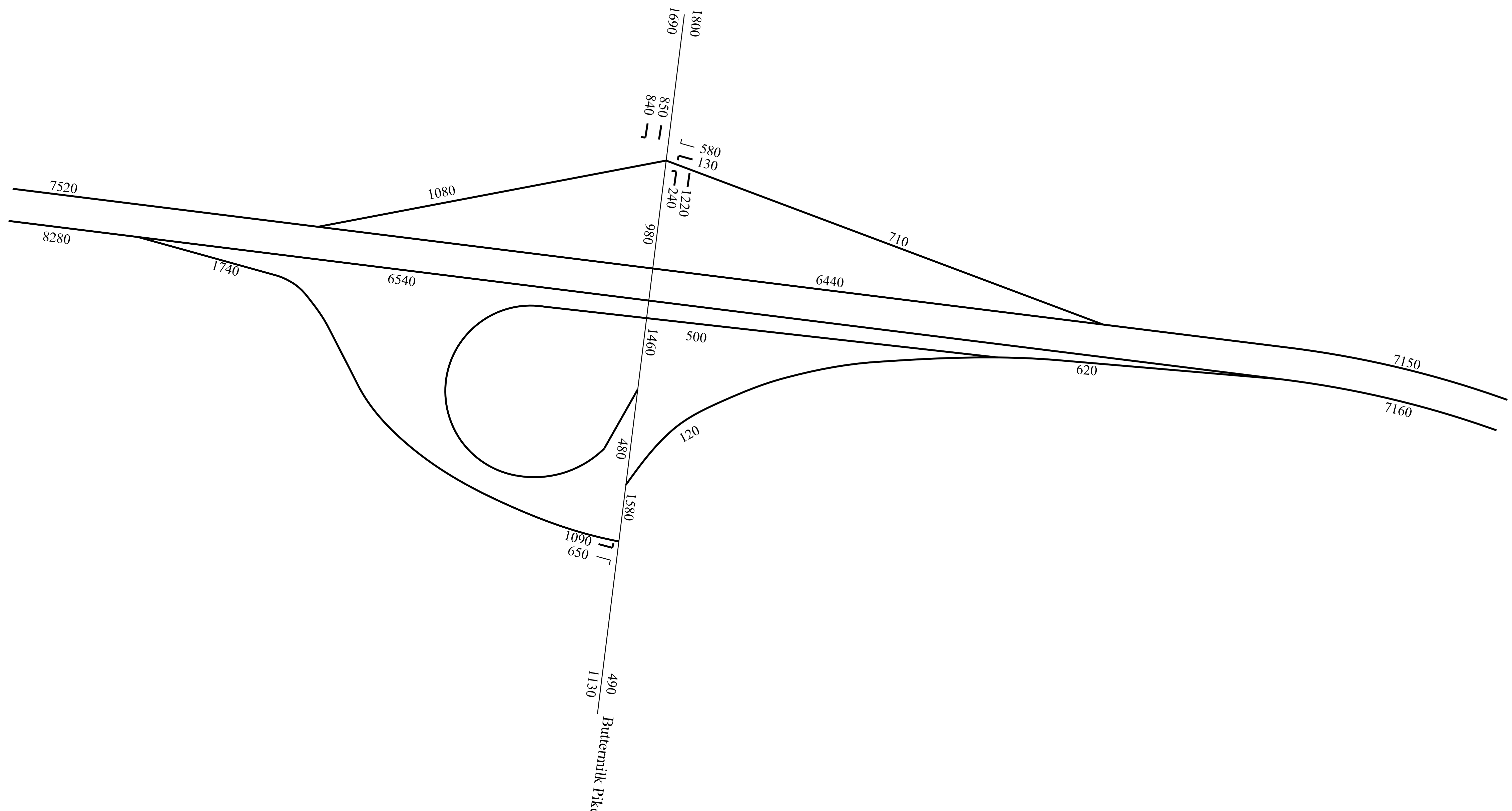
BURGESS & NIPLE	



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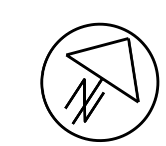


HAM - 71/75 - 0.00/0.22 PID - 75119

BRENT SPENCE BRIDGE

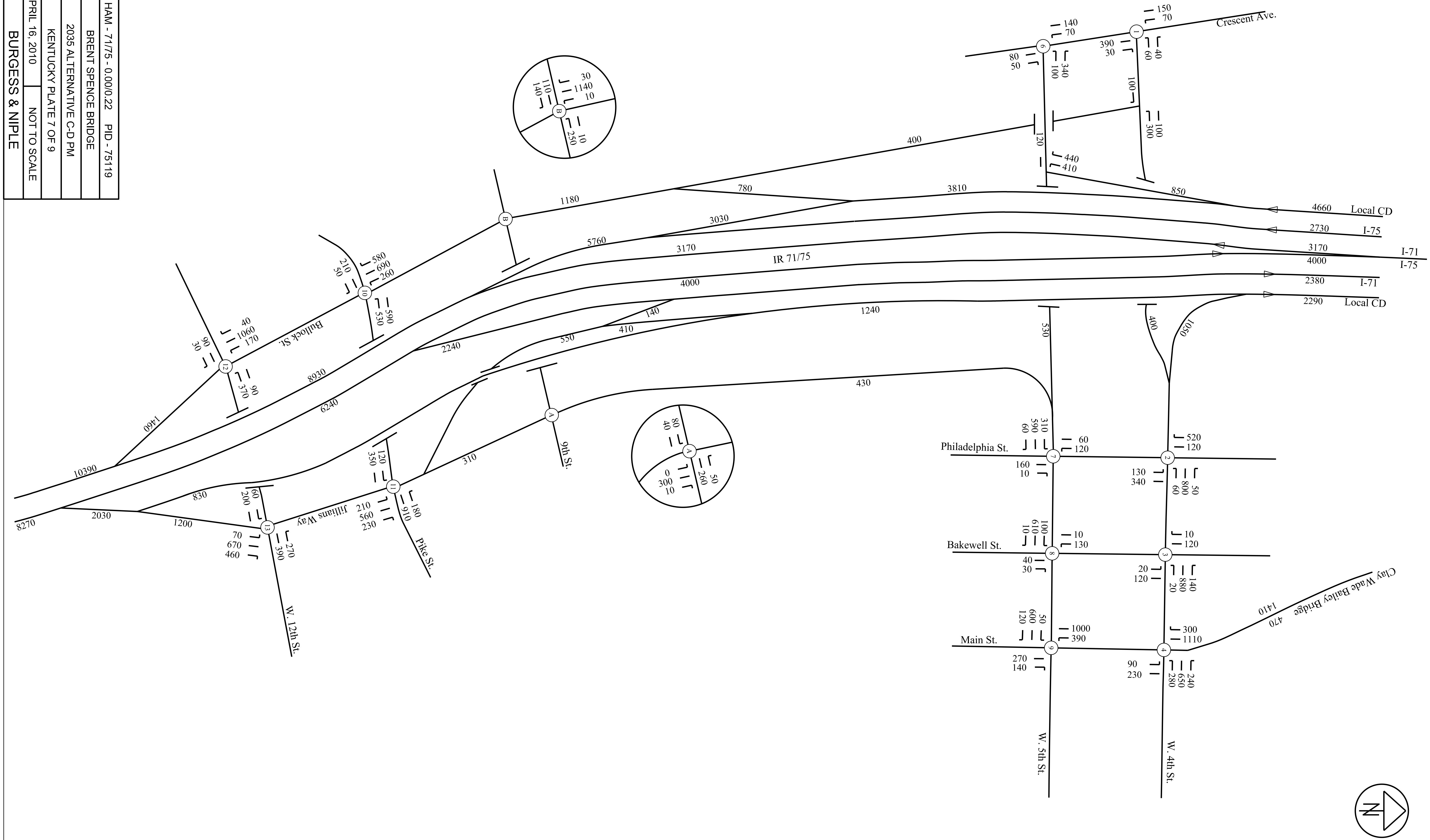
2035 ALTERNATIVE C-D PM

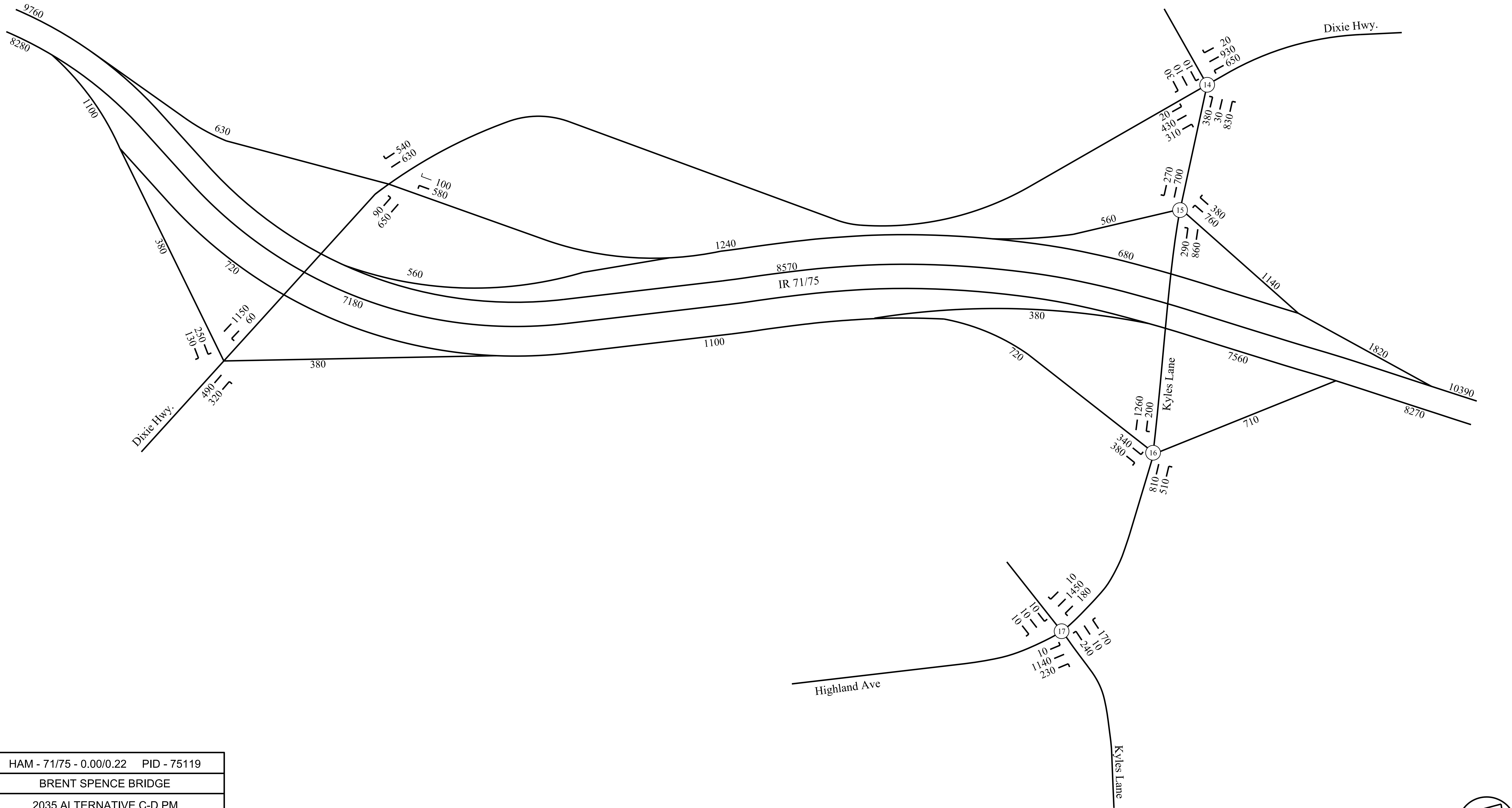
KENTUCKY PLATE 7 OF 9

APRIL 16, 2010

NOT TO SCALE

BURGESS & NIPLE





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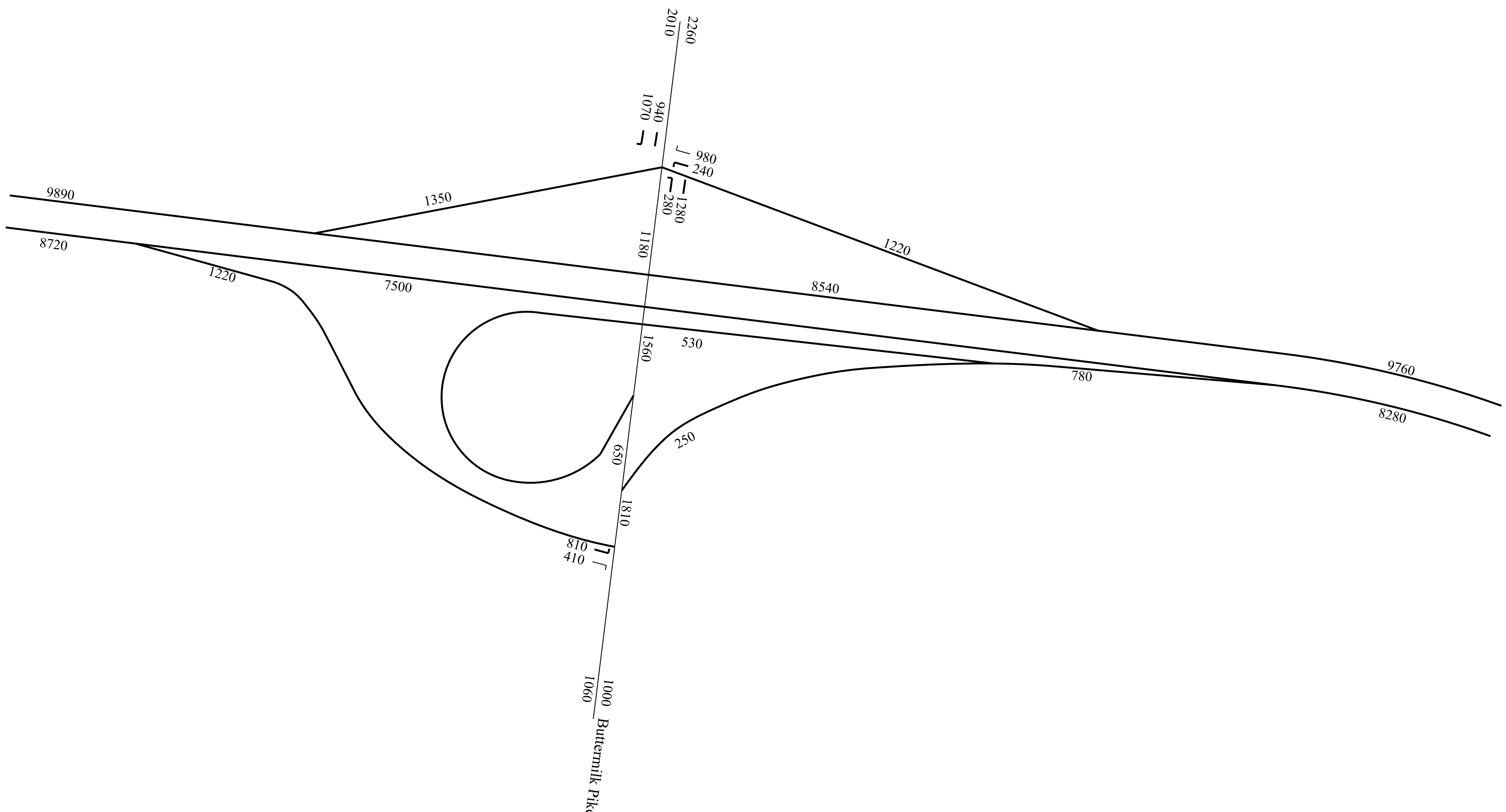
KENTUCKY PLATE 8 OF 9	
APRIL 16, 2010	NOT TO SCALE
BURGESS & NIPLE	



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2035 ALTERNATIVE C-D PM	
KENTUCKY PLATE 9 OF 9	
APRIL 16, 2010	NOT TO SCALE
BURGESS & NIPLE	

May 14, 2010

Randy Kill
Burgess & Niple
5085 Reed Road
Columbus, OH 43220

RE: HAM-71/75-0.00/0.22, PID 75119, Build Alt. C-D Certified Traffic *Revised*

Dear Mr. Kill:

In reply to the revised traffic forecasts received May 14, 2010, the Office of Multi-Modal Planning has reviewed the 2035 traffic for the subject study and the volumes that were provided are reasonable.

The traffic forecasts shown on the attached pages provided by Burgess & Niple are be certified for use in the HAM-71/75-0.00/0.22 project.

If you have any questions, please contact me at (614) 644-8195 or at rebecca.salak@dot.state.oh.us.

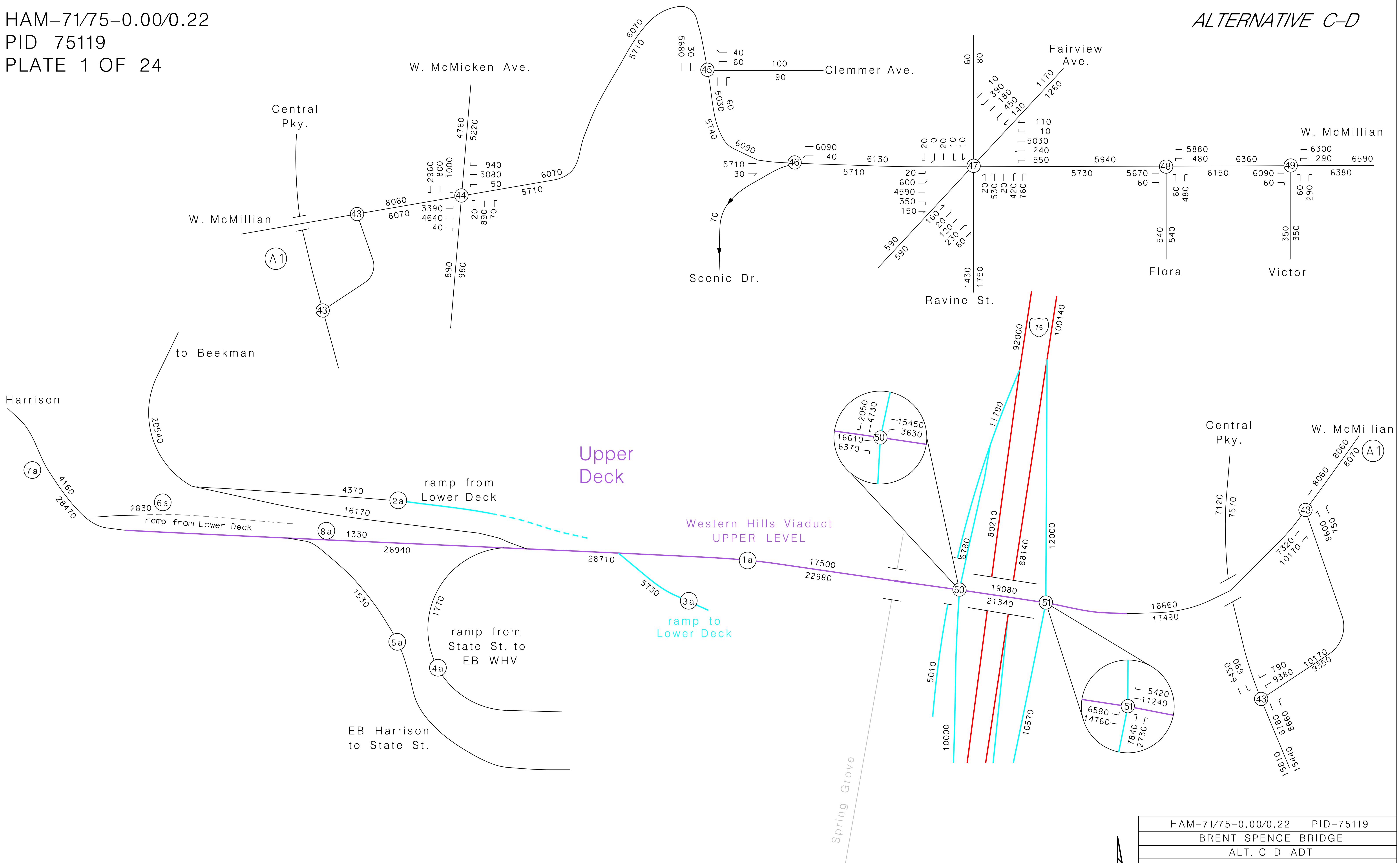
Sincerely,

Becky Salak
Modeling & Forecasting
Office of Multi-Modal Planning

c: M. Byram, OMP – L. Duguid, OMP - File

HAM-71/75-0.00/0.22
PID 75119
PLATE 1 OF 24

ALTERNATIVE C-D



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ALT. C-D ADT	
BURGESS & NIPLE	
MAY 14, 2010	NOT TO SCALE

HAM-71/75-0.00/0.22
PID 75119
PLATE 2 OF 24

ALTERNATIVE C-D

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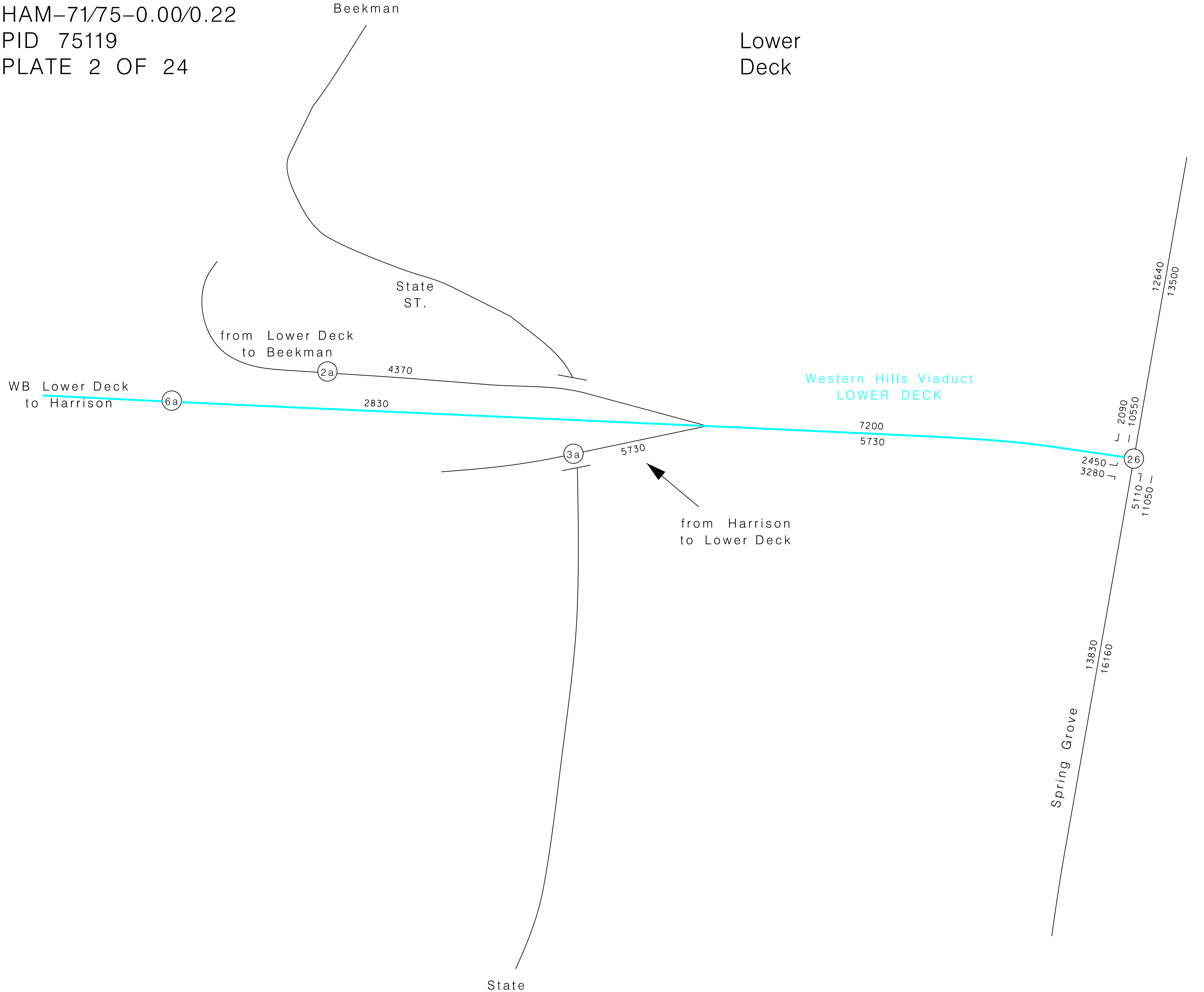

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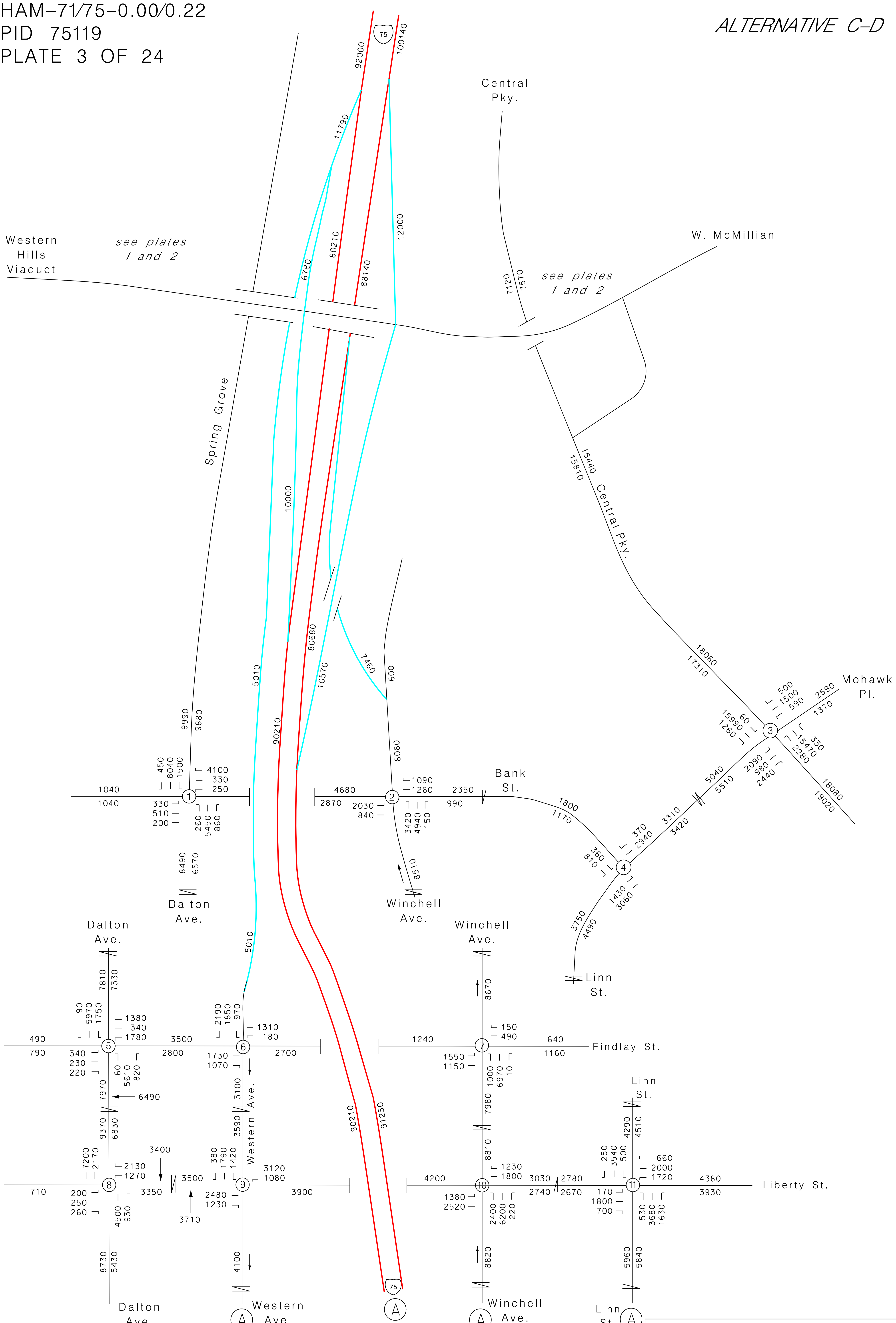
BURGESS & NIPLE	
MAY 14, 2010	NOT TO SCALE

HAM-71/75-0.00/0.22
PID 75119
PLATE 3 OF 24

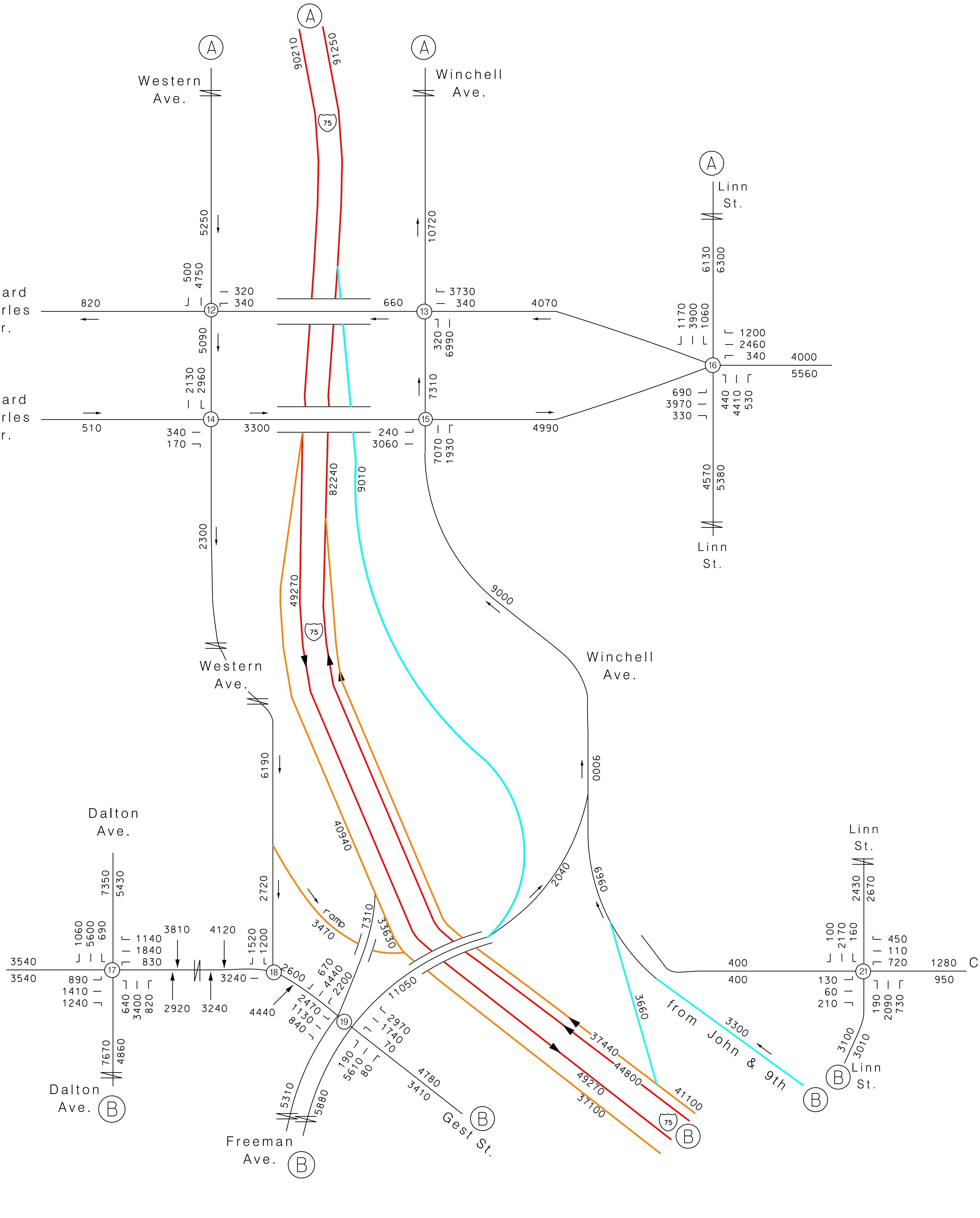
ALTERNATIVE C-D



HAM-71/75-0.00/0.22 PID-75119
BRENT SPENCE BRIDGE
ALT. C-D ADT
BURGESS & NIPLE
MAY 14, 2010 / NOT TO SCALE

HAM-71/75-0.00/0.22
PID 75119
PLATE 4 OF 24

ALTERNATIVE C-D



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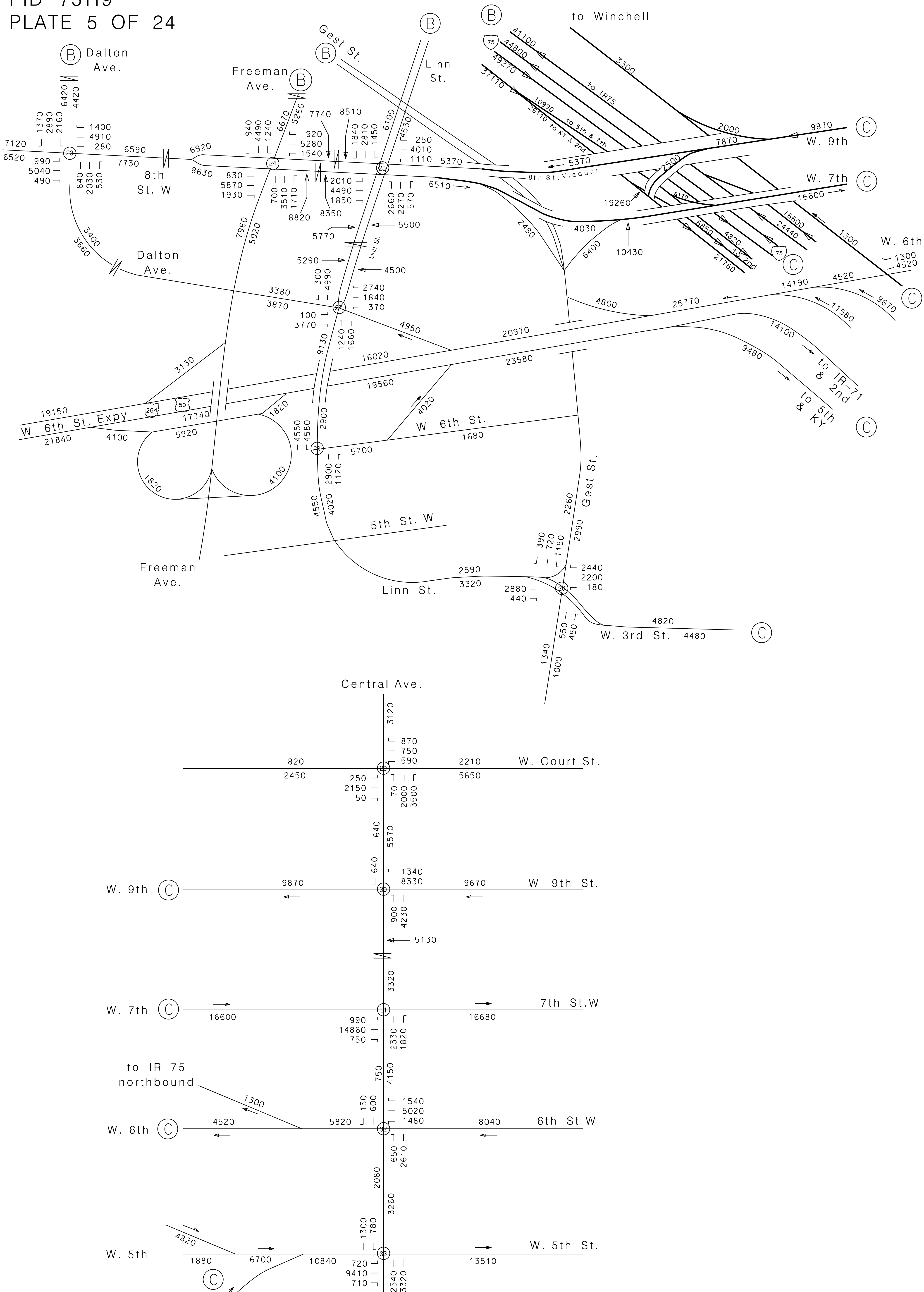
MAY 14, 2010	NOT TO SCALE

HAM-71/75-0.00/0.22
PID 75119
PLATE 5 OF 24

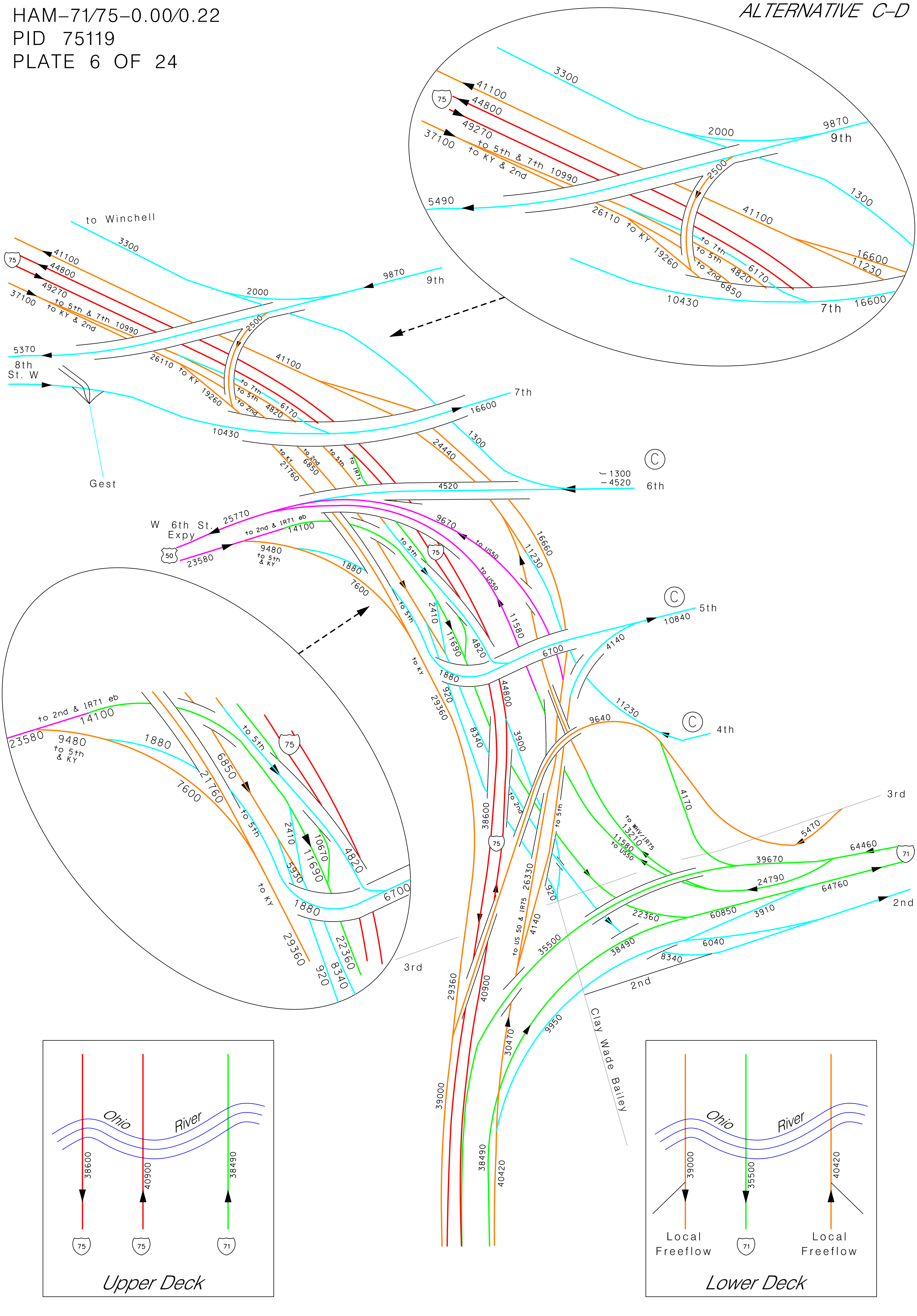
ALTERNATIVE C-D



HAM-71/75-0.00/0.22 PID-75119
BRENT SPENCE BRIDGE
REVISED ALT. I ADT
BURGESS & NIPLE
JULY 19, 2010 NOT TO SCALE

HAM-71/75-0.00/0.22
PID 75119
PLATE 6 OF 24

ALTERNATIVE C-D



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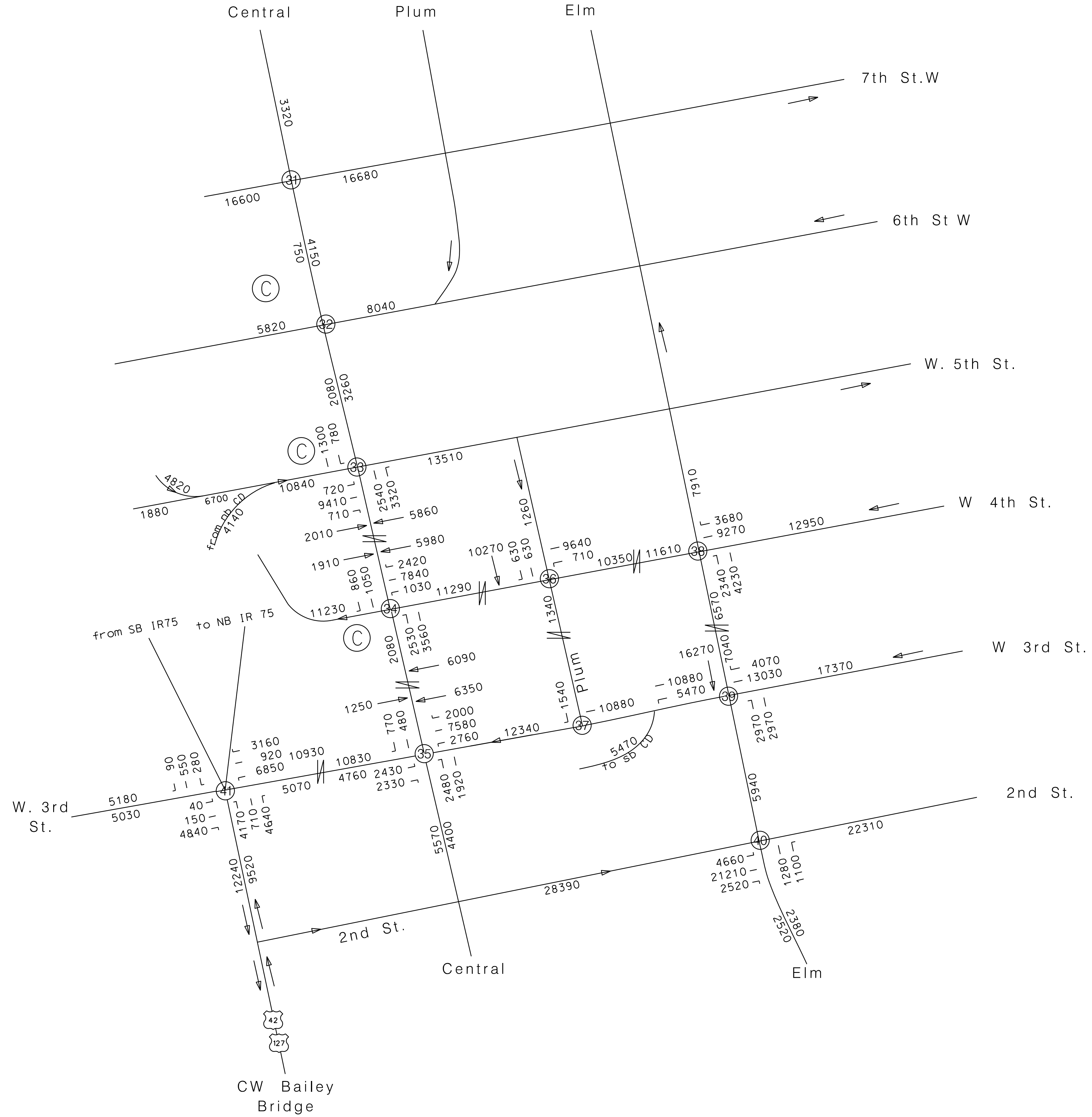
BRENT SPENCE BRIDGE
ALT. C-D ADT
BURGESS & NIPLE
MAY 14, 2010 | NOT TO SCALE

HAM-71/75-0.00/0.22
PID 75119
PLATE 7 OF 24

ALTERNATIVE C-D



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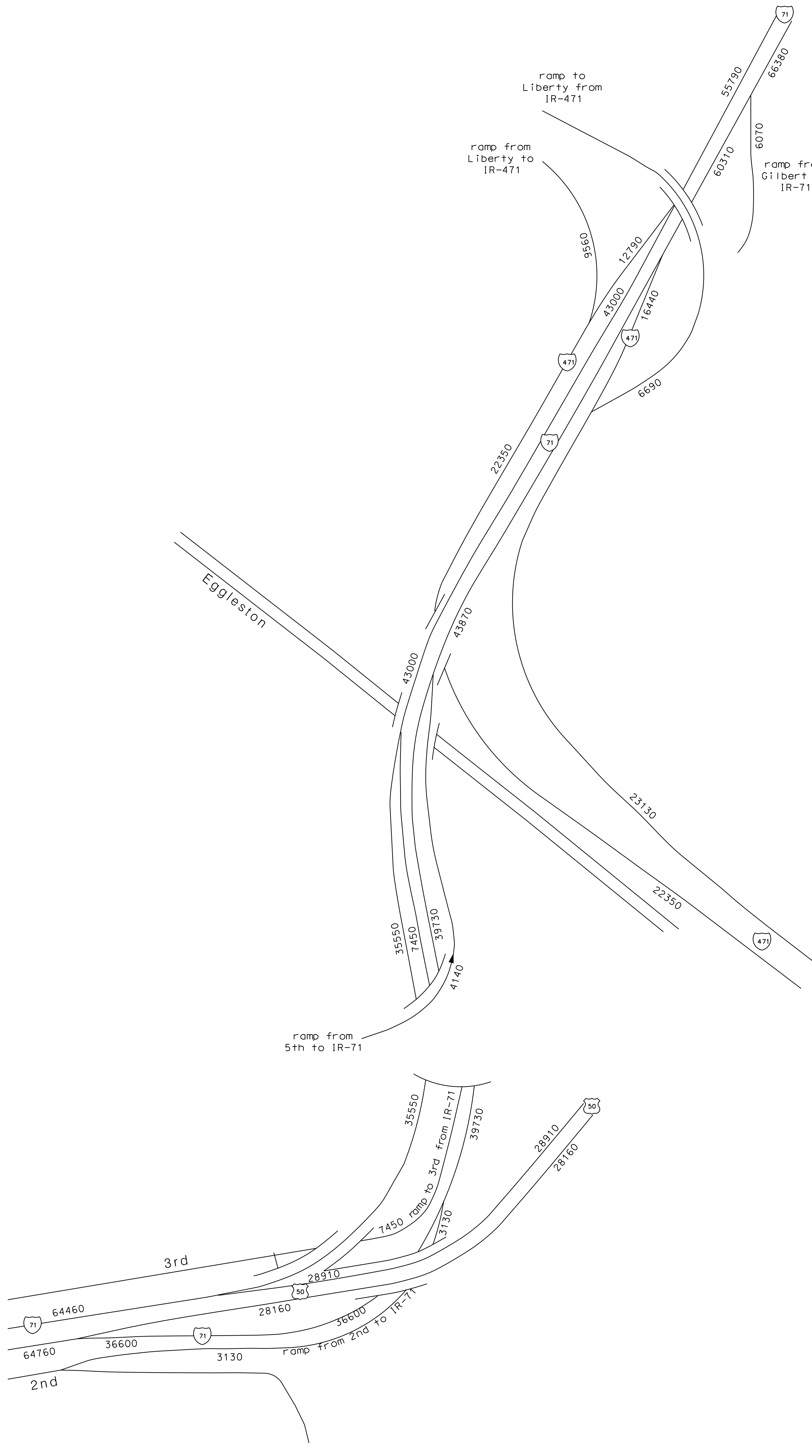
REVISED ALT. I ADT	
BURGESS & NIPLE	
JULY 19, 2010	NOT TO SCALE

ALTERNATIVE C-D



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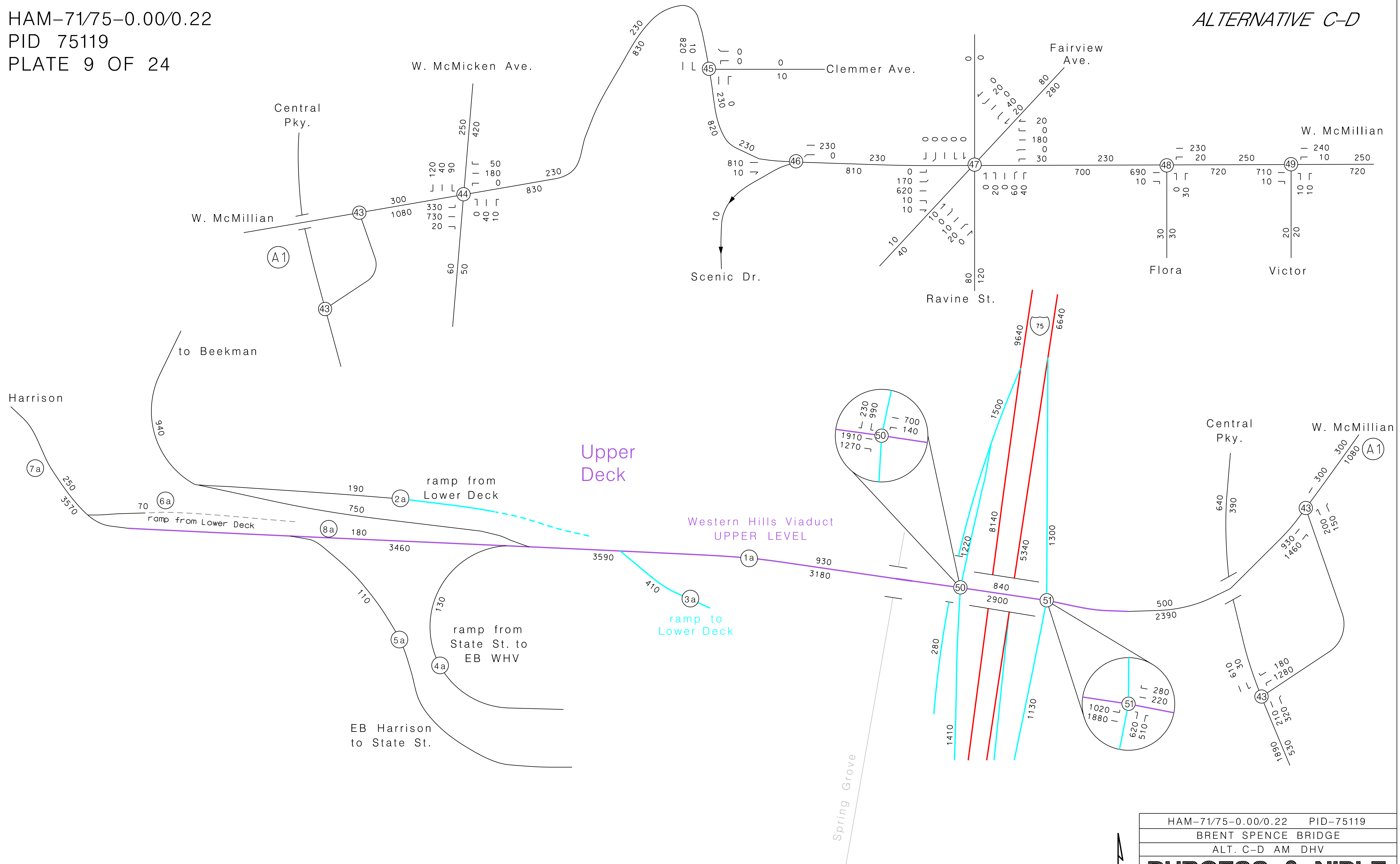
ALT. C-D ADT	
BURGESS & NIPLE	
MAY 14, 2010	NOT TO SCALE

HAM-71/75-0.00/0.22
PID 75119
PLATE 9 OF 24

ALTERNATIVE C-D



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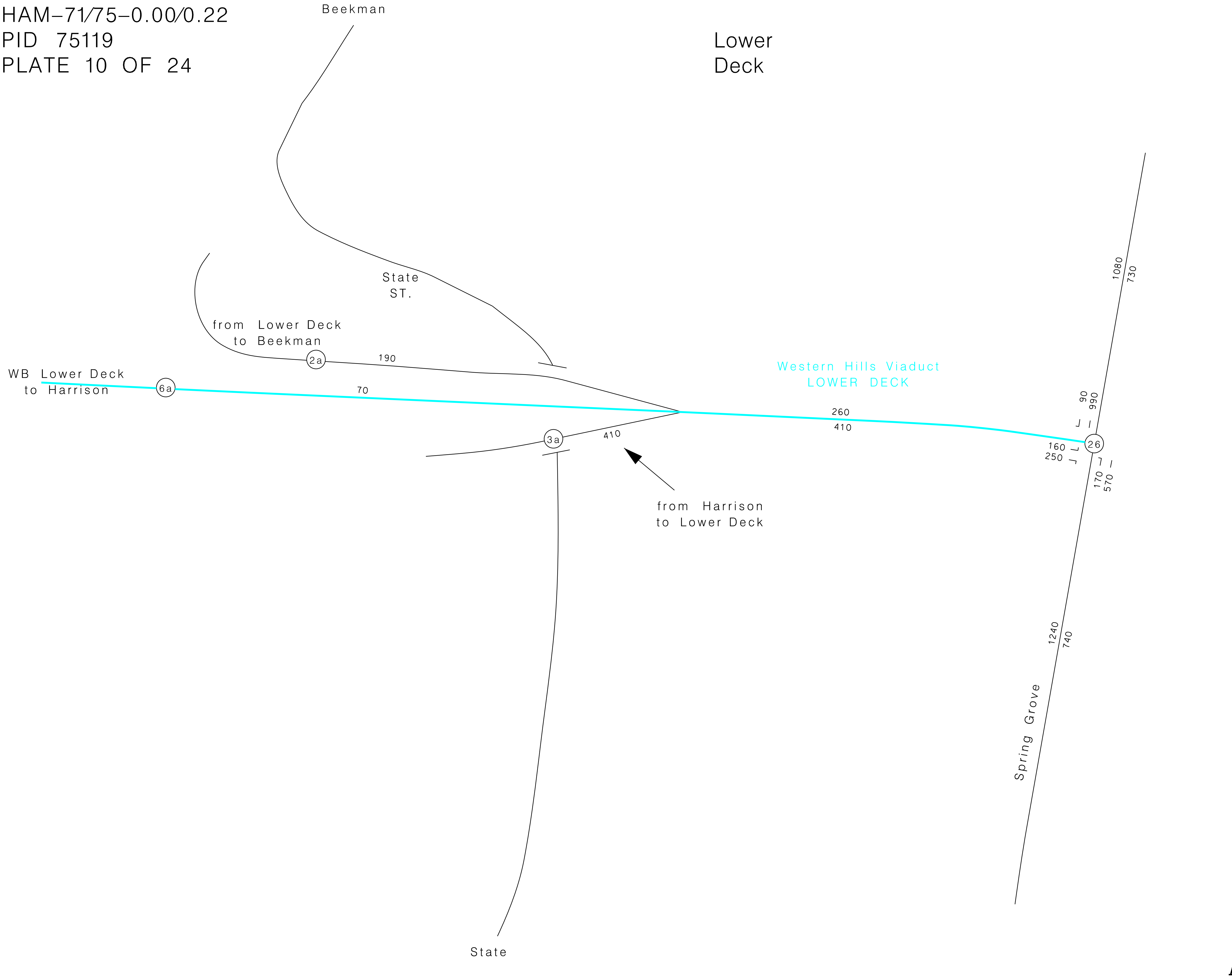
ALT. C-D AM DHV	
BURGESS & NIPLE	
MAY 14, 2010	NOT TO SCALE

HAM-71/75-0.00/0.22
PID 75119
PLATE 10 OF 24

ALTERNATIVE C-D



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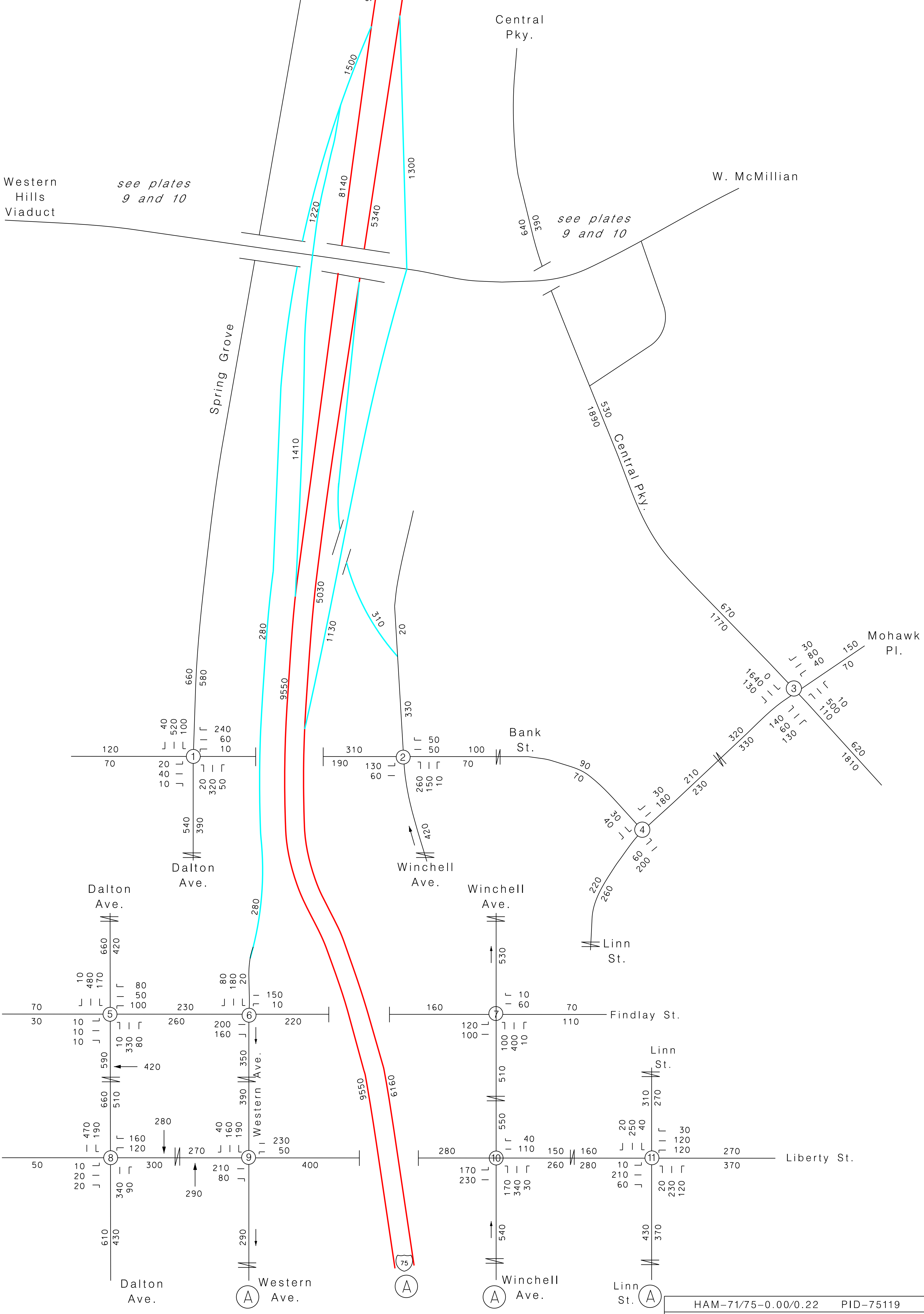
BURGESS & NIPLE	
MAY 14, 2010	NOT TO SCALE

HAM-71/75-0.00/0.22
PID 75119
PLATE 11 OF 24

ALTERNATIVE C-D



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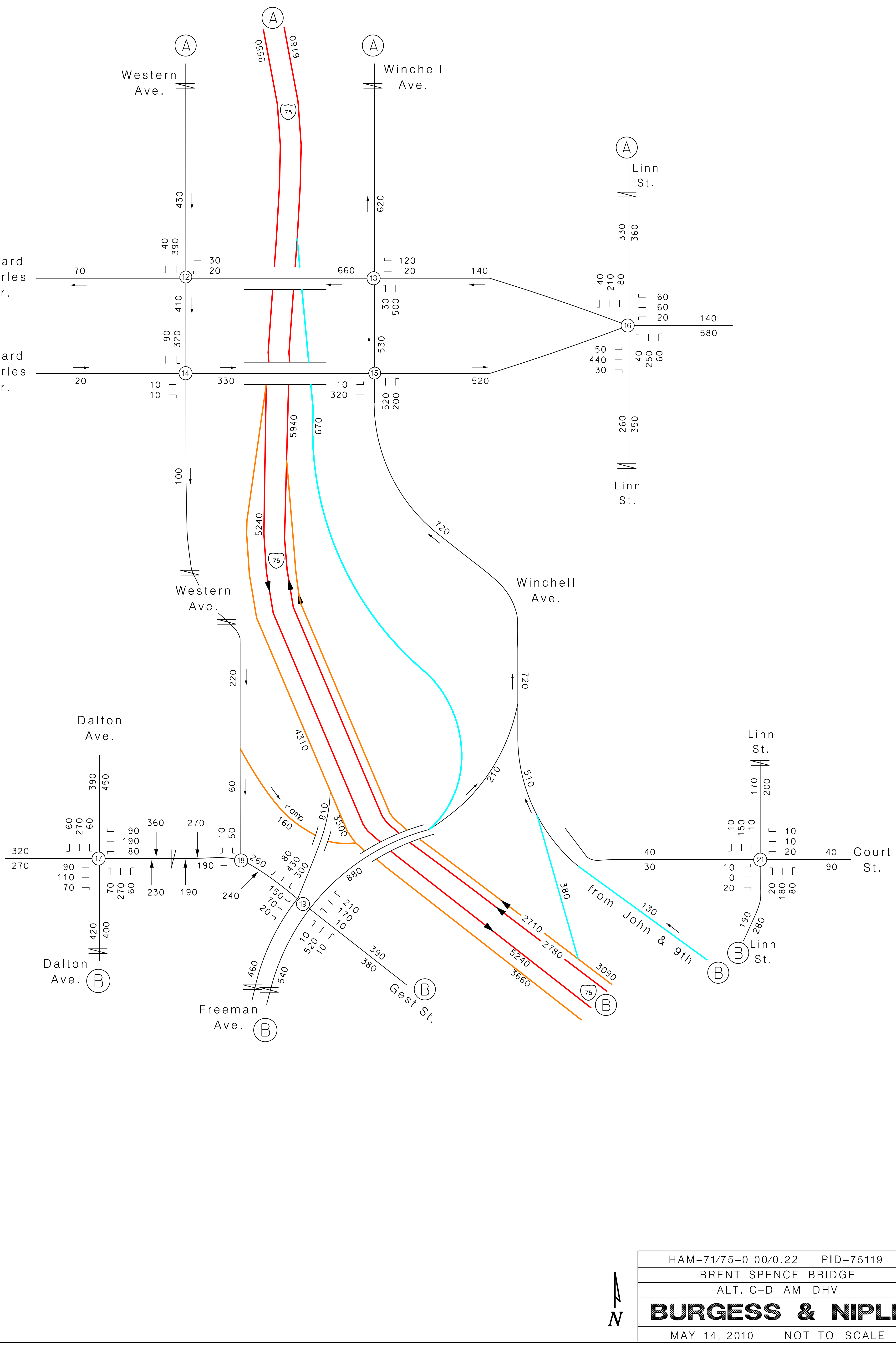
BRENT SPENCE BRIDGE
ALT. C-D AM DHV
BURGESS & NIPLE
MAY 14, 2010 NOT TO SCALE

HAM-71/75-0.00/0.22
PID 75119
PLATE 12 OF 24

ALTERNATIVE C-D



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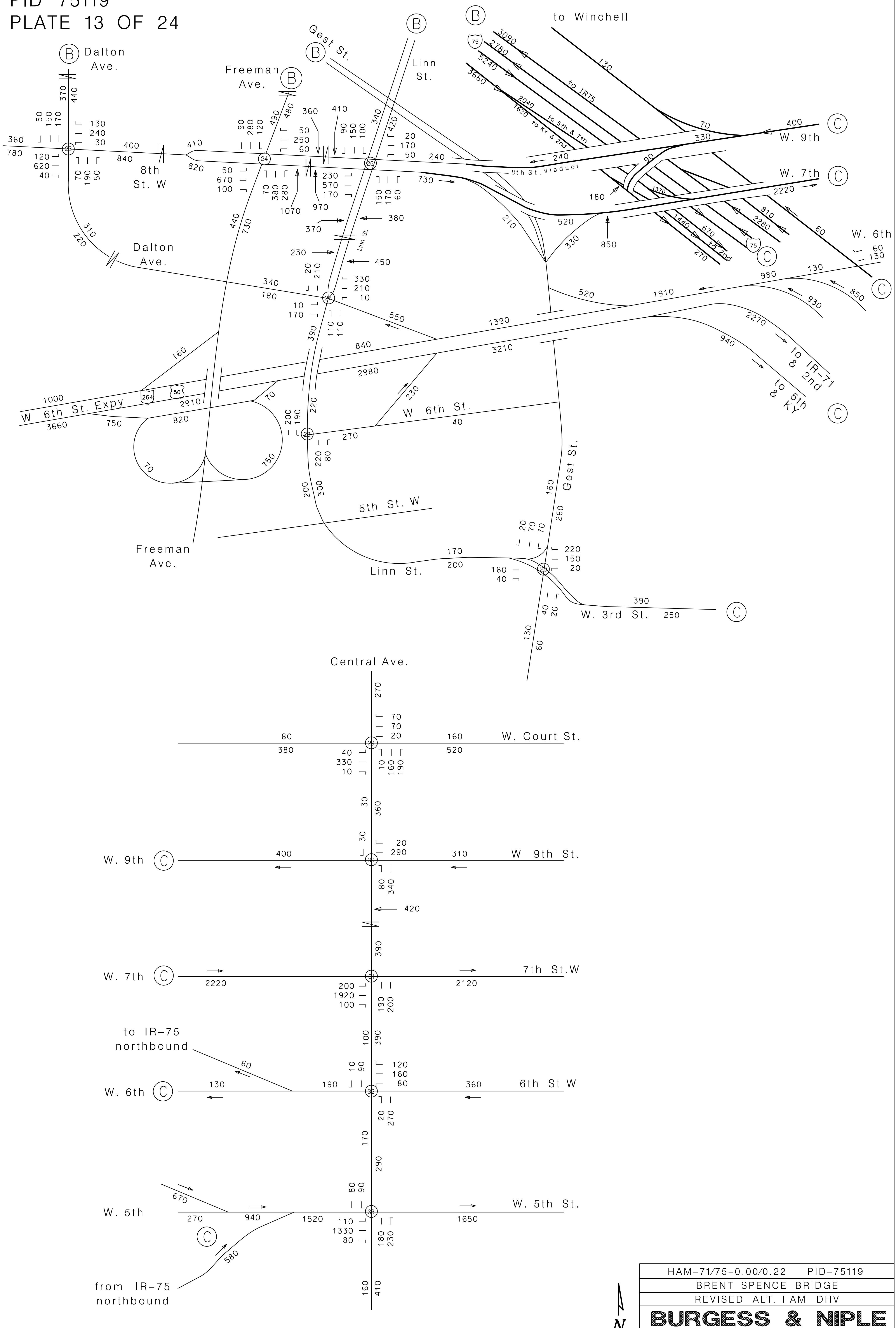
BRENT SPENCE BRIDGE
ALT. C-D AM DHV
BURGESS & NIPLE
MAY 14, 2010 | NOT TO SCALE

HAM-71/75-0.00/0.22
PID 75119
PLATE 13 OF 24

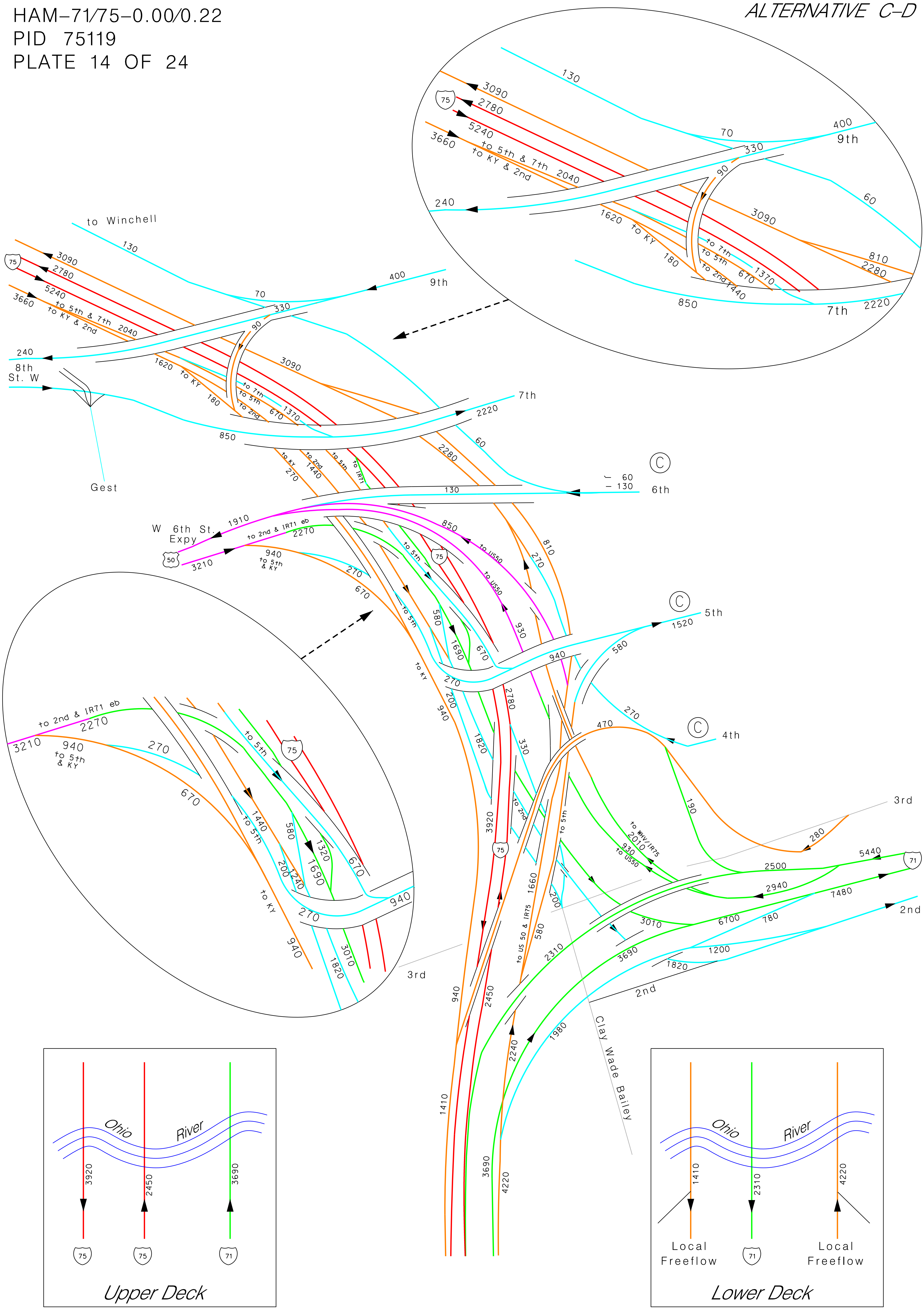
ALTERNATIVE C-D



HAM-71/75-0.00/0.22 PID-75119
BRENT SPENCE BRIDGE
REVISED ALT. I AM DHV
BURGESS & NIPLE
JULY 19, 2010 | NOT TO SCALE

HAM–71/75–0.00/0.22
PID 75119
PLATE 14 OF 24

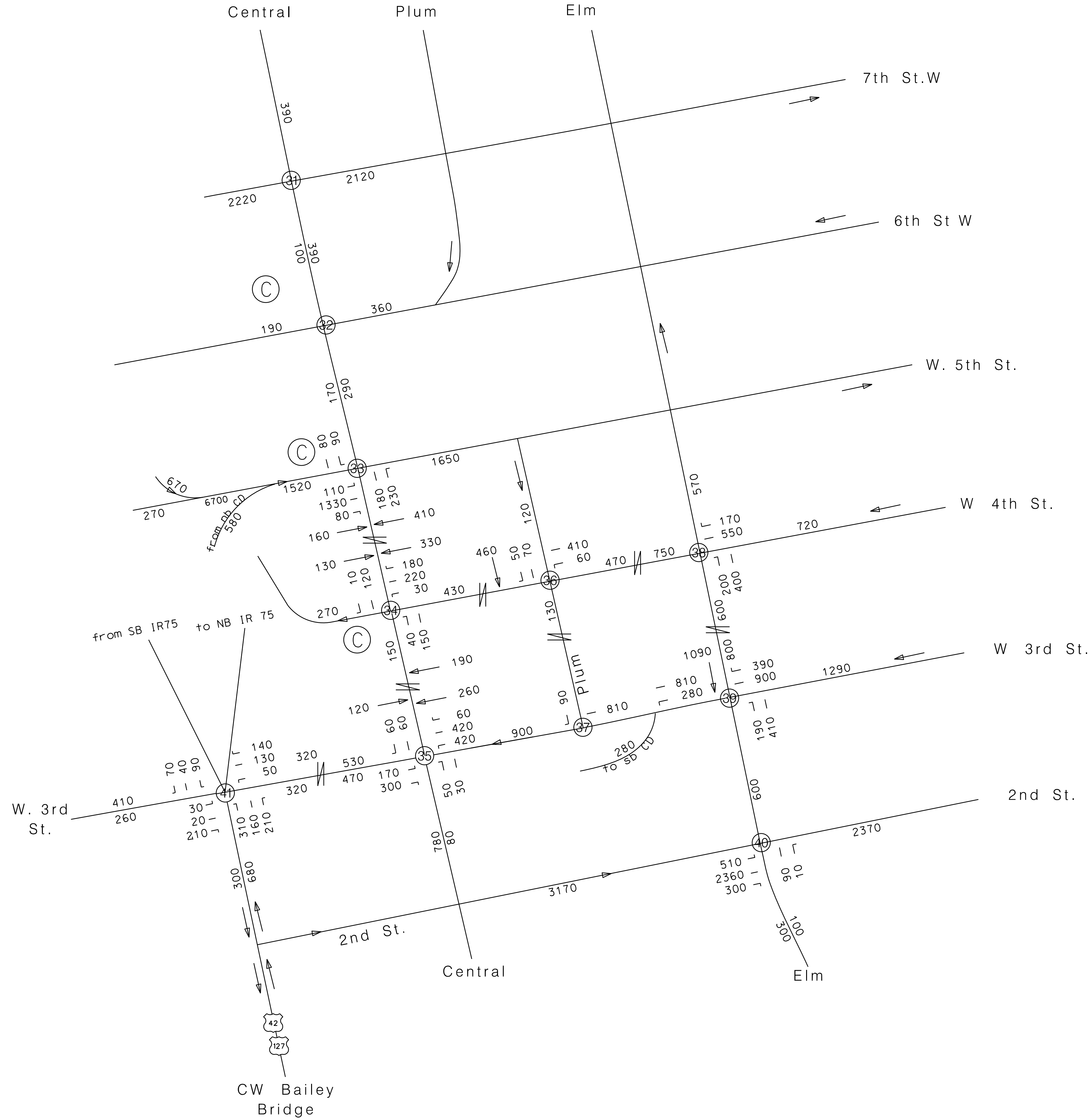
ALTERNATIVE C–D



HAM–71/75–0.00/0.22 PID–75119
BRENT SPENCE BRIDGE
ALT. C–D AM DHV
BURGESS & NIPLE
MAY 14, 2010 NOT TO SCALE

HAM-71/75-0.00/0.22
PID 75119
PLATE 15 OF 24

ALTERNATIVE C-D



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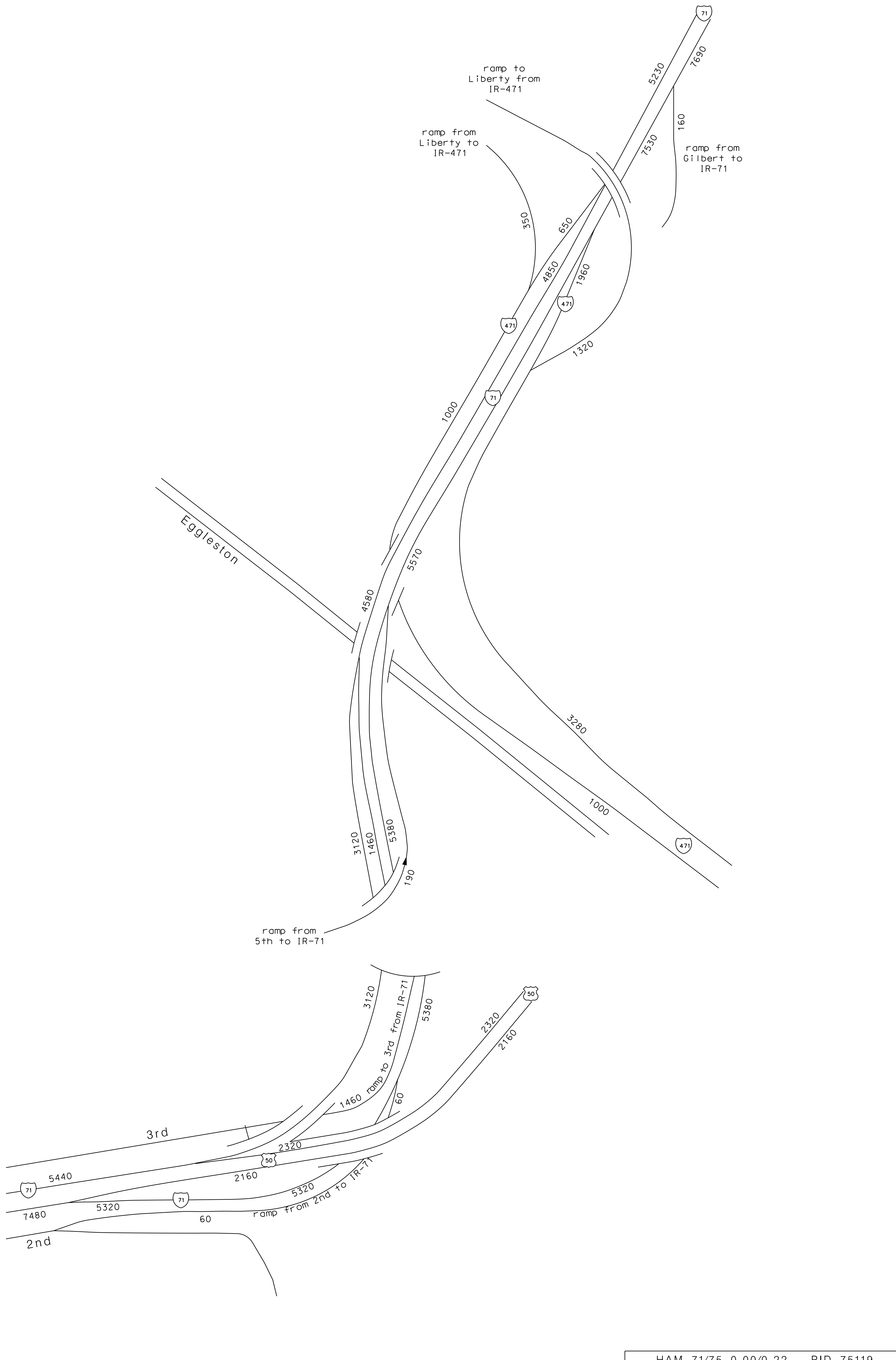
REVISED ALT. I AM DHV	
BURGESS & NIPLE	
JULY 19, 2010	NOT TO SCALE

ALTERNATIVE C-D



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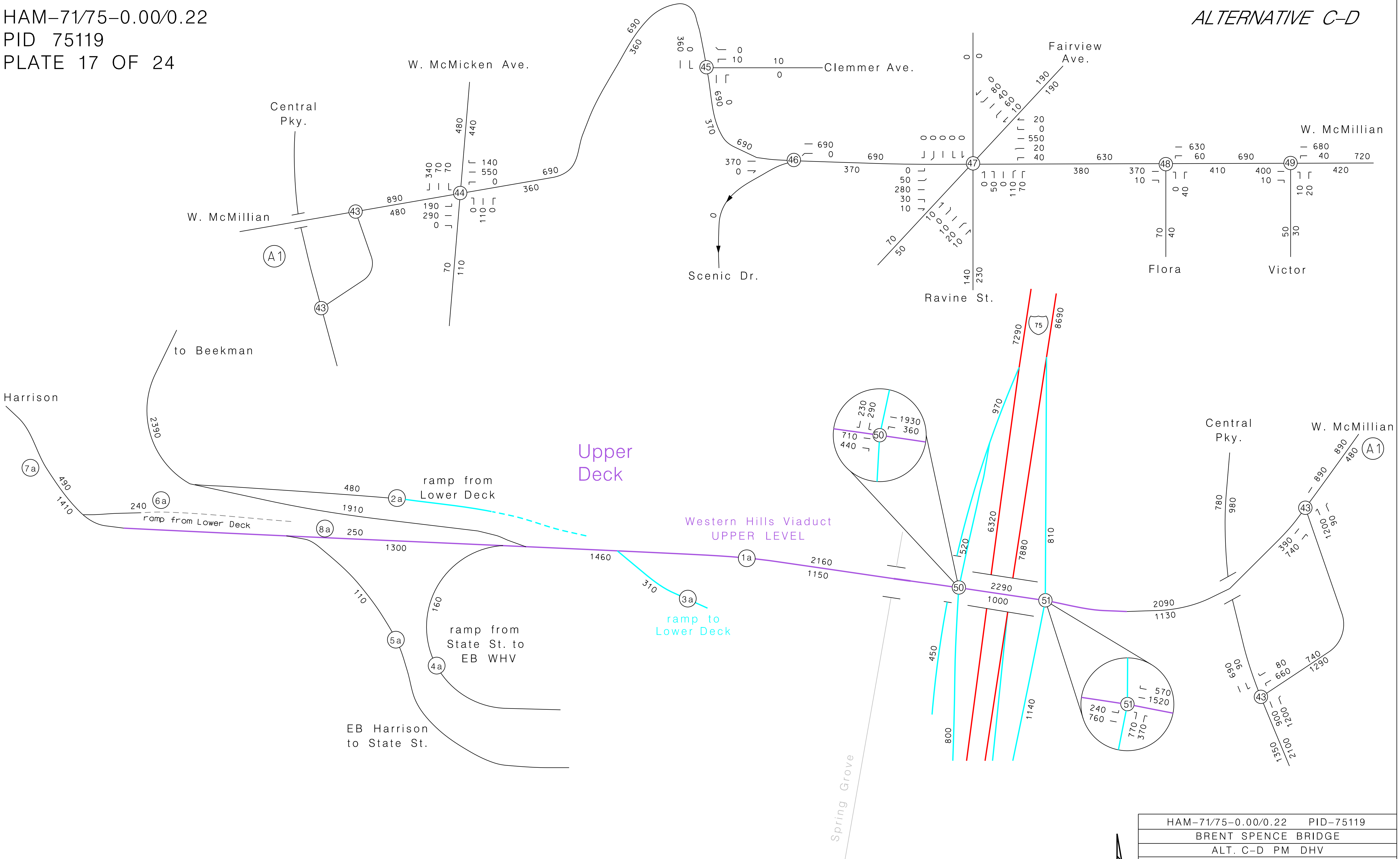
BURGESS & NIPLE	
MAY 14, 2010	NOT TO SCALE

ALTERNATIVE C-D



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ALT. C-D PM DHV	
BURGESS & NIPLE	
MAY 14, 2010	NOT TO SCALE

HAM-71/75-0.00/0.22
PID 75119
PLATE 18 OF 24

ALTERNATIVE C-D

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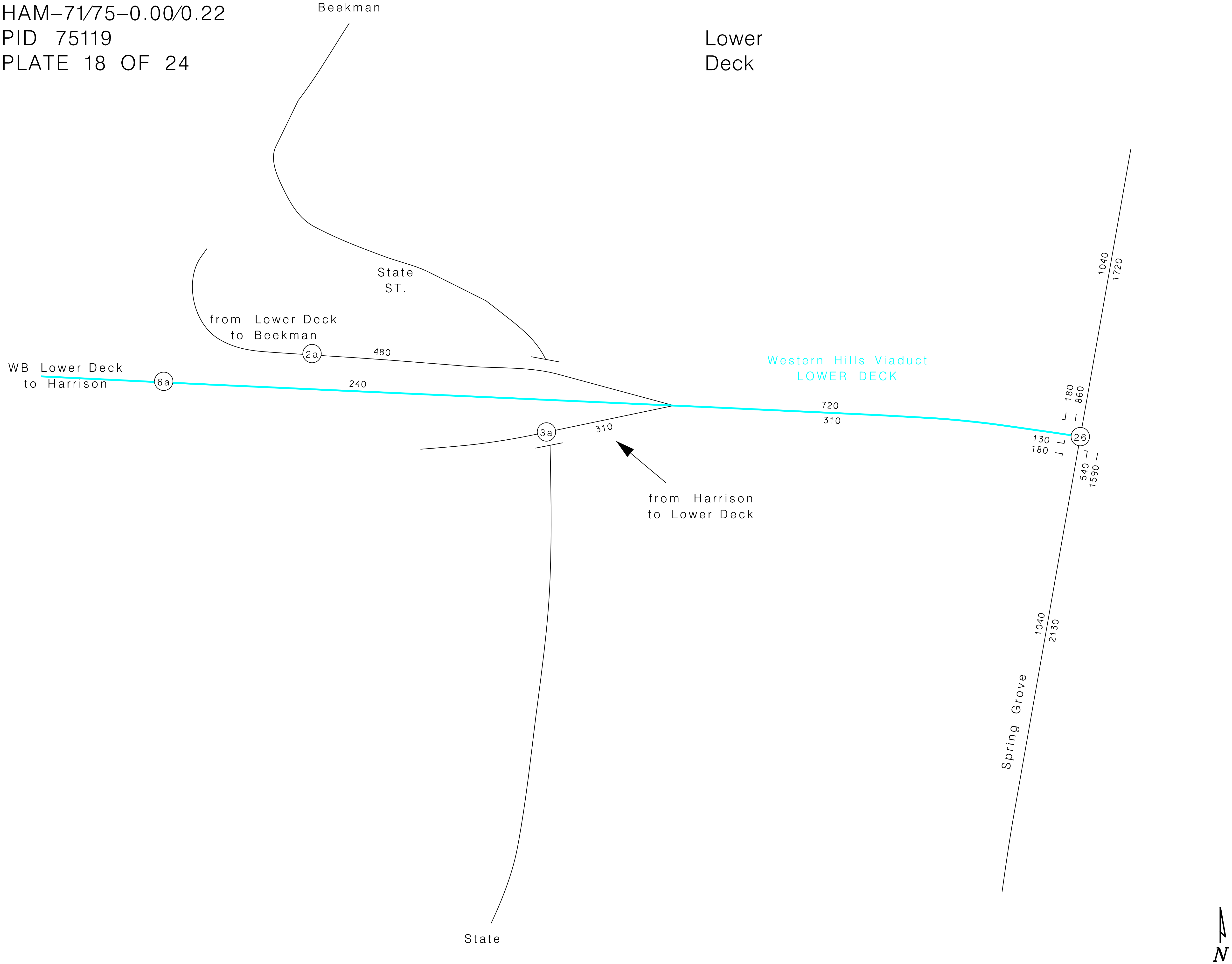

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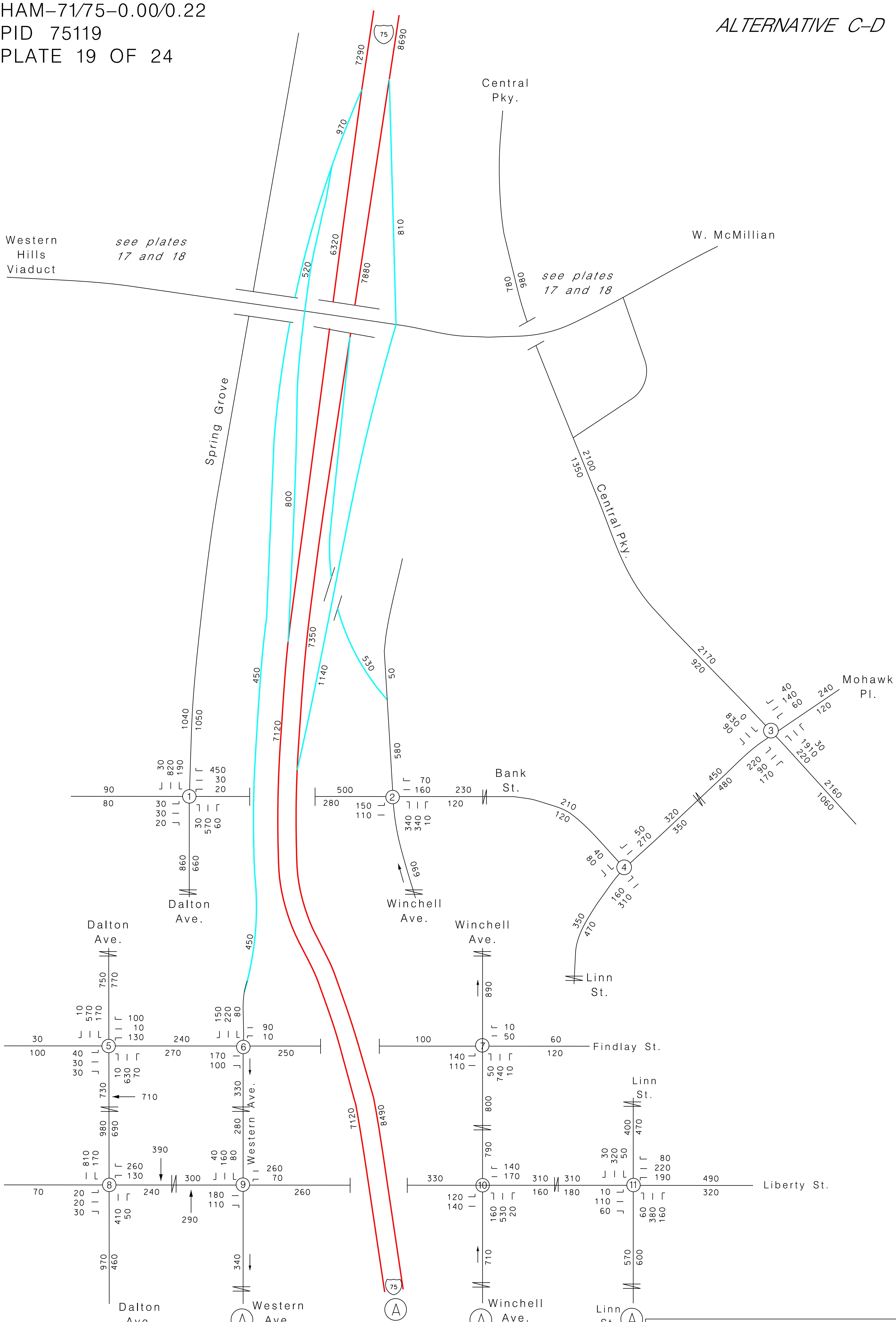
HAM-71/75-0.00/0.22
PID 75119
PLATE 19 OF 24

ALTERNATIVE C-D



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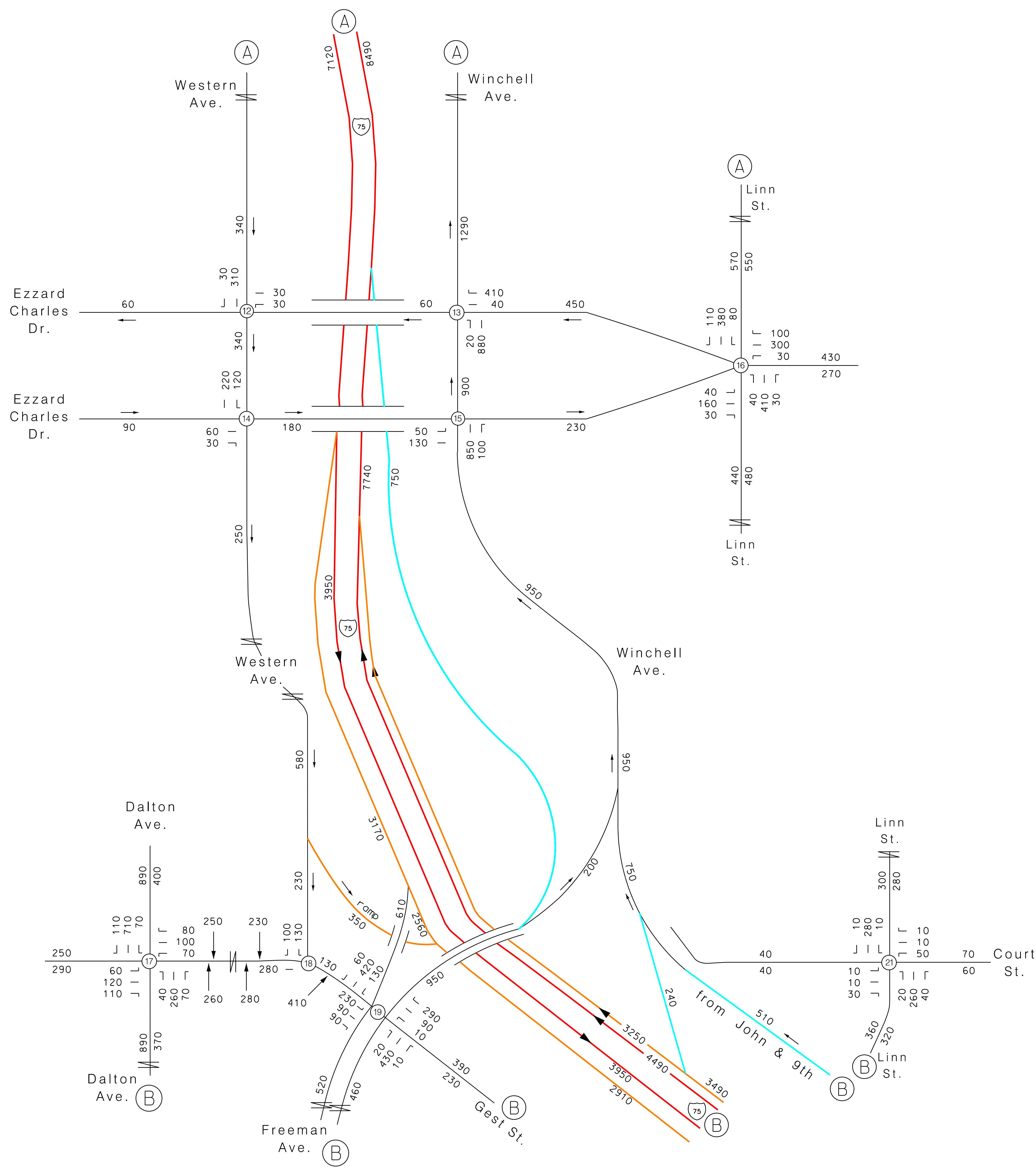
ALT. C-D PM DHV
BURGESS & NIPLE
MAY 14, 2010 NOT TO SCALE

HAM-71/75-0.00/0.22
PID 75119
PLATE 20 OF 24

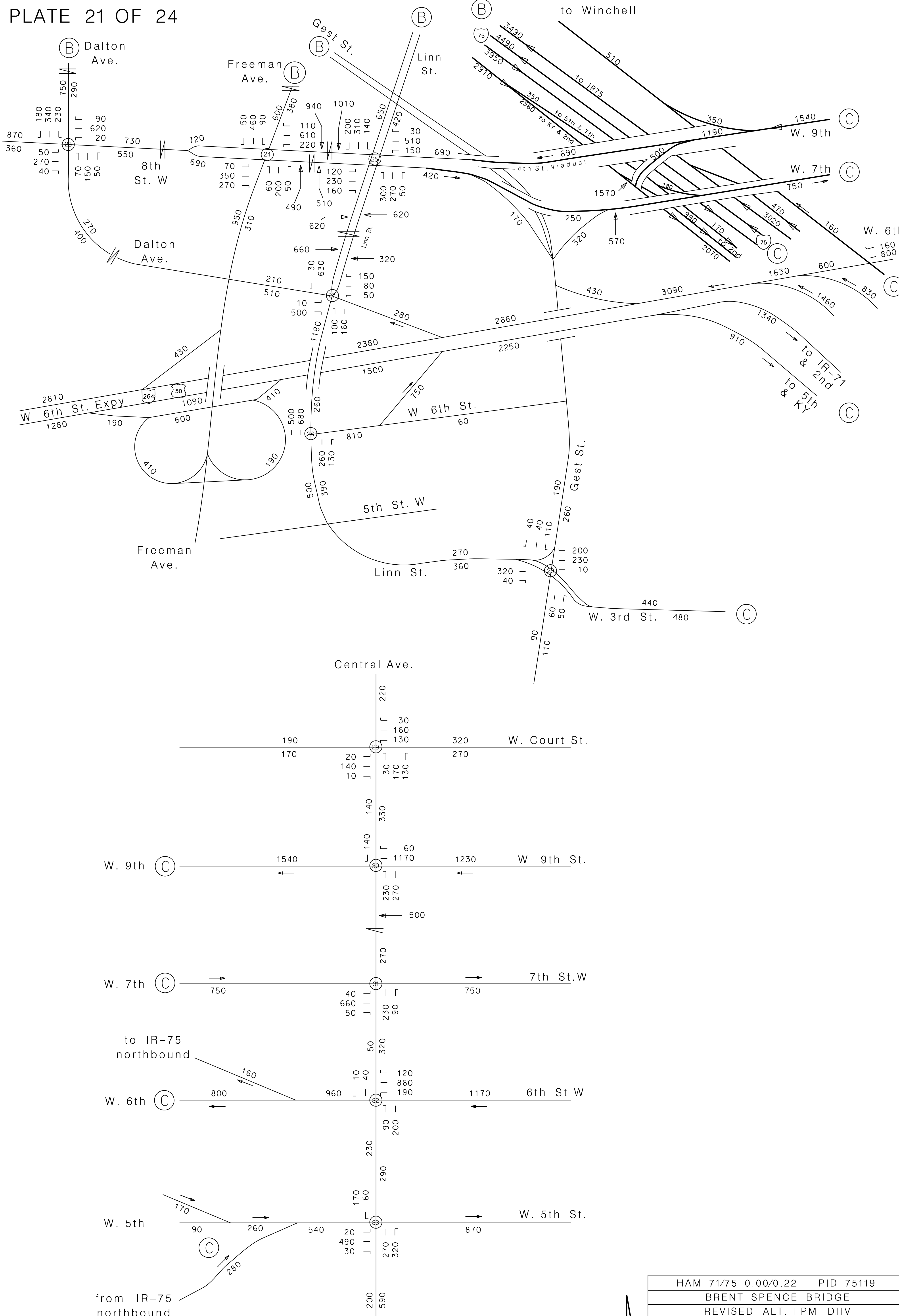
ALTERNATIVE C-D



HAM-71/75-0.00/0.22 PID-75119
BRENT SPENCE BRIDGE
ALT. C-D PM DHV
BURGESS & NIPLE
MAY 14, 2010 · NOT TO SCALE

HAM-71/75-0.00/0.22
PID 75119
PLATE 21 OF 24

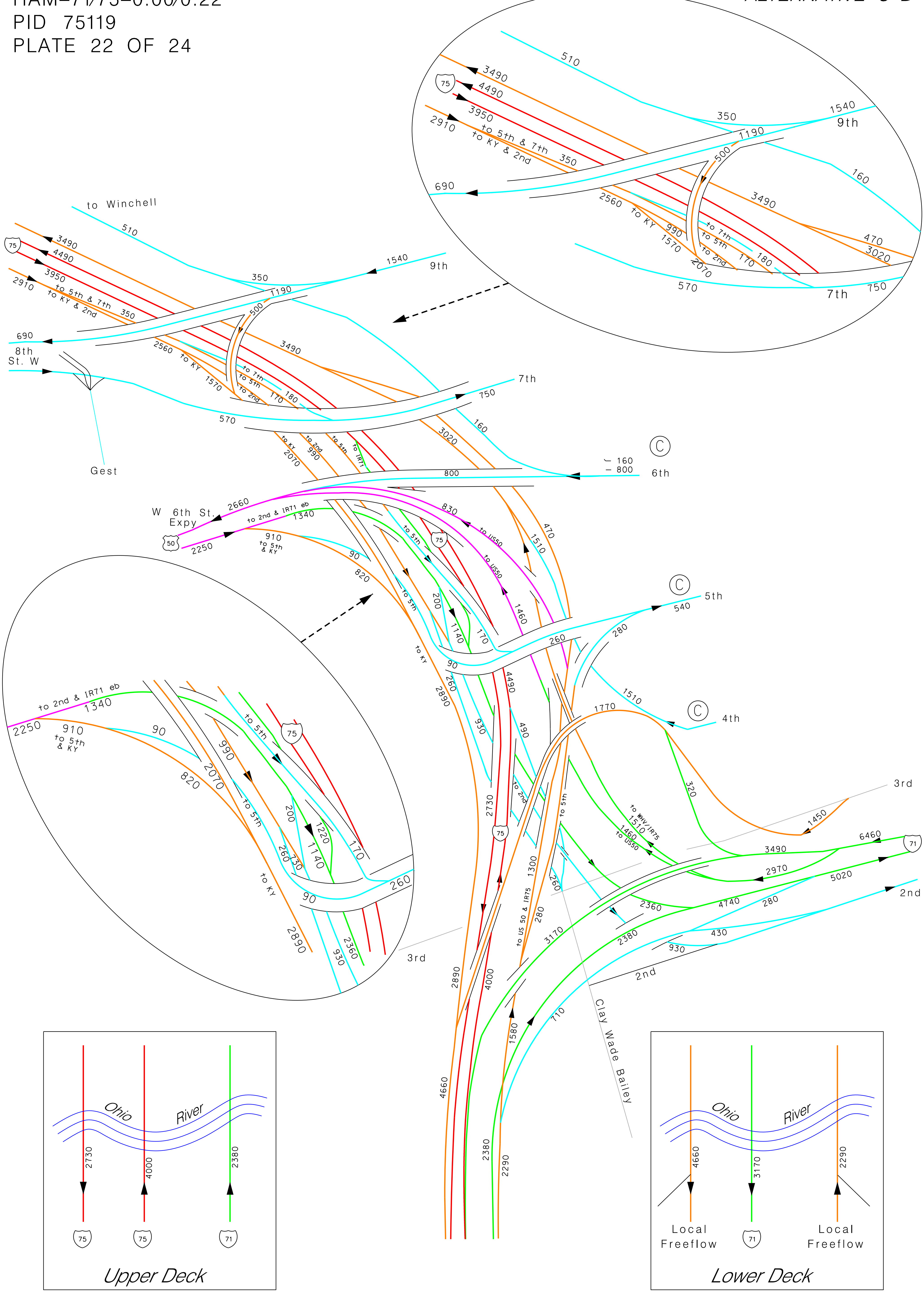
ALTERNATIVE C-D



HAM-71/75-0.00/0.22 PID-75119
BRENT SPENCE BRIDGE
REVISED ALT. I PM DHV
BURGESS & NIPLE
JULY 19, 2010 | NOT TO SCALE

HAM-71/75-0.00/0.22
PID 75119
PLATE 22 OF 24

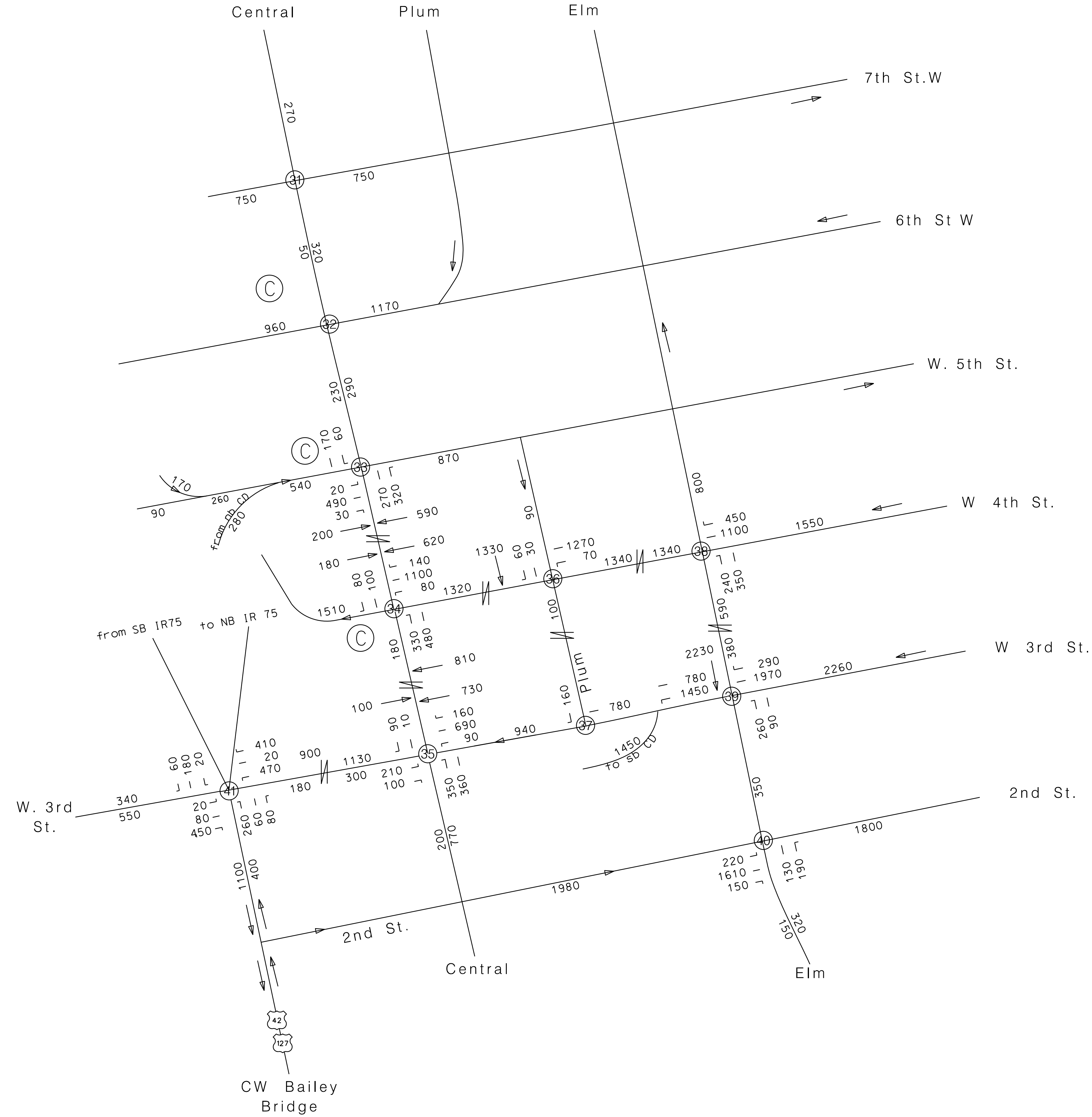
ALTERNATIVE C-D



HAM-71/75-0.00/0.22 PID-75119
BRENT SPENCE BRIDGE
ALT. C-D PM DHV
BURGESS & NIPLE
MAY 14, 2010 NOT TO SCALE

HAM-71/75-0.00/0.22
PID 75119
PLATE 23 OF 24

ALTERNATIVE C-D



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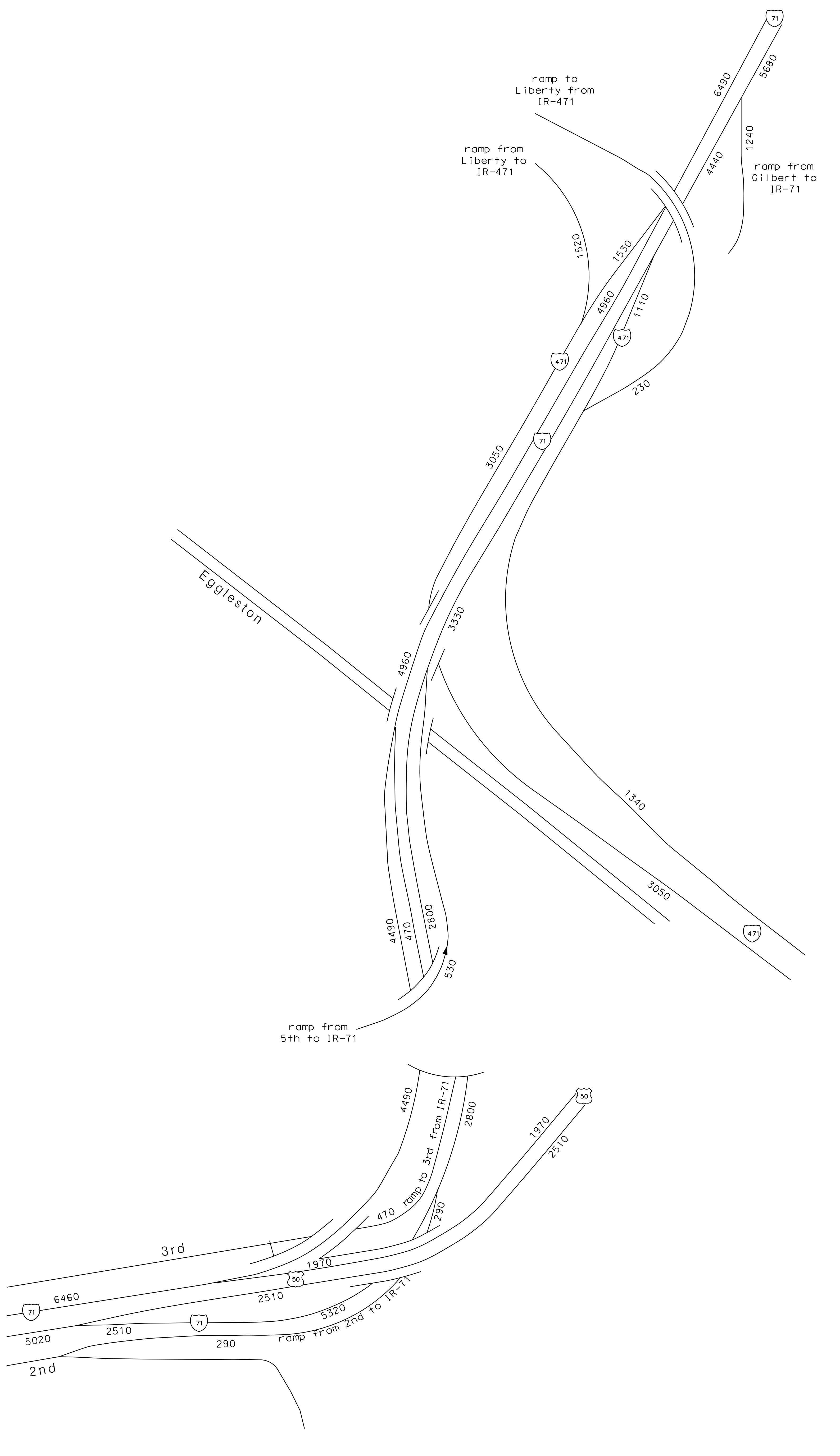
HAM-71/75-0.00/0.22 PID-75119	
BRENT SPENCE BRIDGE	
REVISED ALT. I PM DHV	
BURGESS & NIPLE	
JULY 19, 2010	NOT TO SCALE

ALTERNATIVE C-D



HAM-71/75-0.00/0.22 PID-75119	
BRENT SPENCE BRIDGE	
ALT. C-D PM DHV	
BURGESS & NIPLE	
MAY 14, 2010	NOT TO SCALE

HAM - 71/75 - 0.00/0.22 PID - 75119

BRENT SPENCE BRIDGE

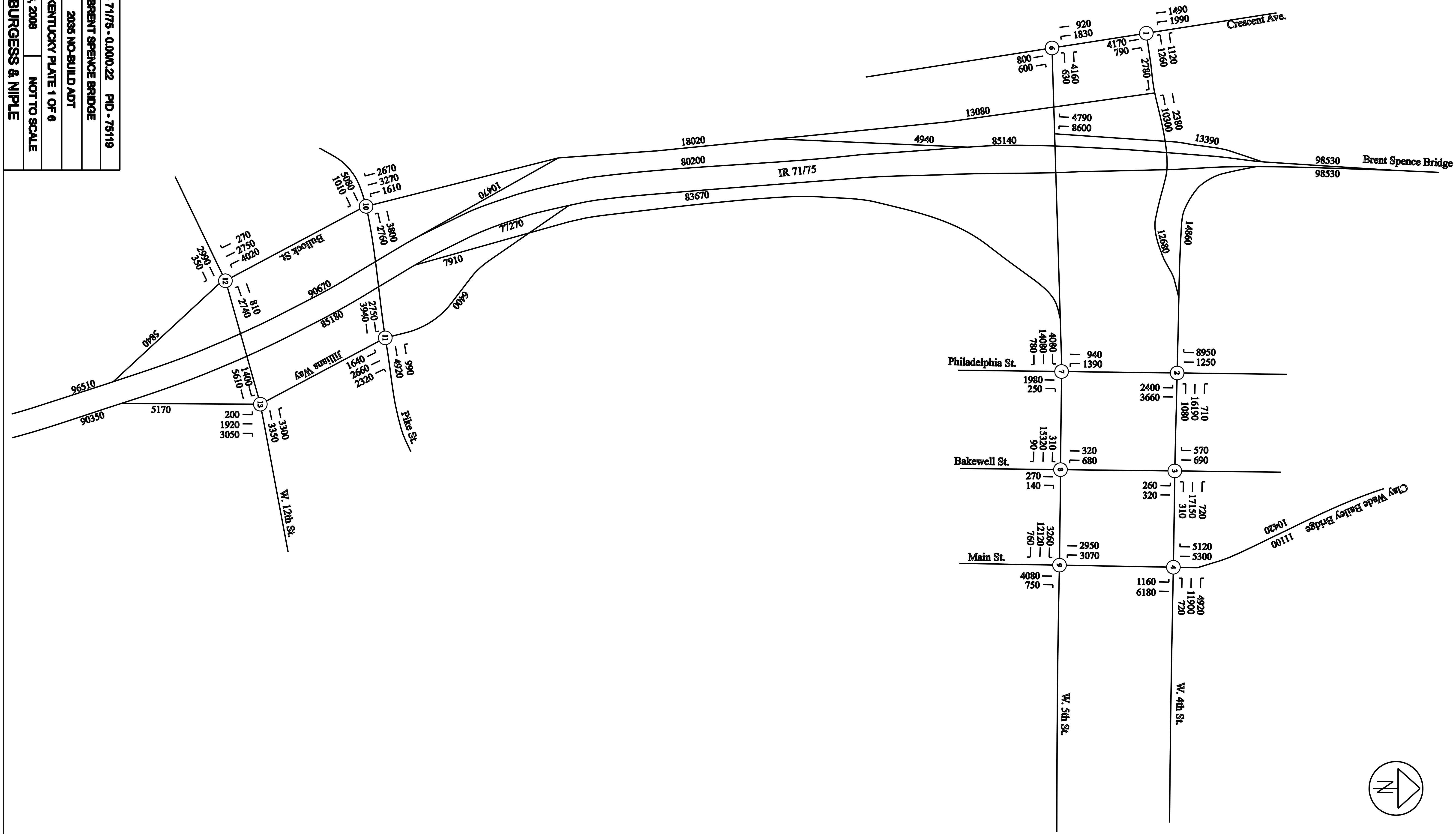
2035 NO-BUILD ADT

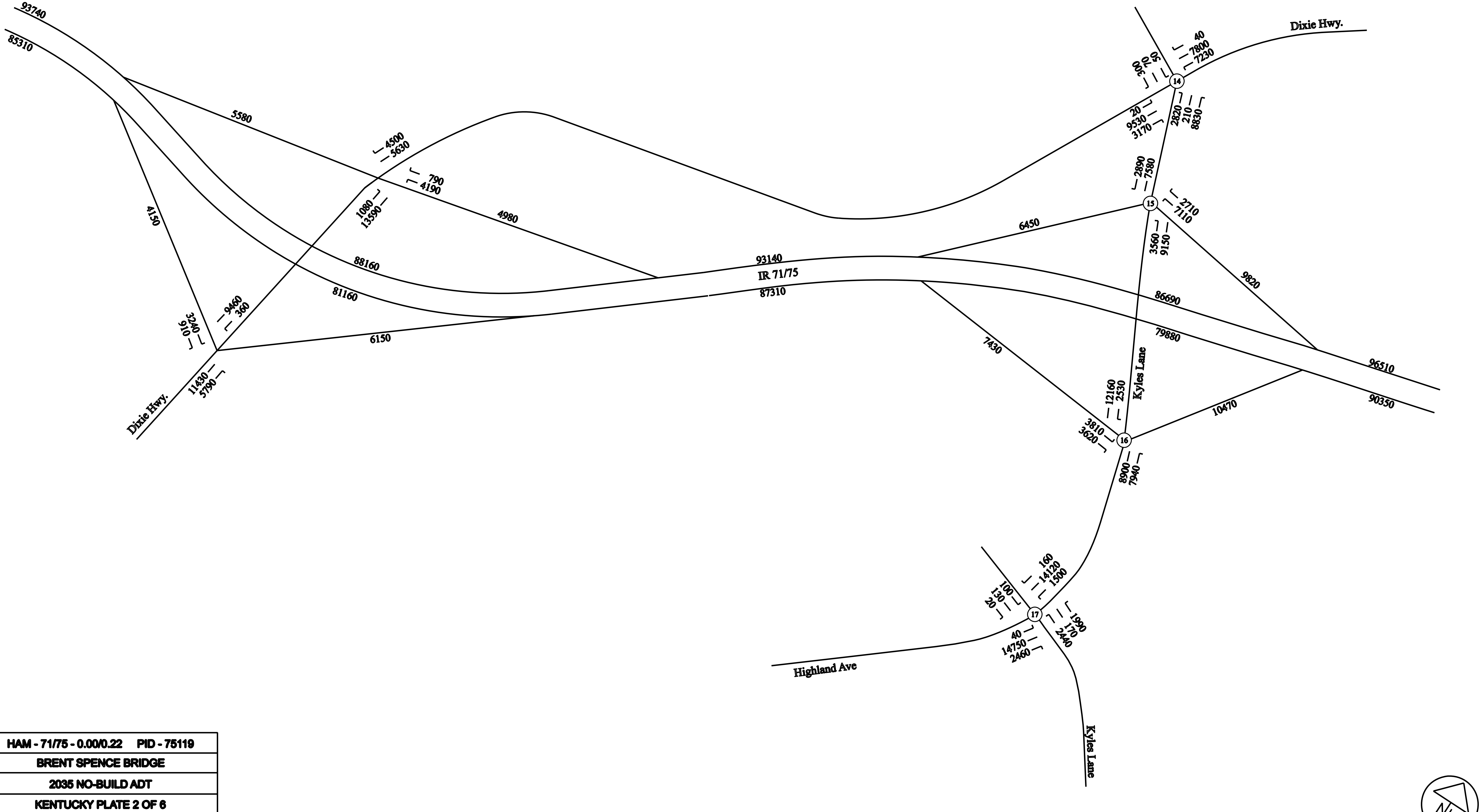
KENTUCKY PLATE 1 OF 6

MAY 23, 2008

NOT TO SCALE

BURGESS & NIPLE





HAM - 71/75 - 0.00/0.22 PID - 75119
BRENT SPENCE BRIDGE
2035 NO-BUILD ADT
KENTUCKY PLATE 2 OF 6
MAY 23, 2008 — NOT TO SCALE
BURGESS & NIPLE

HAM - 71/75 - 0.00/0.22 PID - 75119

BRENT SPENCE BRIDGE

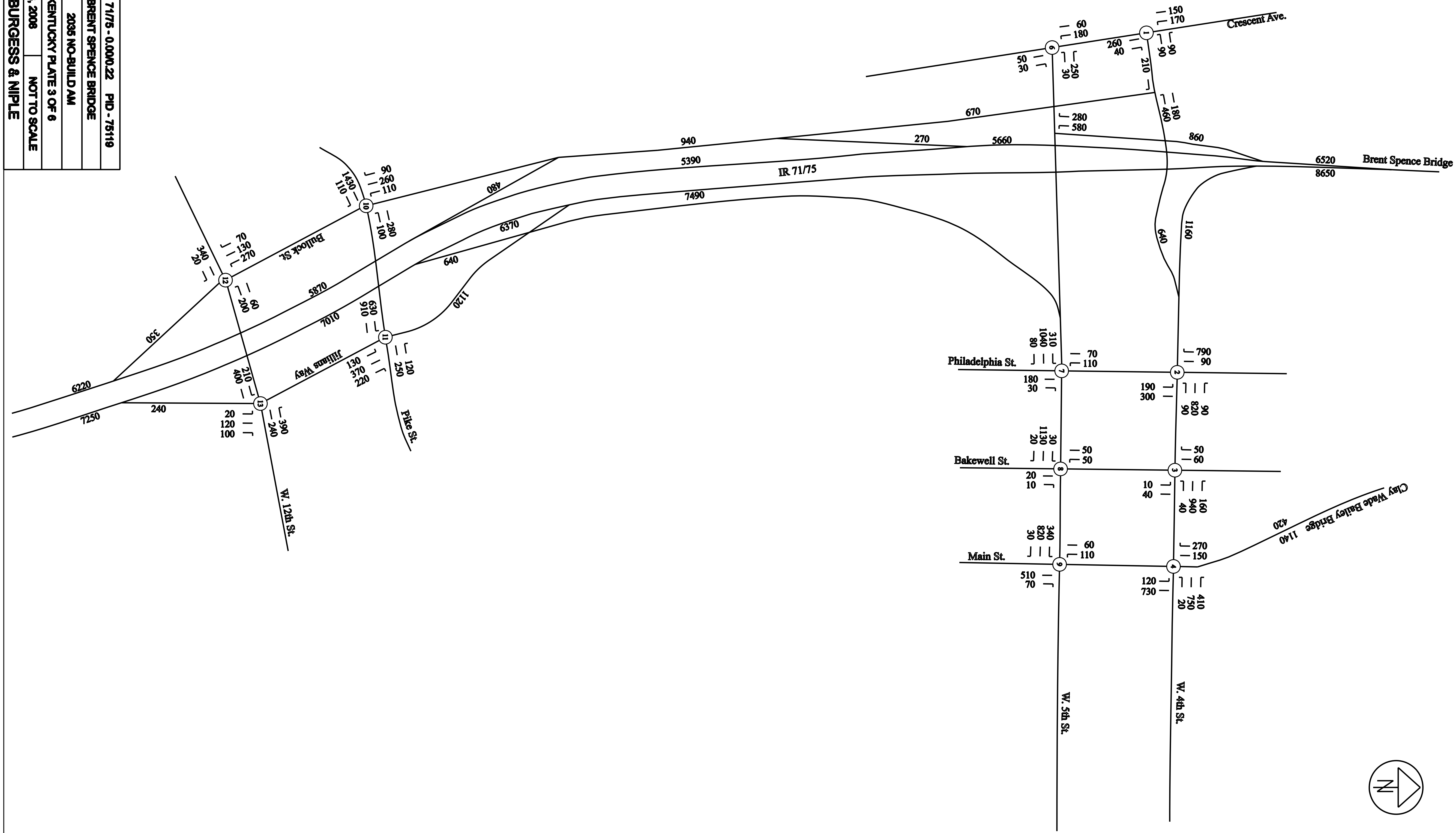
2035 NO-BUILD AM

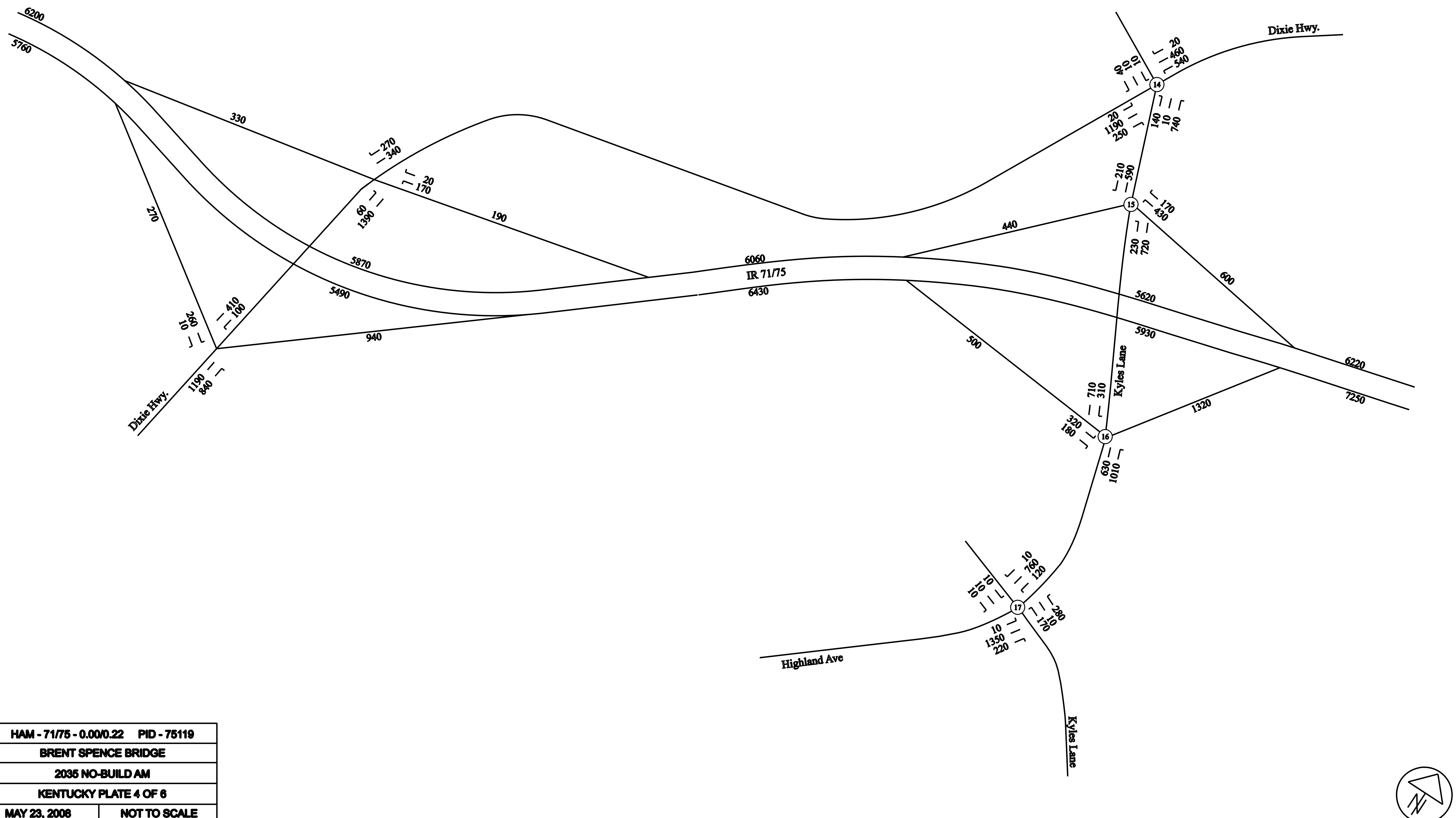
KENTUCKY PLATE 3 OF 6

MAY 23, 2006

NOT TO SCALE

BURGESS & NIPLE





HAM - 71/75 - 0.00/0.22 PID - 75119	
BRENT SPENCE BRIDGE	
2035 NO-BUILD AM	
KENTUCKY PLATE 4 OF 6	
MAY 23, 2008	NOT TO SCALE
BURGESS & NIPLE	

HAM - 71/75 - 0.00/0.22 PID - 75119

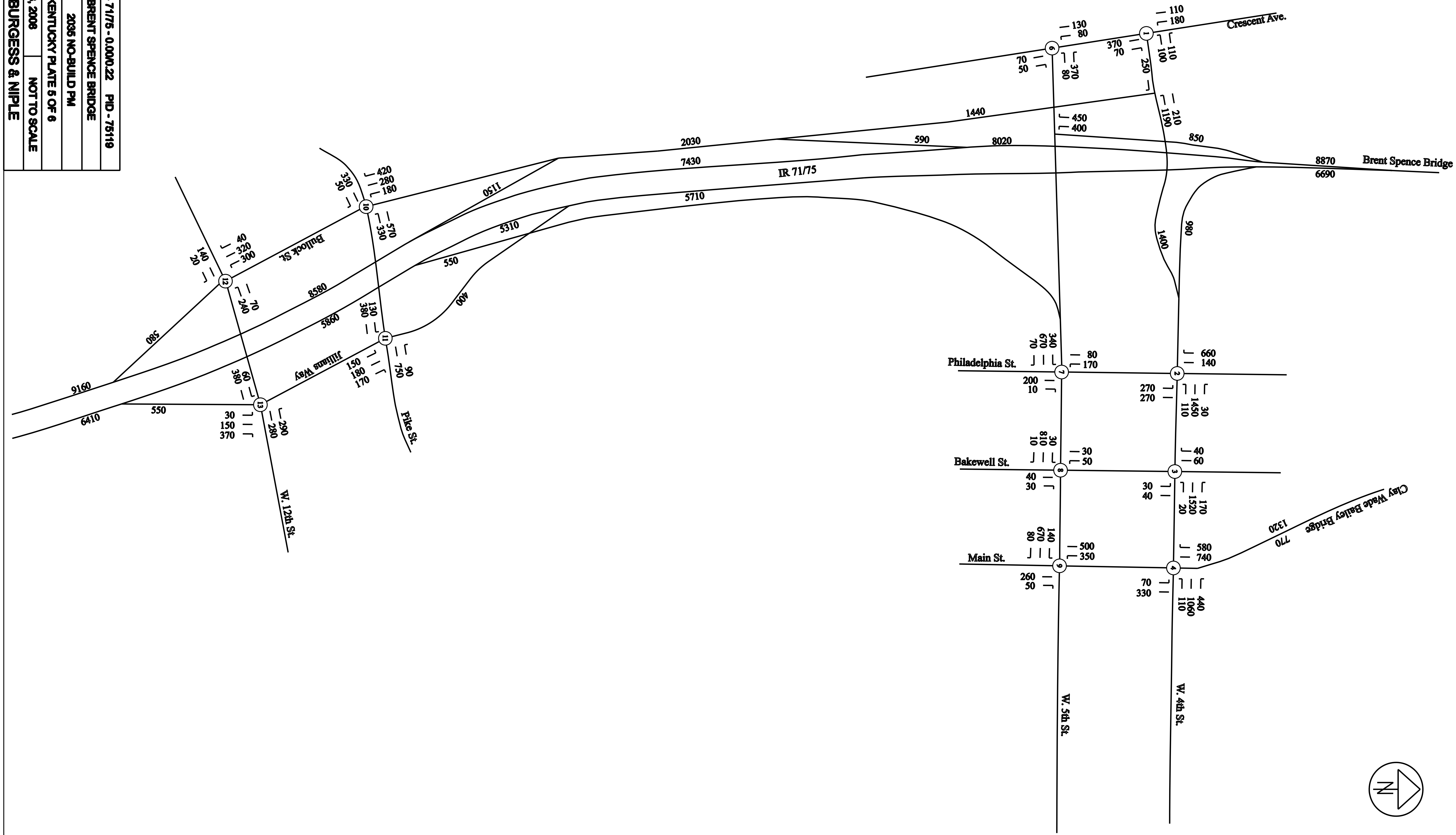
BRENT SPENCE BRIDGE

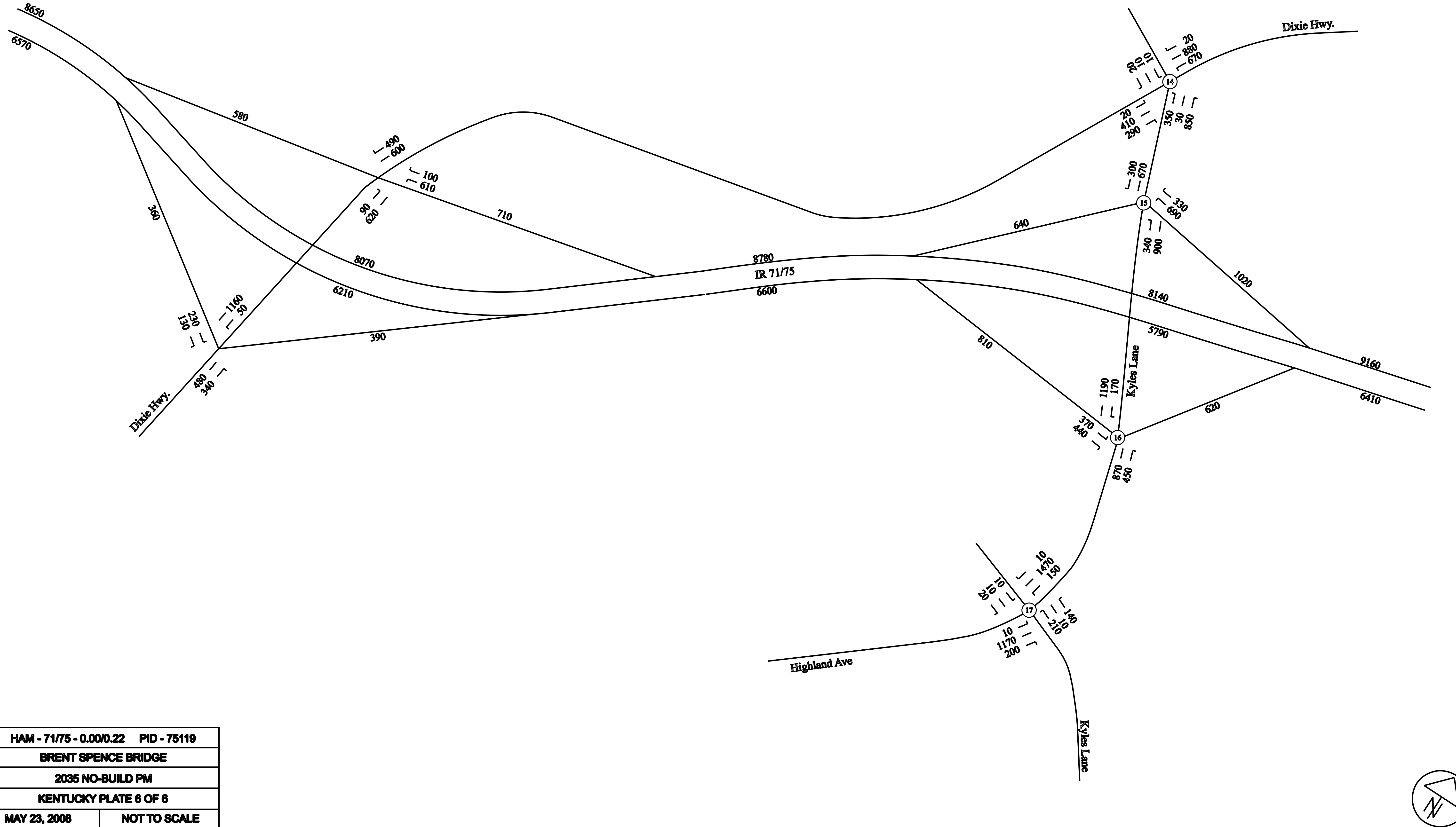
2035 NO-BUILD PM

KENTUCKY PLATE 5 OF 6

MAY 23, 2006 | NOT TO SCALE

BURGESS & NIPLE





HAM - 71/75 - 0.00/0.22 PID - 75119	
BRENT SPENCE BRIDGE	
2035 NO-BUILD PM	
KENTUCKY PLATE 6 OF 6	
MAY 23, 2008	NOT TO SCALE
BURGESS & NIPLE	

INTER-OFFICE COMMUNICATION

TO: Stefan Spinosa, PE, Technical Services Engineer, District 8

FROM: Leigh A. Oesterling, Project Analyses Admin., Office of Technical Services

SUBJECT: **HAM-71/75-0.00/0.22, PID 75119 – 2035 No-Build Certified Traffic**

DATE: April 10, 2008

As requested, the Office of Technical Services has prepared certified design traffic for the Brent Spence Bridge project (PID 75119). Attached are 21 plates showing 2035 ADT, A.M., and P.M. design hour volumes for the No-Build Alternative. Build alternatives will be sent at a later date.

If needed, K and D factors can be calculated from the attached plates. Truck factors are attached separately.

If you have any questions, please contact me at (614) 752-5747.

LAO:lo

attachment

c: J. McQuirt, OTS–P. Siddle, OTS–File

HAM-71/75-0.00/0.22
PID 75119 - Brent Spence Bridge
TRUCK FACTORS

from machine counts				
SITE CODE	DESCRIPTION	T24	AM TD	PM TD
T-01-OH	W. 4th St to IR 75 NB	0.05	0.09	0.04
T-02-OH	IR 71/FWW NB to W. 6th St. Expy (US 50)	0.07	0.07	0.06
T-03-OH	IR 75 NB to W. 5th Street	0.03	0.02	0.02
T-04-OH	IR 75 NB to W. 6th St. Expy (US 50)	0.06	0.04	0.03
T-05-OH	W. 6th St to IR 75 NB	0.07	0.11	0.04
T-06-OH	W. 9th St to IR 75 NB	0.03	0.12	0.02
T-07-OH	Freeman Ave to IR 75 NB	0.21	0.21	0.09
T-08-OH	Winchell Ave to IR 75 NB	0.05	0.08	0.01
T-09-OH	Winchell/Bank to IR 75 NB	0.13	0.15	0.09
T-10-OH	IR 71/FWW to IR 75 NB	0.07	0.06	0.03
T-11-OH	IR 71/FWW NB to 2nd St.	0.04	0.03	0.05
T-12-OH	IR 75 NB to IR 71/FWW	0.16	0.10	0.11
T-13-OH	IR 75 SB to Findlay St.	0.09	0.05	0.12
T-14-OH	IR 75 SB to Western Ave	0.05	0.03	0.06
T-15-OH	Western Ave to IR 75 SB	0.14	0.17	0.10
T-16-OH	IR 75 to Freeman	0.20	0.14	0.09
T-17-OH	IR 75 SB to W. 7th St.	0.05	0.07	0.03
T-18-OH	W. 9th St. to IR 75 SB	0.03	0.04	0.02
T-19-OH	W. 8th St. EB to W. 7th St. EB	0.08	0.07	0.12
T-20-OH	W. 9th St. WB to W. 8th St. WB	0.08	0.11	0.06
T-21-OH	IR 75 SB to 5th St.	0.03	0.04	0.04
T-22-OH	W. 6th St Expy EB (US 50) to 5th St.	0.04	0.04	0.02
T-23-OH	IR 75 SB to 2nd Street	0.03	0.01	0.02
T-24-OH	IR 71/FWW to IR 75 SB	0.20	0.10	0.14
T-25-OH	3rd St. WB to IR 75 SB	0.05	0.11	0.05
T-26-OH	IR 75 SB to IR 71/FWW	0.07	0.07	0.04
T-27-OH	Freeman Ave to W. 6th St Expy WB (US 50)	0.13	0.26	0.05
T-28-OH	Freeman Ave to W. 6th St Expy EB (US 50)	0.14	0.26	0.08
T-29-OH	W. 6th St Expy EB (US 50) to Freeman Ave	0.07	0.04	0.04
T-30-OH	W. 6th St Expy WB (US 50) to Linn St	0.08	0.06	0.06
T-31-OH	W. 6th St EB to W. 6th St Expy EB (US 50)	0.09	0.13	0.04
T-32-OH	W. 6th St. EB to Gest St	0.11	0.32	0.08
T-33-OH	W. 6th St Expy EB (US 50) to IR 75 SB	0.09	0.09	0.05
T-34-OH	W. 6th St Expy EB (US 50) to IR 71/FWW	0.05	0.03	0.04
T-35-OH	W. 6th St Expy EB (US 50) to 2nd St	0.02	0.01	0.02
T-36-OH	Western Hills Viaduct EB to IR 75 SB	0.03	0.03	0.03
T-37-OH	Western Hills Viaduct EB to IR 75 NB	0.05	0.04	0.08
T-38-OH	IR 75 SB to Western Hills Viaduct WB	0.06	0.21	0.05
T-39-OH	IR 75 NB to Western Hills Viaduct WB	0.04	0.04	0.02
T-40-OH	Clay Wade Bailey Brdg SB to Second St	0.04	0.08	0.02
T-41-OH	Clay Wade Bailey Brdg NB to Second St	0.03	0.02	0.02
T-42-OH	IR 75 SB north of Western Hills Viaduct	0.19	0.12	0.16
T-43-OH	IR 75 NB north of Western Hills Viaduct	0.17	0.14	0.14
T-44-OH	IR 75 SB south of SB ramp to Freeman Ave	0.15	0.08	0.11
T-45-OH	IR 75 NB south of NB ramp from Freeman Ave	0.17	0.13	0.10
T-46-OH	IR 75 SB btw 6th & 5th St. Viaducts	0.24	0.14	0.16
T-47-OH	IR 75 NB btw 6th & 5th St. Viaducts	0.24	0.16	0.20
1001	Liberty to IR 471 SB	0.02	0.03	0.01
2001	IR 471 NB to Liberty	0.03	0.02	0.03
3001	Gilbert to IR 71 NB	0.05	0.09	0.02

Office of Technical Services
Ohio Department of Transportation
April 10, 2008

HAM-71/75-0.00/0.22
PID 75119 - Brent Spence Bridge
TRUCK FACTORS

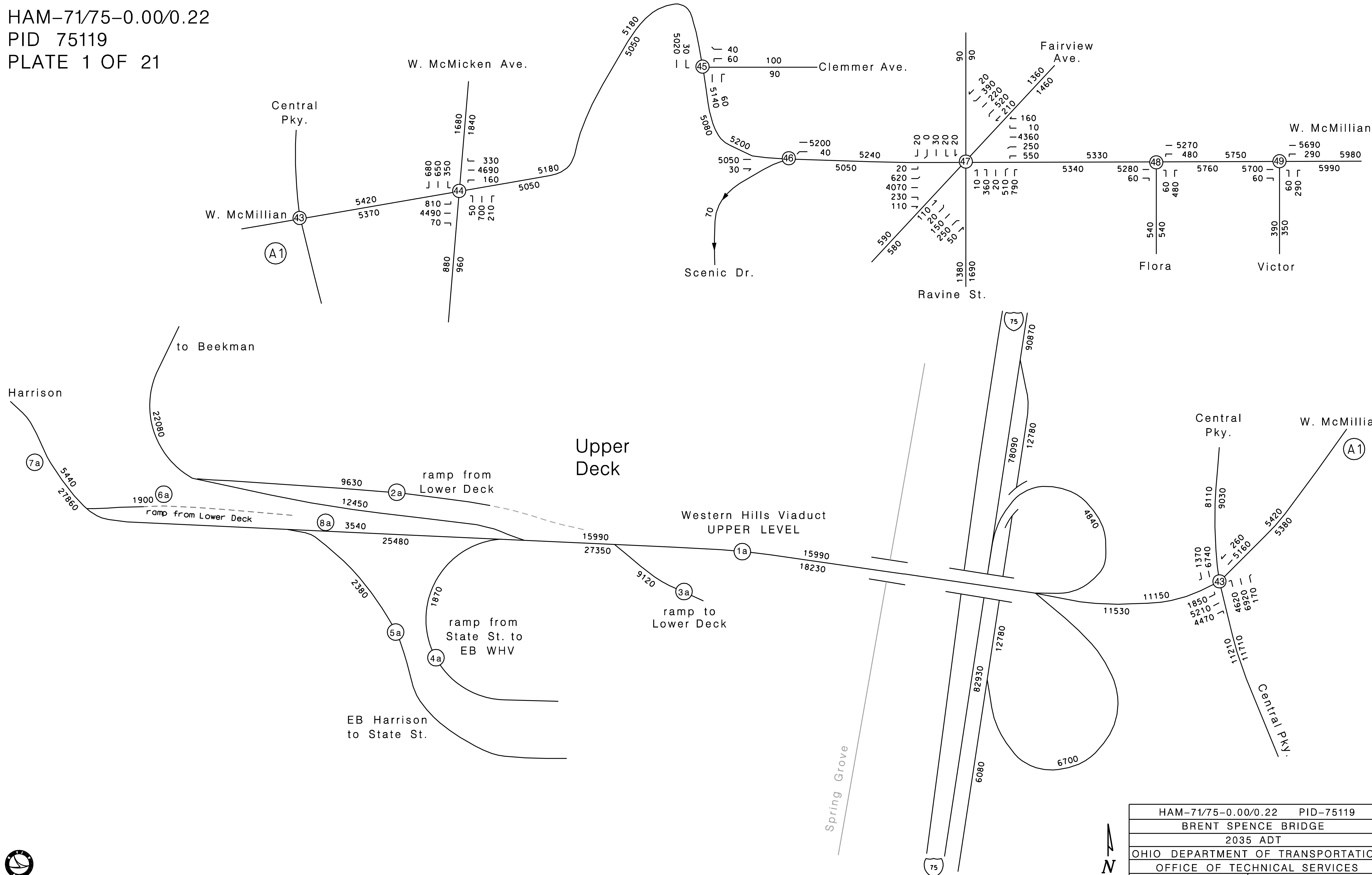
from ODOT Traffic Survey Reports				
SITE CODE	DESCRIPTION	T24	AM TD	PM TD
	HAM-71-0.00 (Brent Spence Bridge)	0.11	0.07	0.07
	HAM-71-0.22 (northeast of IR 75)	0.17	0.10	0.10
	HAM-71-1.26 (northeast of US 50 ramps)	0.14	0.08	0.08
	HAM-71-1.92 (north of IR 471 ramps)	0.12	0.07	0.07
	HAM-75-0.71 (north of US 50/6th St Expy)	0.15	0.09	0.09
	HAM-75-0.86 (north of 9th Street)	0.18	0.11	0.11
	HAM-75-1.24 (north of Freeman Ave)	0.16	0.10	0.10
	HAM-75-1.42 (north of Ezzard Charles)	0.16	0.10	0.10
	HAM-75-1.90 (north of Findlay)	0.16	0.10	0.10
	HAM-75-2.51 (north of Wester Hills Viaduct)	0.16	0.10	0.10
from ODOT ramp counts				
SITE CODE	DESCRIPTION	T24	AM TD	PM TD
103931	IR 471 NB to IR 71 NB	0.05	0.04	0.04
104031	IR 71 SB to IR 471 SB	0.13	0.11	0.12
104731	IR 71 NB to US 50 EB	0.09	0.08	0.08
103731	2nd St to IR 71 NB	0.02	0.03	0.01
104231	US 50 WB to IR 71 SB	0.03	0.01	0.02
104131	IR 71 SB to 3rd Street	0.06	0.06	0.04
103831	5th Street to IR 71 NB	0.06	0.06	0.06

HAM-71/75-0.00/0.22
PID 75119 - Brent Spence Bridge
TRUCK FACTORS

from intersection turning movement counts (where vehicle class is available)				
SITE CODE	DESCRIPTION	T24	AM TD	PM TD
43	WHV/McMillan @ Central Pkwy			
	East Leg	0.01	0.01	0.01
	North Leg	0.01	0.01	0.01
	West Leg	0.01	0.01	0.01
	South Leg	0.01	0.01	0.01
26	WHV Lower Level @ Spring Grove			
	North Leg	0.05	0.05	0.03
	West Leg	0.08	0.12	0.06
	South Leg	0.08	0.08	0.04
44	McMillan @ McMicken			
	East Leg	0.04	0.06	0.03
	North Leg	0.08	0.10	0.05
	West Leg	0.02	0.03	0.01
	South Leg	0.18	0.26	0.13
45	McMillan @ Clemmer			
	East Leg	0.00	0.00	0.00
	North Leg	0.05	0.06	0.02
	South Leg	0.05	0.06	0.02
46	McMillan @ Scenic			
	East Leg	0.05	0.06	0.02
	West Leg	0.05	0.06	0.02
	South Leg	0.00	0.00	0.00
47	McMillan @ Ravine @ Fairview			
	East Leg	0.05	0.07	0.03
	North Leg	0.13	0.08	0.23
	West Leg	0.05	0.06	0.02
	South Leg	0.04	0.03	0.03
	Northeast Leg (Fairview)	0.04	0.04	0.03
	Southwest Leg (Fairview)	0.11	0.25	0.05
48	McMillan @ Flora			
	East Leg	0.05	0.07	0.03
	West Leg	0.05	0.07	0.03
	South Leg	0.00	0.00	0.00
49	McMillan @ Victor			
	East Leg	0.05	0.07	0.02
	West Leg	0.05	0.07	0.03
	South Leg	0.03	0.04	0.03
	All other local streets	0.02	0.01	0.01

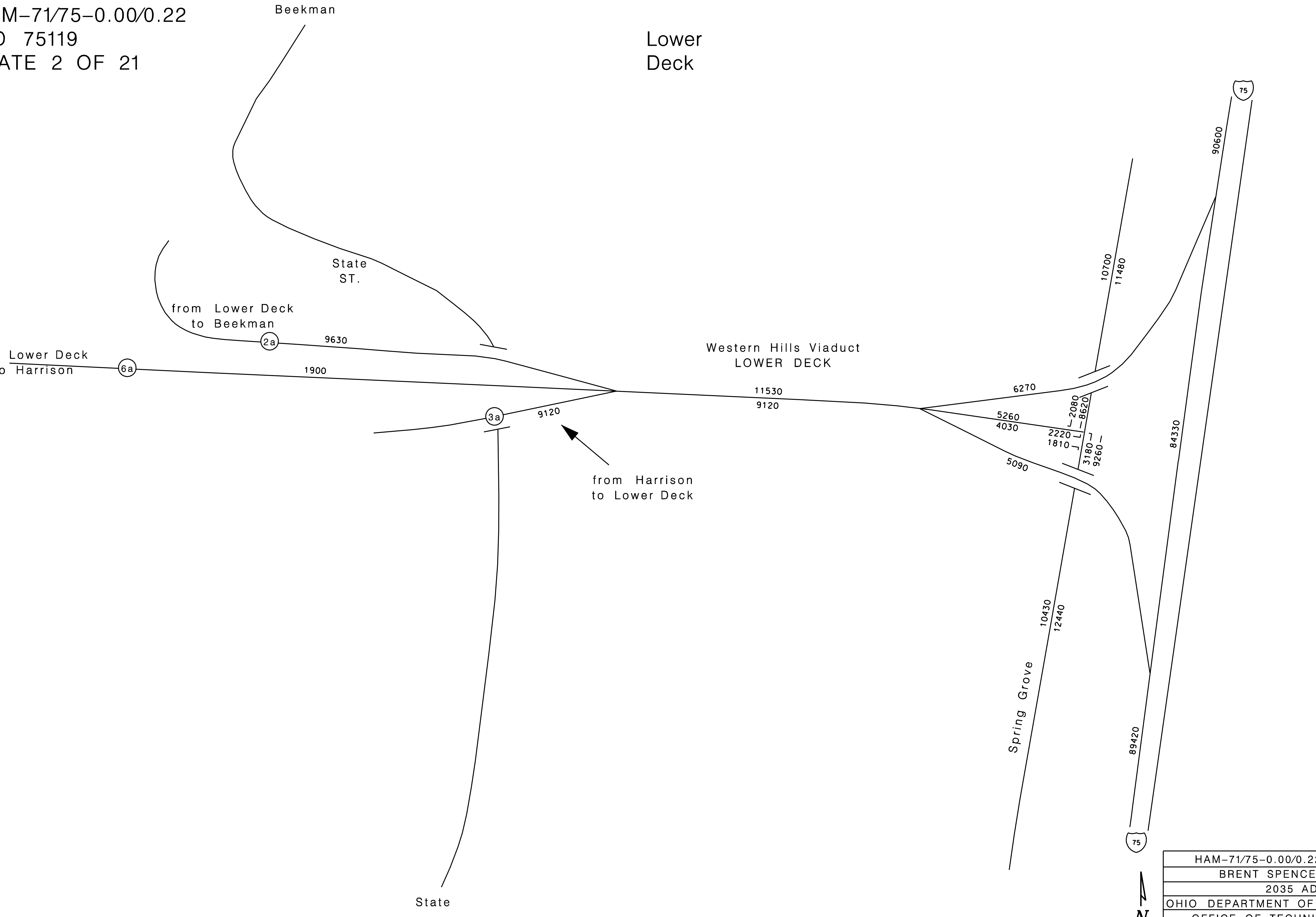
Office of Technical Services
Ohio Department of Transportation
April 10, 2008

HAM-71/75-0.00/0.22
PID 75119
PLATE 1 OF 21



HAM-71/75-0.00/0.22 PID-75119
BRENT SPENCE BRIDGE
2035 ADT
OHIO DEPARTMENT OF TRANSPORTATION
OFFICE OF TECHNICAL SERVICES
APRIL 10, 2008 | NOT TO SCALE

HAM-71/75-0.00/0.22
PID 75119
PLATE 2 OF 21



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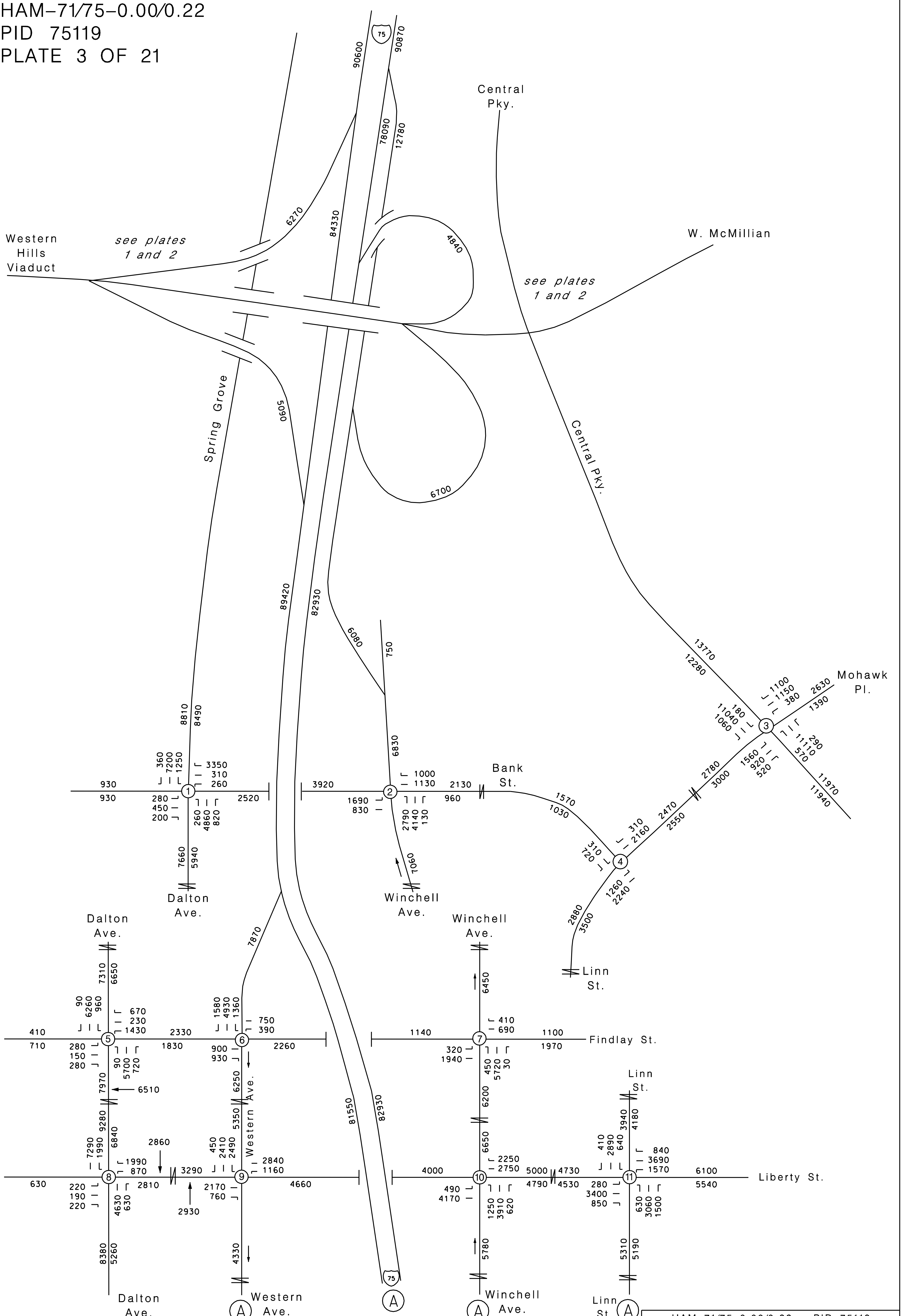
BRENT SPENCE BRIDGE	
2035 ADT	
OHIO DEPARTMENT OF TRANSPORTATION	
OFFICE OF TECHNICAL SERVICES	
APRIL 10, 2008	NOT TO SCALE

HAM-71/75-0.00/0.22
PID 75119
PLATE 3 OF 21



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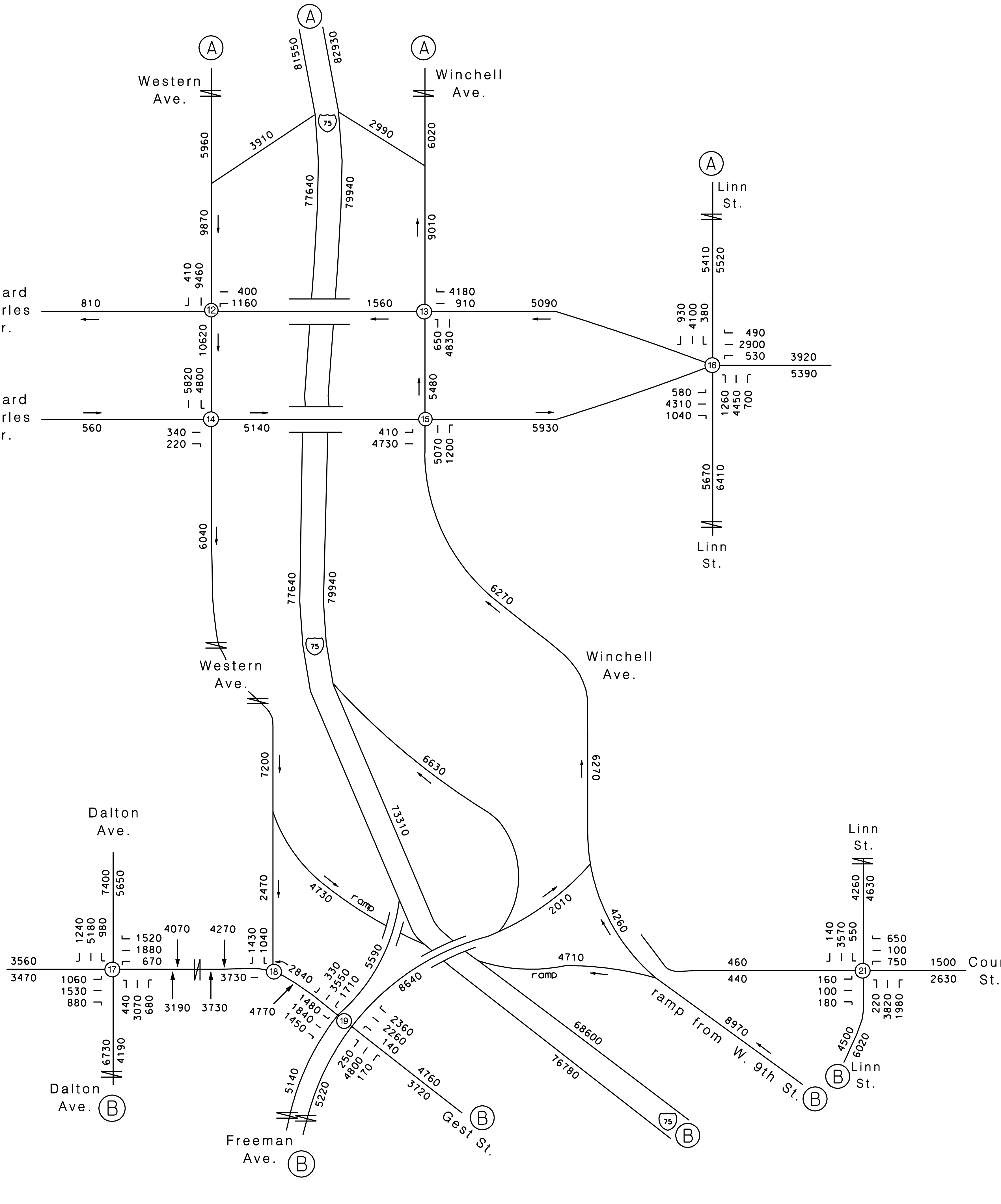
BRENT SPENCE BRIDGE	
2035 ADT	
OHIO DEPARTMENT OF TRANSPORTATION	
OFFICE OF TECHNICAL SERVICES	
APRIL 10, 2008	NOT TO SCALE

HAM-71/75-0.00/0.22
PID 75119
PLATE 4 OF 21



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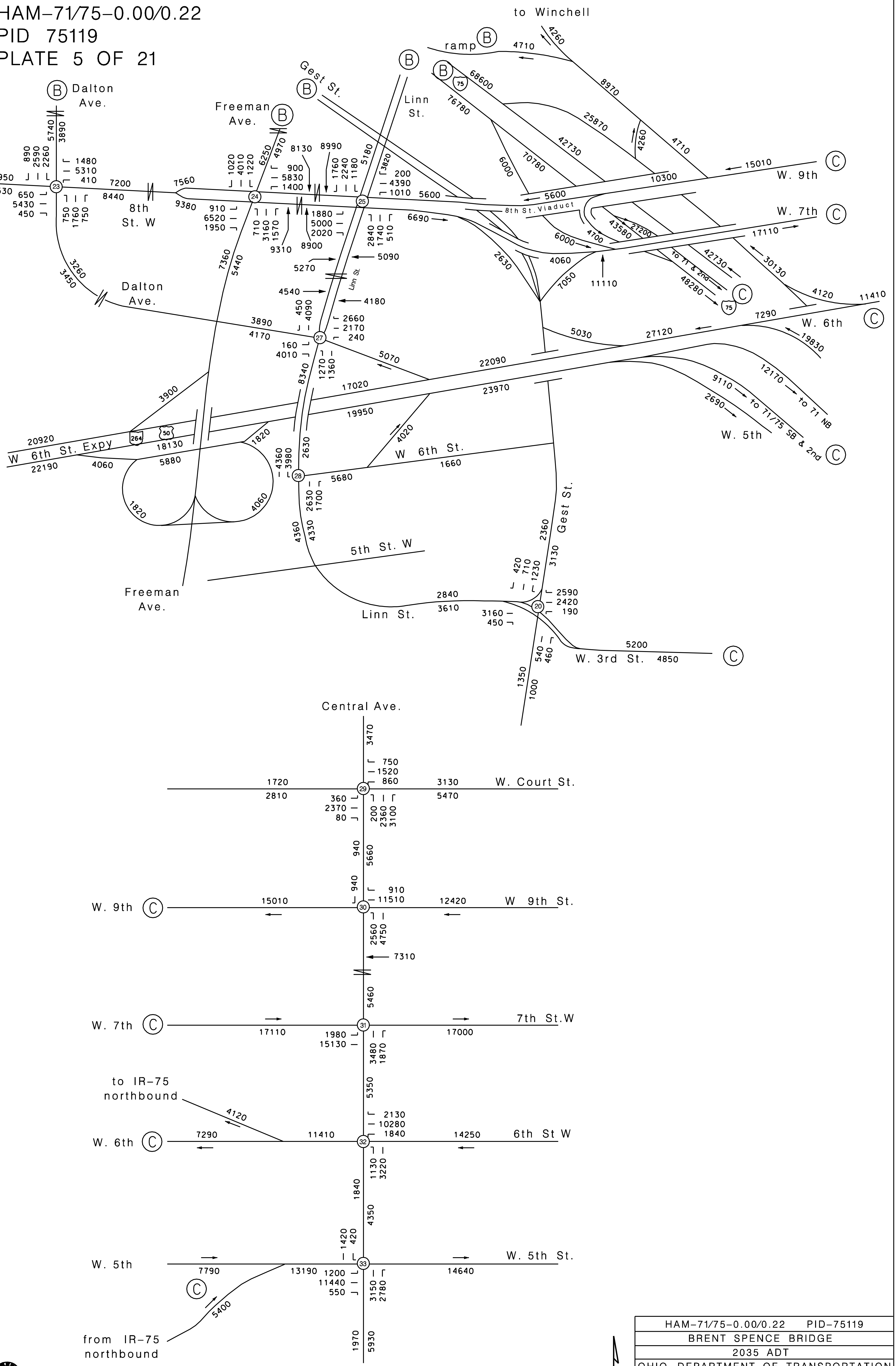
2035 ADT	
OHIO DEPARTMENT OF TRANSPORTATION	
OFFICE OF TECHNICAL SERVICES	
APRIL 10, 2008	NOT TO SCALE

HAM-71/75-0.00/0.22
PID 75119
PLATE 5 OF 21



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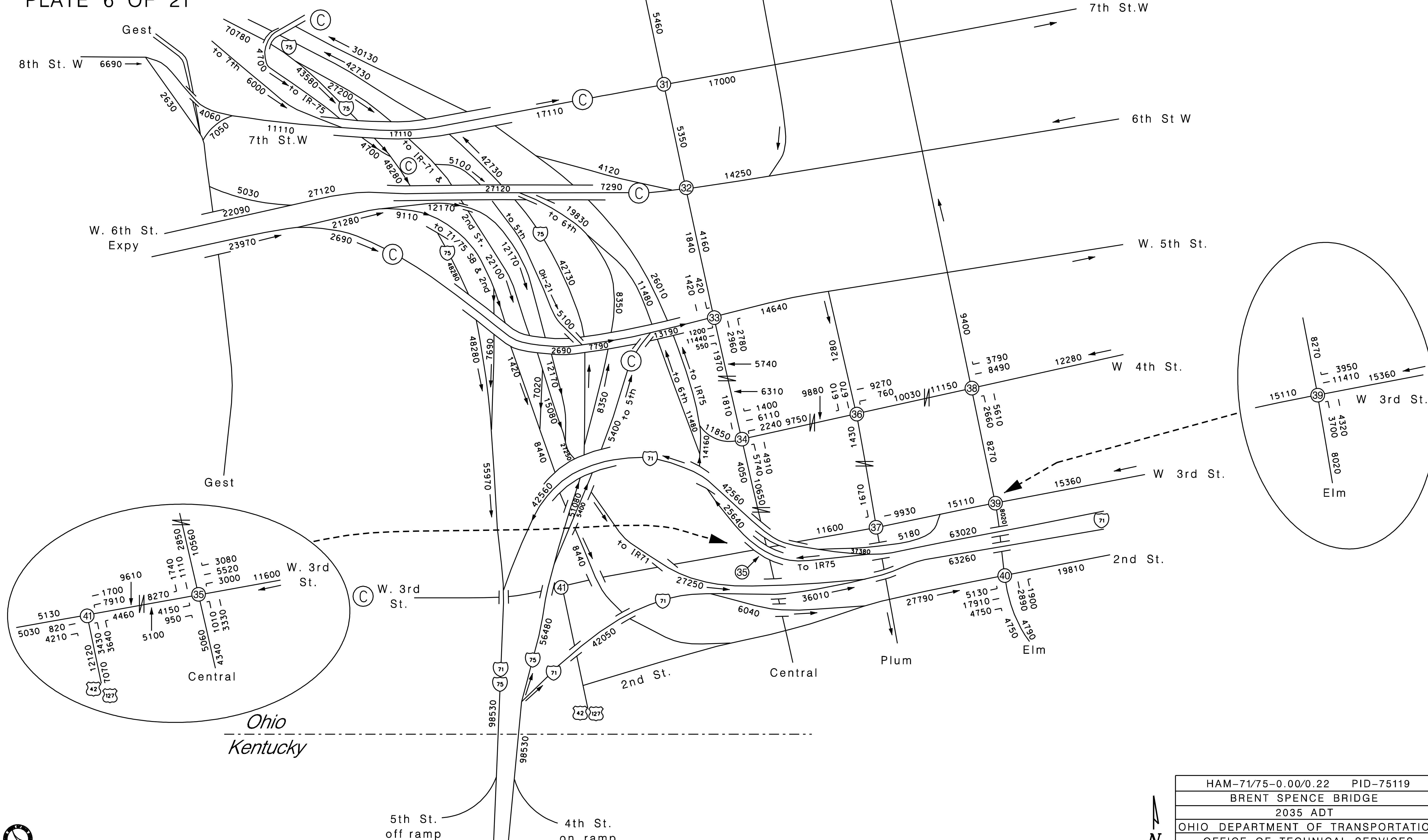
BRENT SPENCE BRIDGE	
2035 ADT	
OHIO DEPARTMENT OF TRANSPORTATION	
OFFICE OF TECHNICAL SERVICES	
APRIL 10, 2008	NOT TO SCALE

HAM-71/75-0.00/0.22
PID 75119
PLATE 6 OF 21



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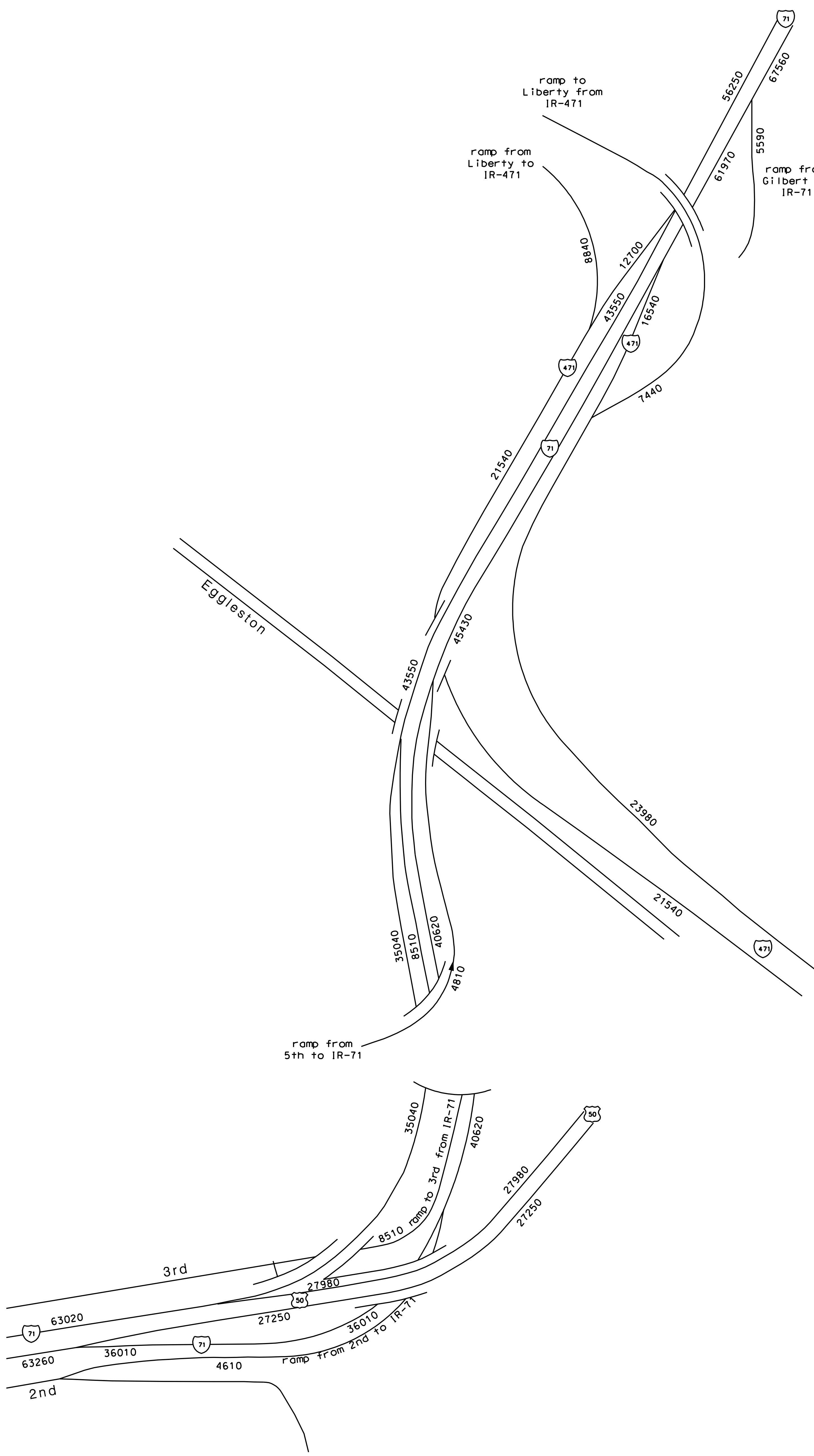
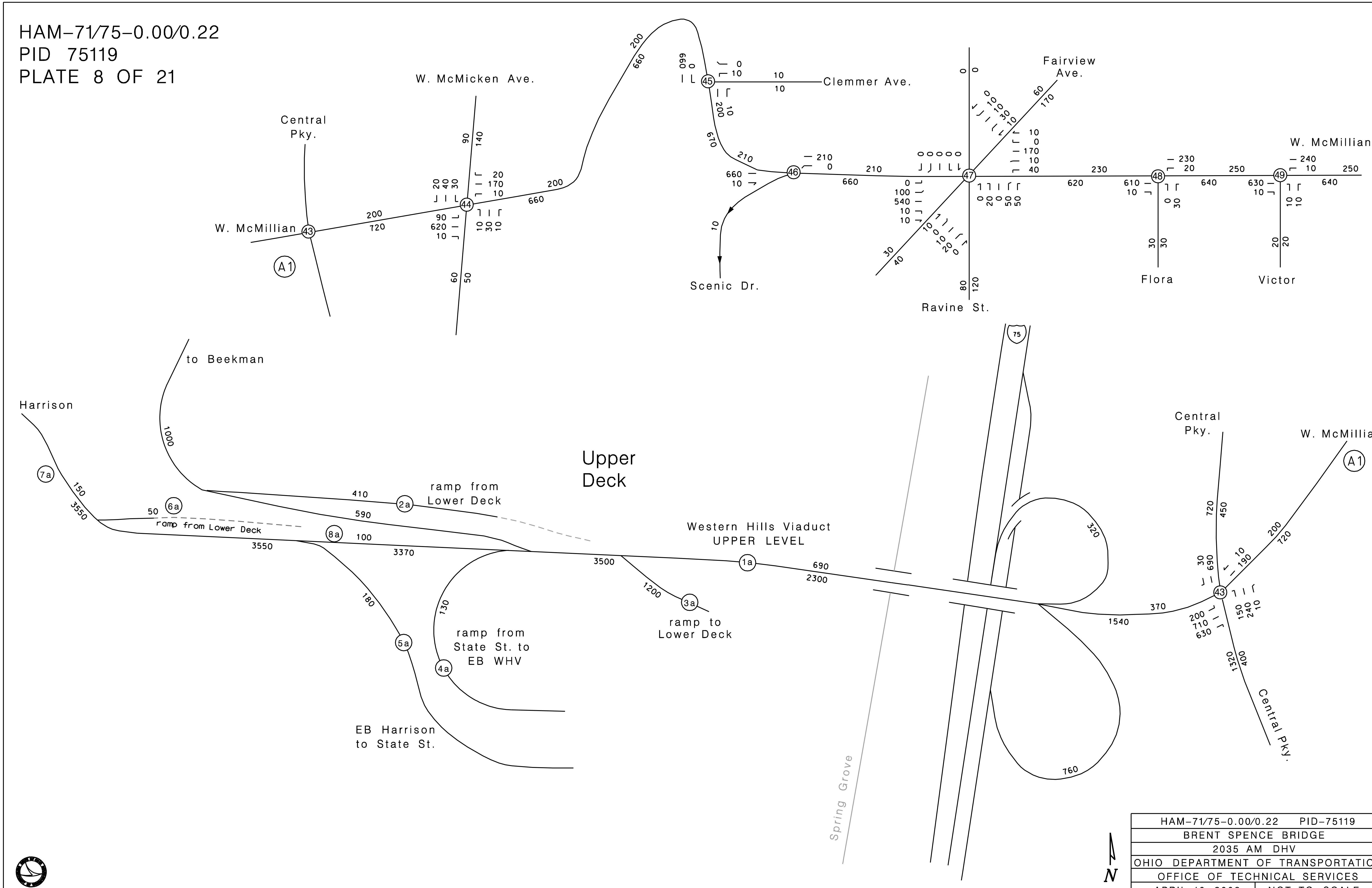
BRENT SPENCE BRIDGE	
2035 ADT	
OHIO DEPARTMENT OF TRANSPORTATION	
OFFICE OF TECHNICAL SERVICES	
APRIL 10, 2008	NOT TO SCALE

HAM-71/75-0.00/0.22
PID 75119
PLATE 7 OF 21

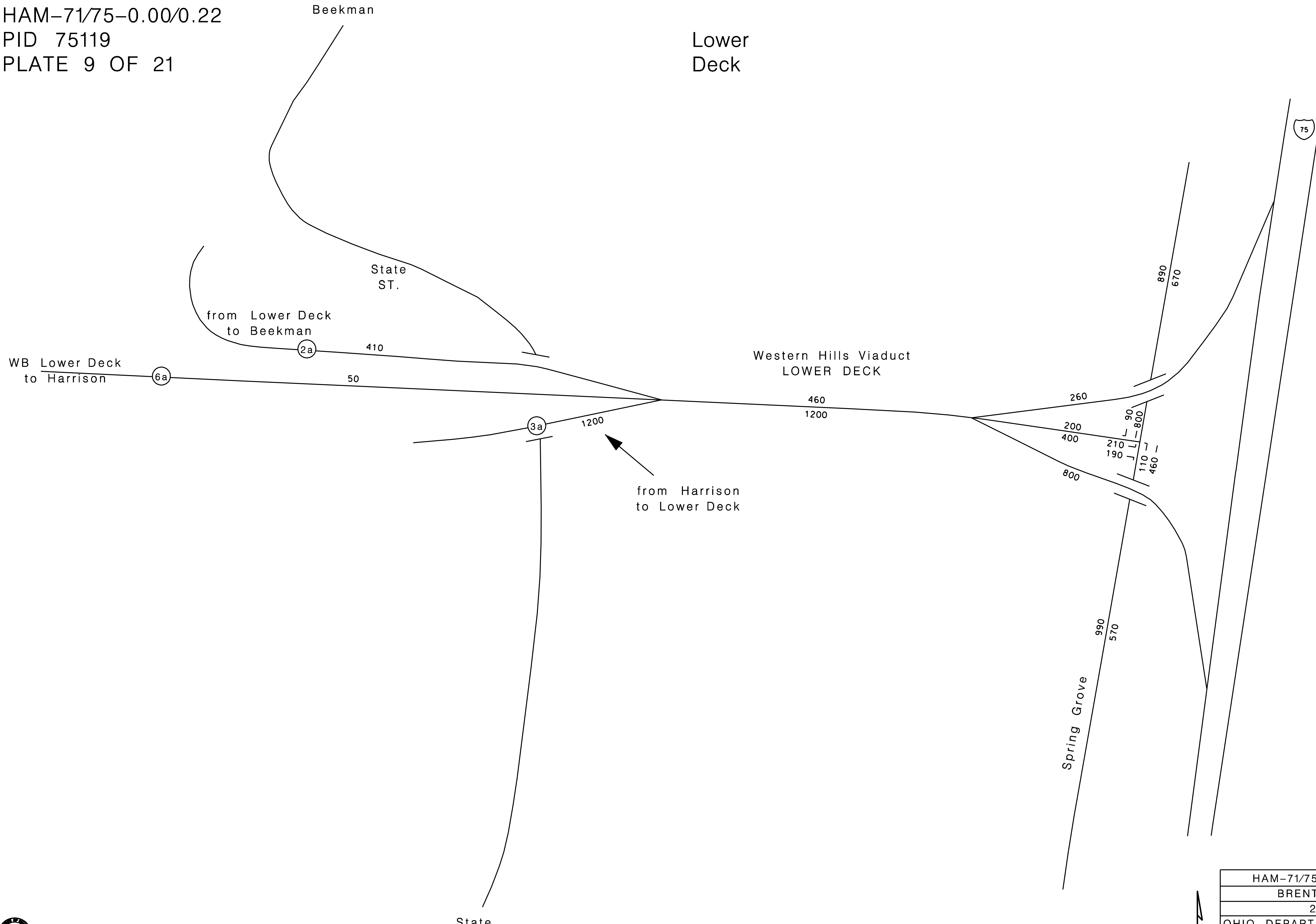


HAM-71/75-0.00/0.22 PID-75119	
BRENT SPENCE BRIDGE	
2035 ADT	
OHIO DEPARTMENT OF TRANSPORTATION	
OFFICE OF TECHNICAL SERVICES	
APRIL 10, 2008	NOT TO SCALE


HAM-71/75-0.00/0.22
PID 75119
PLATE 8 OF 21
Central Pky.
W. McMicken Ave.
W. McMillian
Clemmer Ave.
Fairview Ave.
Scenic Dr.
Ravine St.
Flora
Victor
W. McMillian
to Beekman
Harrison
Upper Deck
ramp from Lower Deck
ramp from Lower Deck
Western Hills Viaduct UPPER LEVEL
ramp to Lower Deck
ramp from State St. to EB WHV
EB Harrison to State St.
Spring Grove
Central Pky.
W. McMillian
Central Pky.
HAM-71/75-0.00/0.22 PID-75119
BRENT SPENCE BRIDGE
2035 AM DHV
OHIO DEPARTMENT OF TRANSPORTATION
OFFICE OF TECHNICAL SERVICES
APRIL 10, 2008
NOT TO SCALE

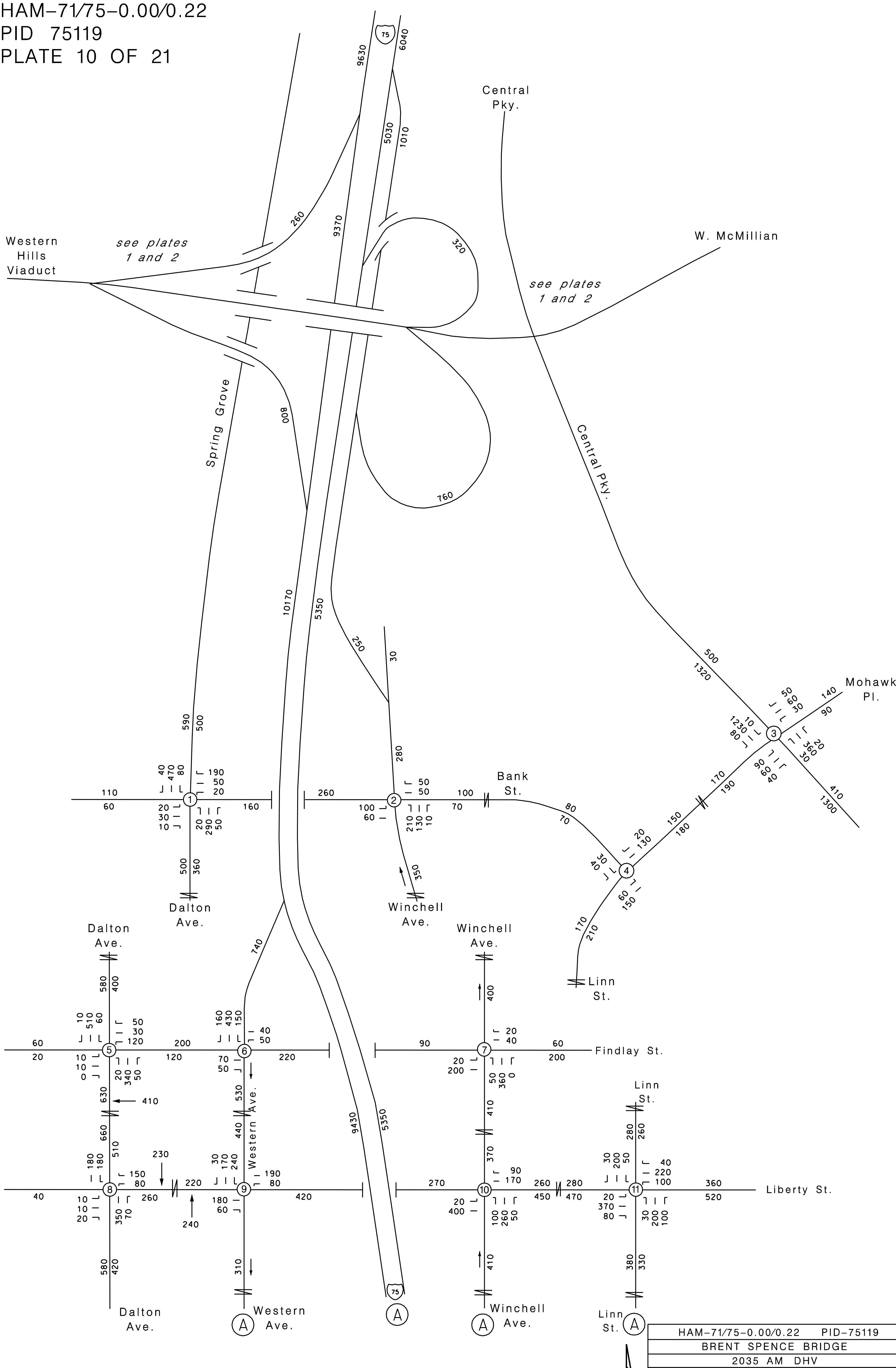
HAM-71/75-0.00/0.22
PID 75119
PLATE 9 OF 21

Lower Deck

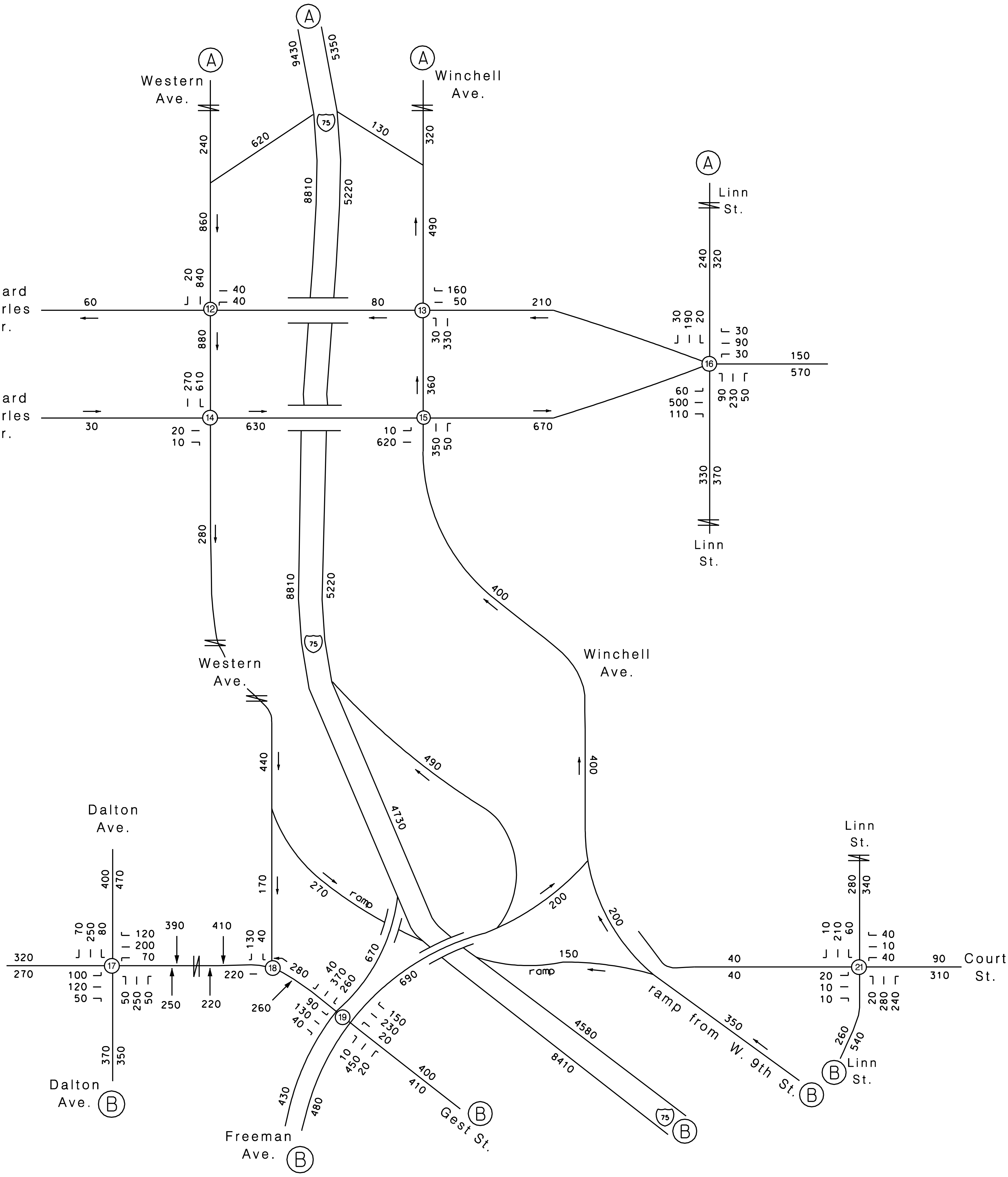


HAM-71/75-0.00/0.22 PID-75119	
BRENT SPENCE BRIDGE	
2035 AM DHV	
OHIO DEPARTMENT OF TRANSPORTATION	
OFFICE OF TECHNICAL SERVICES	
APRIL 10, 2008	NOT TO SCALE

HAM–71/75–0.00/0.22
PID 75119
PLATE 10 OF 21



HAM–71/75–0.00/0.22 PID–75119	
BRENT SPENCE BRIDGE	
2035 AM DHV	
OHIO DEPARTMENT OF TRANSPORTATION	
OFFICE OF TECHNICAL SERVICES	
APRIL 10, 2008	NOT TO SCALE



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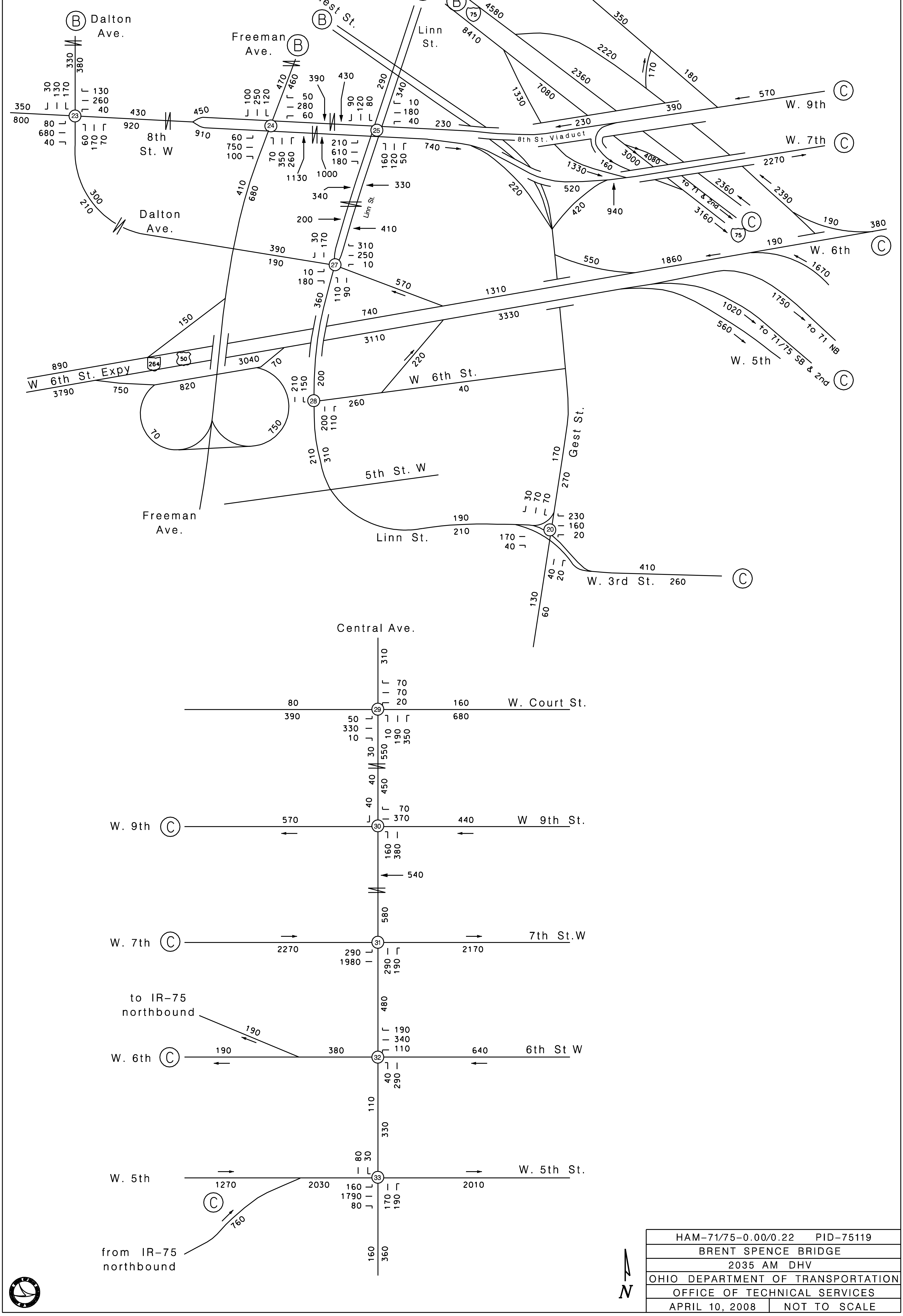
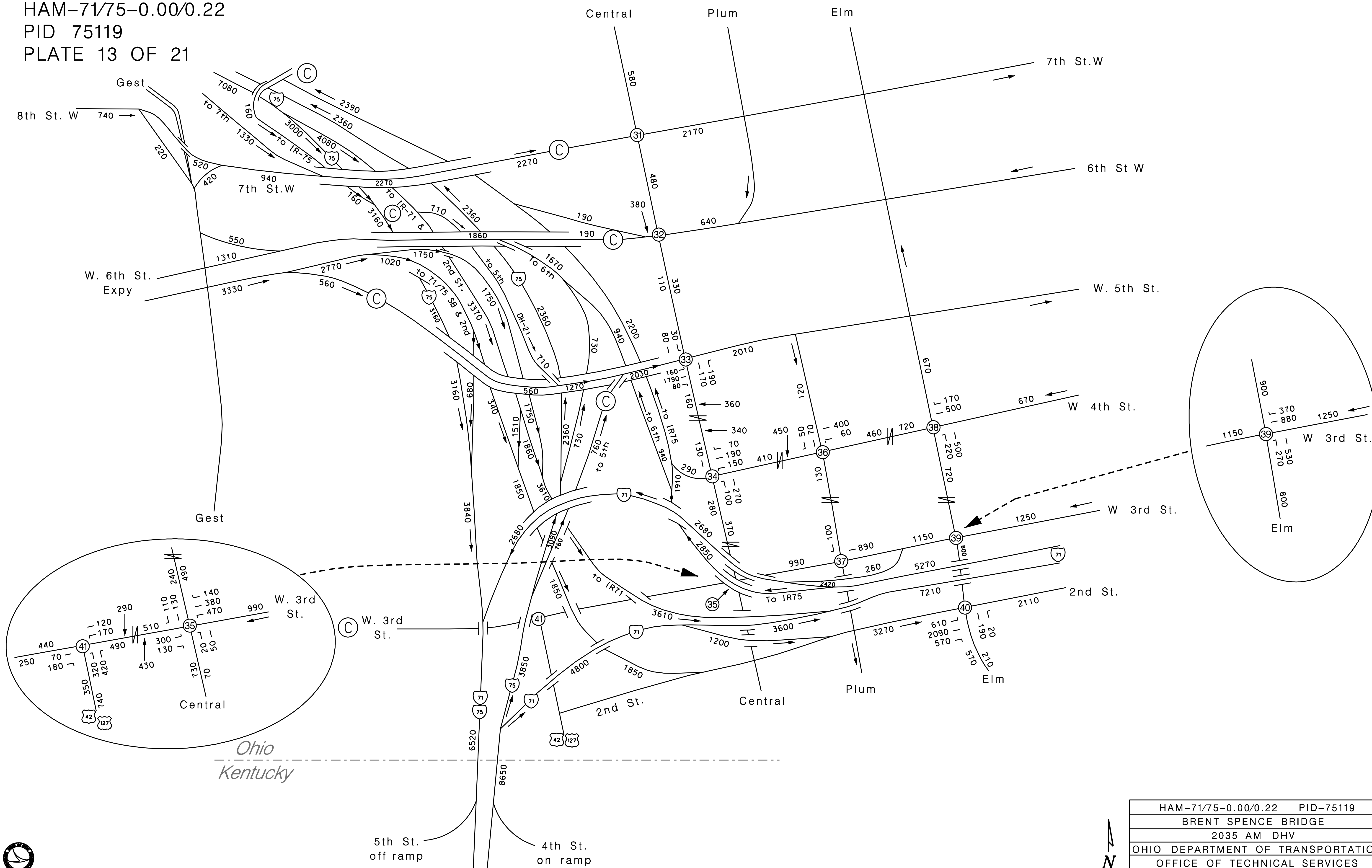
BRENT SPENCE BRIDGE	
2035 AM DHV	
OHIO DEPARTMENT OF TRANSPORTATION	
OFFICE OF TECHNICAL SERVICES	
APRIL 10, 2008	NOT TO SCALE

HAM-71/75-0.00/0.22
PID 75119
PLATE 12 OF 21



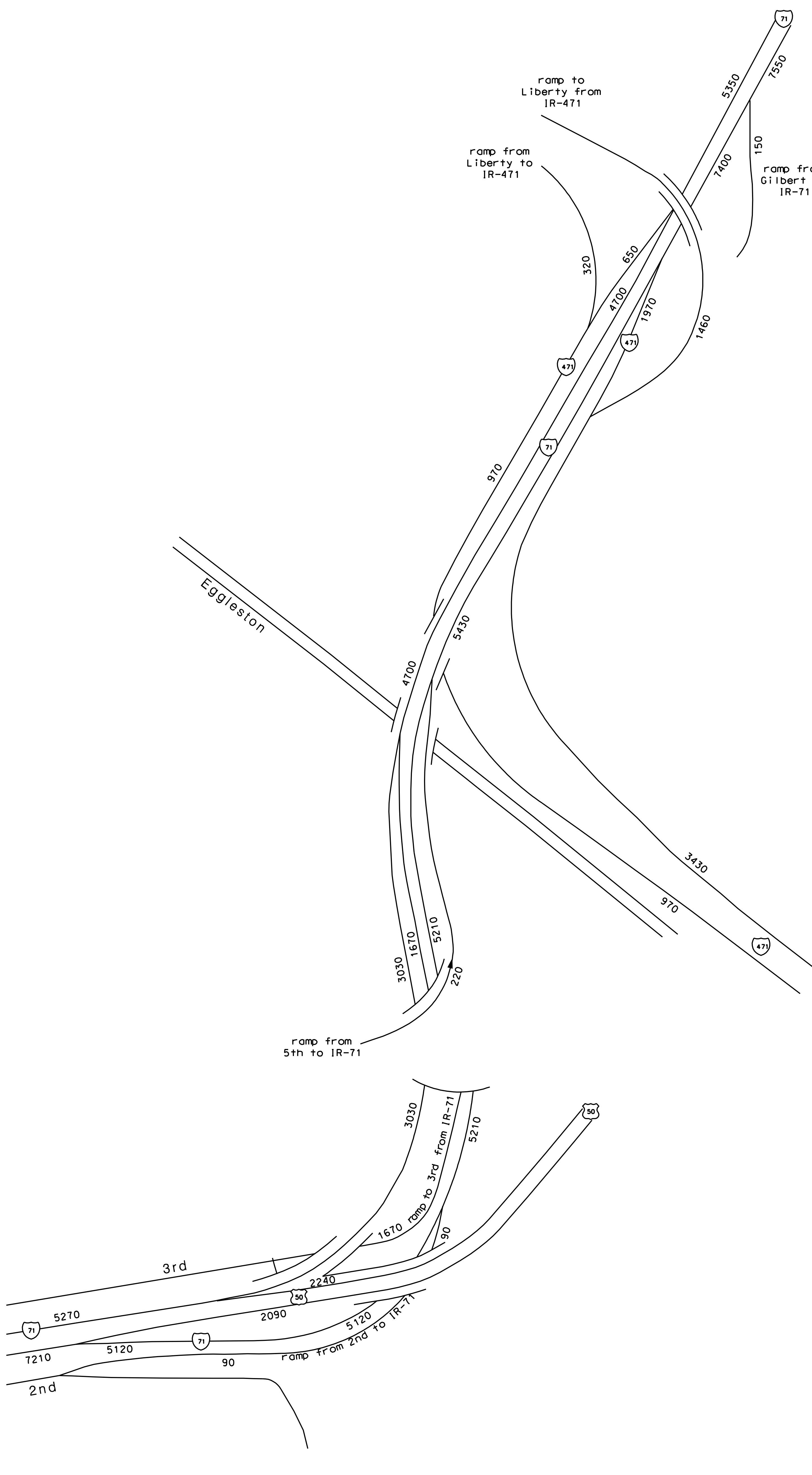
HAM-71/75-0.00/0.22 PID-75119
BRENT SPENCE BRIDGE
2035 AM DHV
OHIO DEPARTMENT OF TRANSPORTATION
OFFICE OF TECHNICAL SERVICES
APRIL 10, 2008 | NOT TO SCALE

HAM-71/75-0.00/0.22
PID 75119
PLATE 13 OF 21



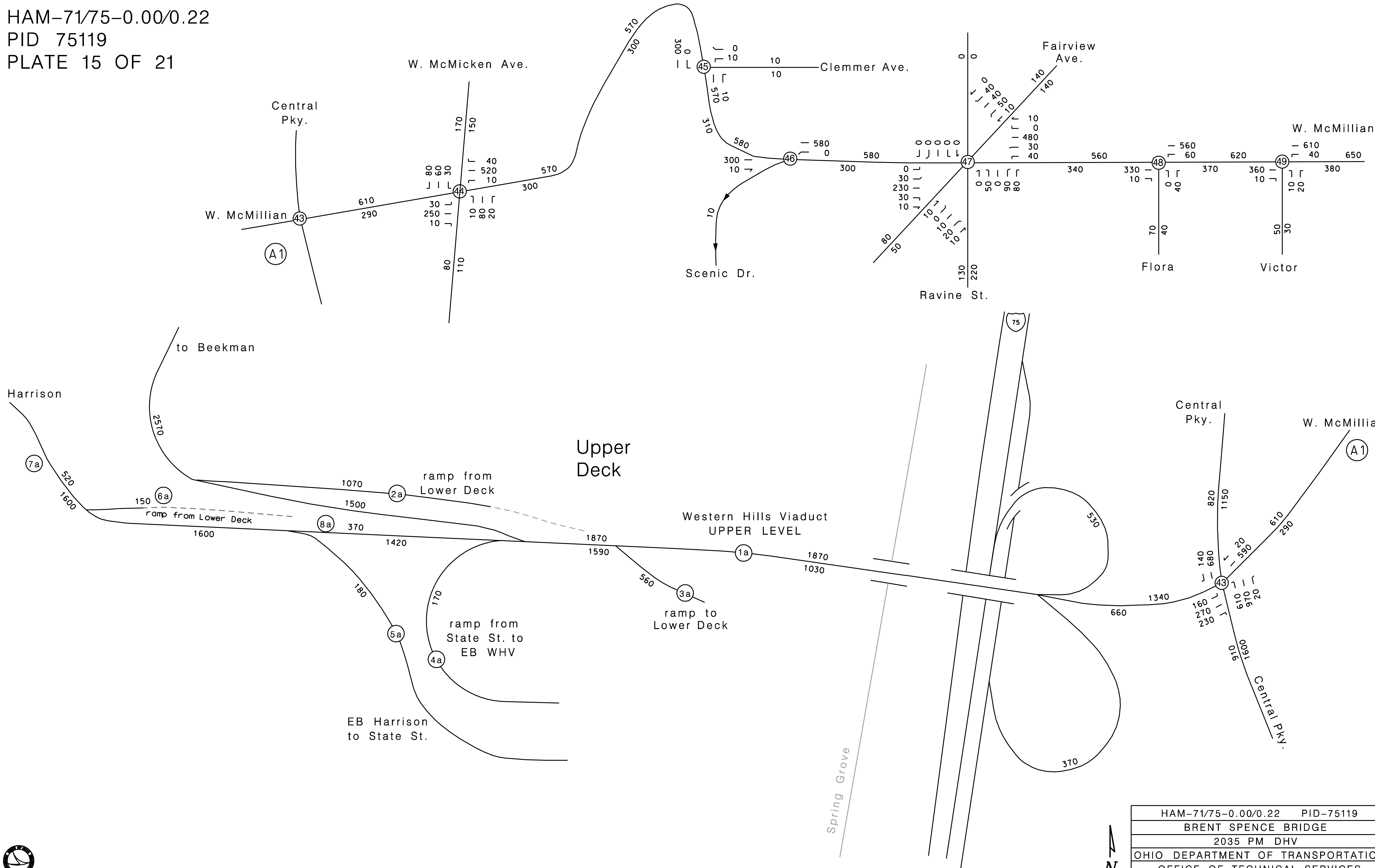
HAM-71/75-0.00/0.22 PID-75119	
BRENT SPENCE BRIDGE	
2035 AM DHV	
OHIO DEPARTMENT OF TRANSPORTATION	
OFFICE OF TECHNICAL SERVICES	
APRIL 10, 2008	NOT TO SCALE

HAM-71/75-0.00/0.22
PID 75119
PLATE 14 OF 21



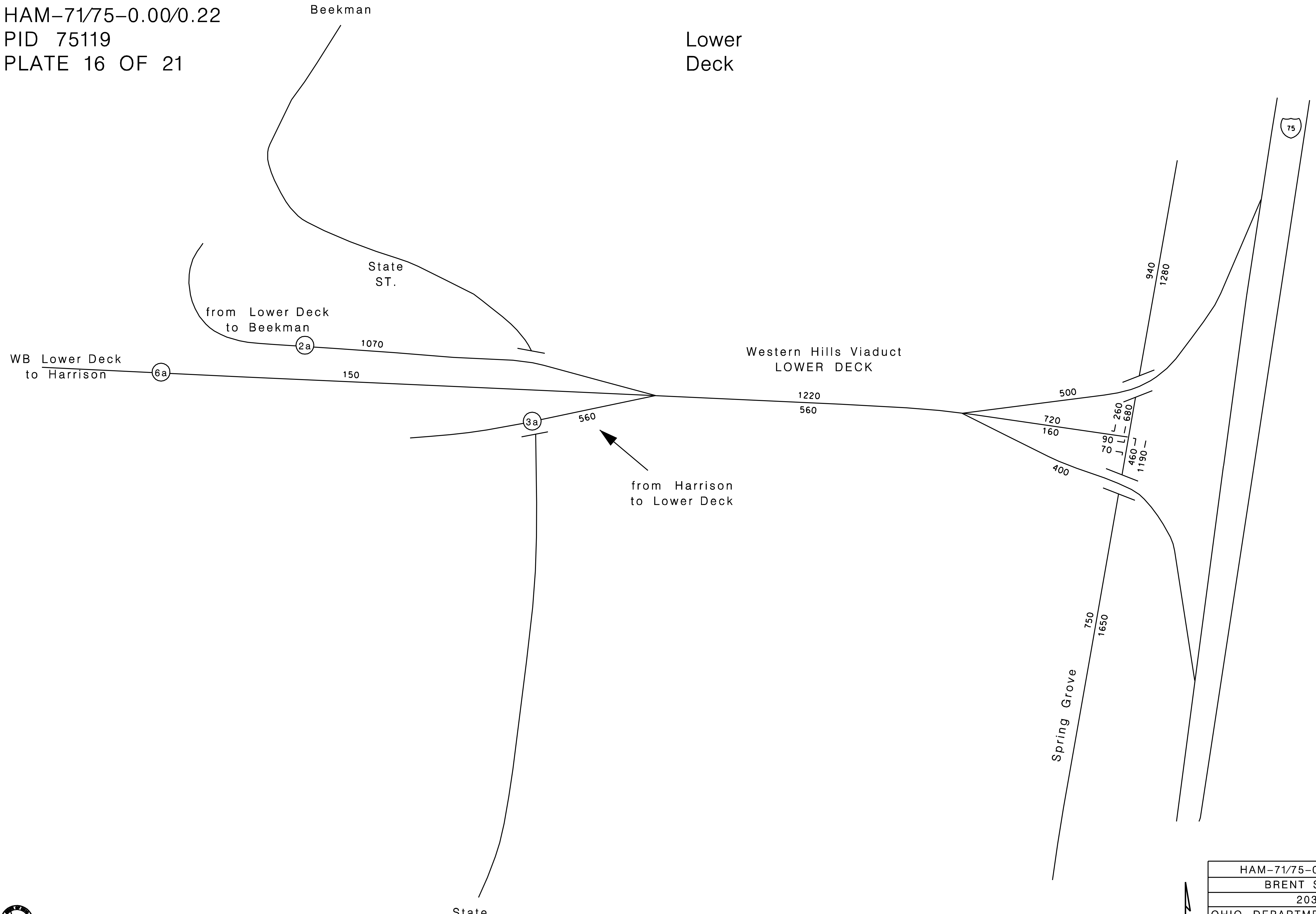
HAM-71/75-0.00/0.22 PID-75119	
BRENT SPENCE BRIDGE	
2035 AM DHV	
OHIO DEPARTMENT OF TRANSPORTATION	
OFFICE OF TECHNICAL SERVICES	
APRIL 10, 2008	NOT TO SCALE

HAM-71/75-0.00/0.22
PID 75119
PLATE 15 OF 21



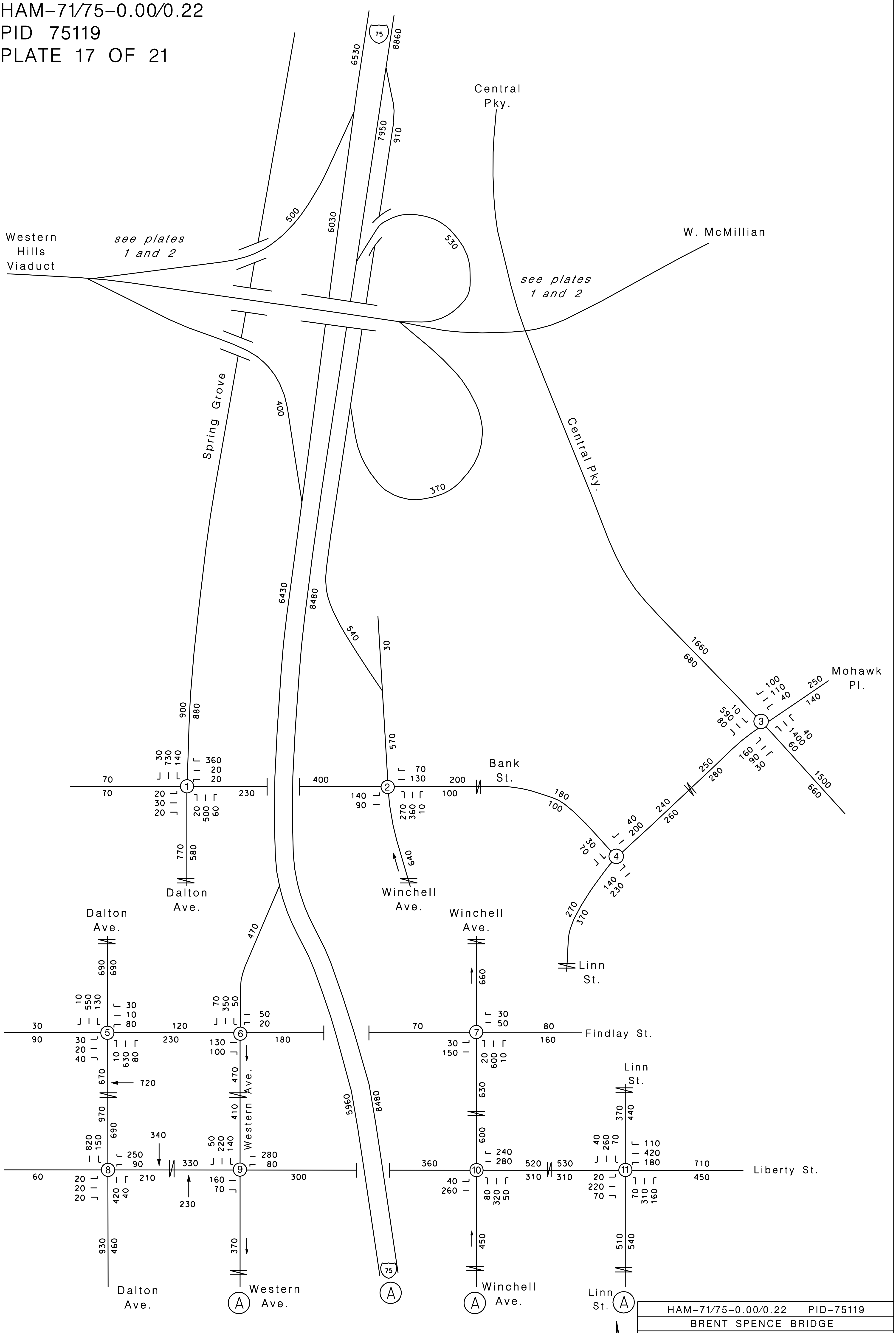
HAM-71/75-0.00/0.22 PID-75119	
BRENT SPENCE BRIDGE	
2035 PM DHV	
OHIO DEPARTMENT OF TRANSPORTATION	
OFFICE OF TECHNICAL SERVICES	
APRIL 10, 2008	NOT TO SCALE

HAM-71/75-0.00/0.22
PID 75119
PLATE 16 OF 21



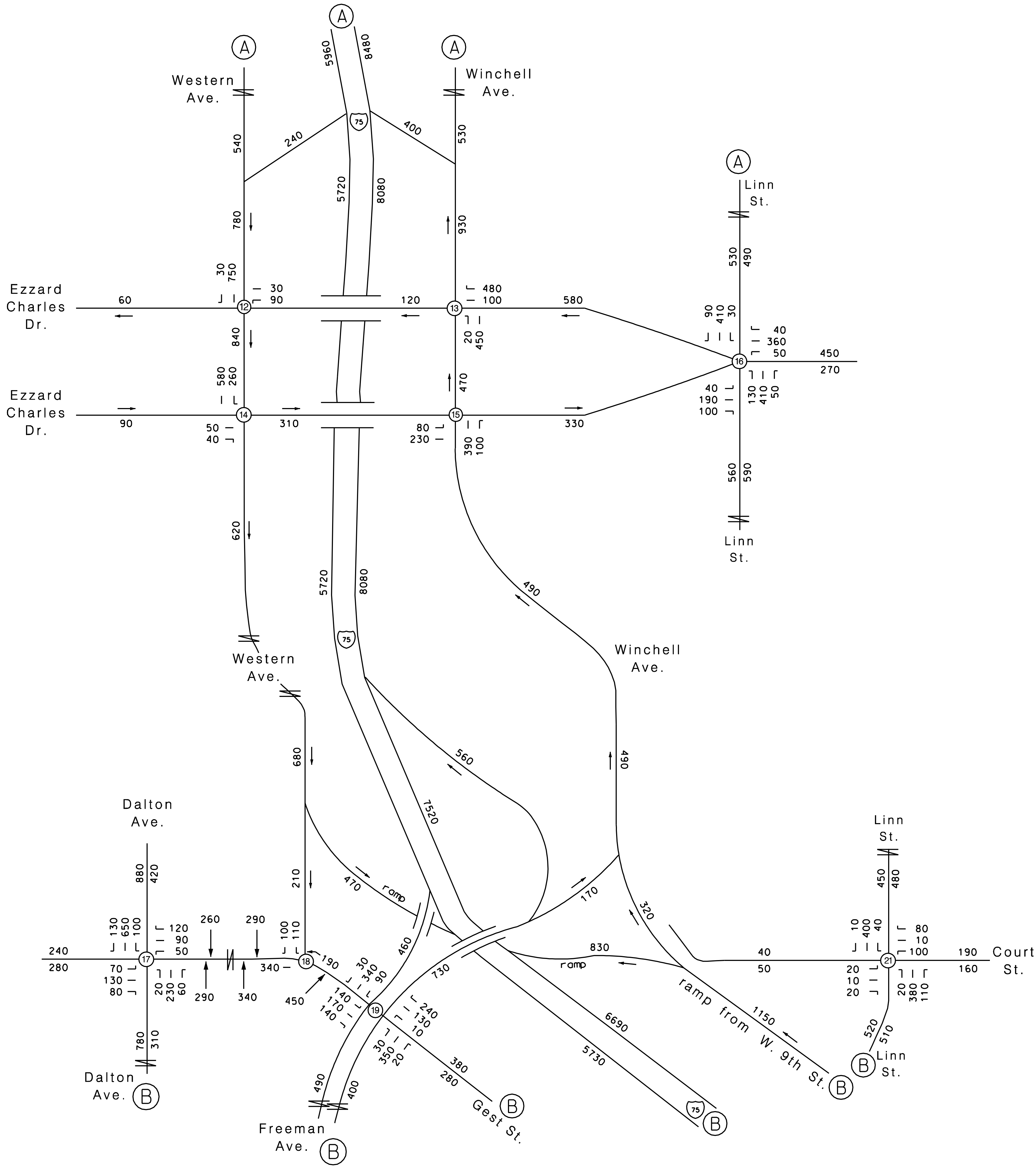
HAM-71/75-0.00/0.22 PID-75119
BRENT SPENCE BRIDGE
2035 PM DHV
OHIO DEPARTMENT OF TRANSPORTATION
OFFICE OF TECHNICAL SERVICES
APRIL 10, 2008 | NOT TO SCALE

HAM-71/75-0.00/0.22
PID 75119
PLATE 17 OF 21



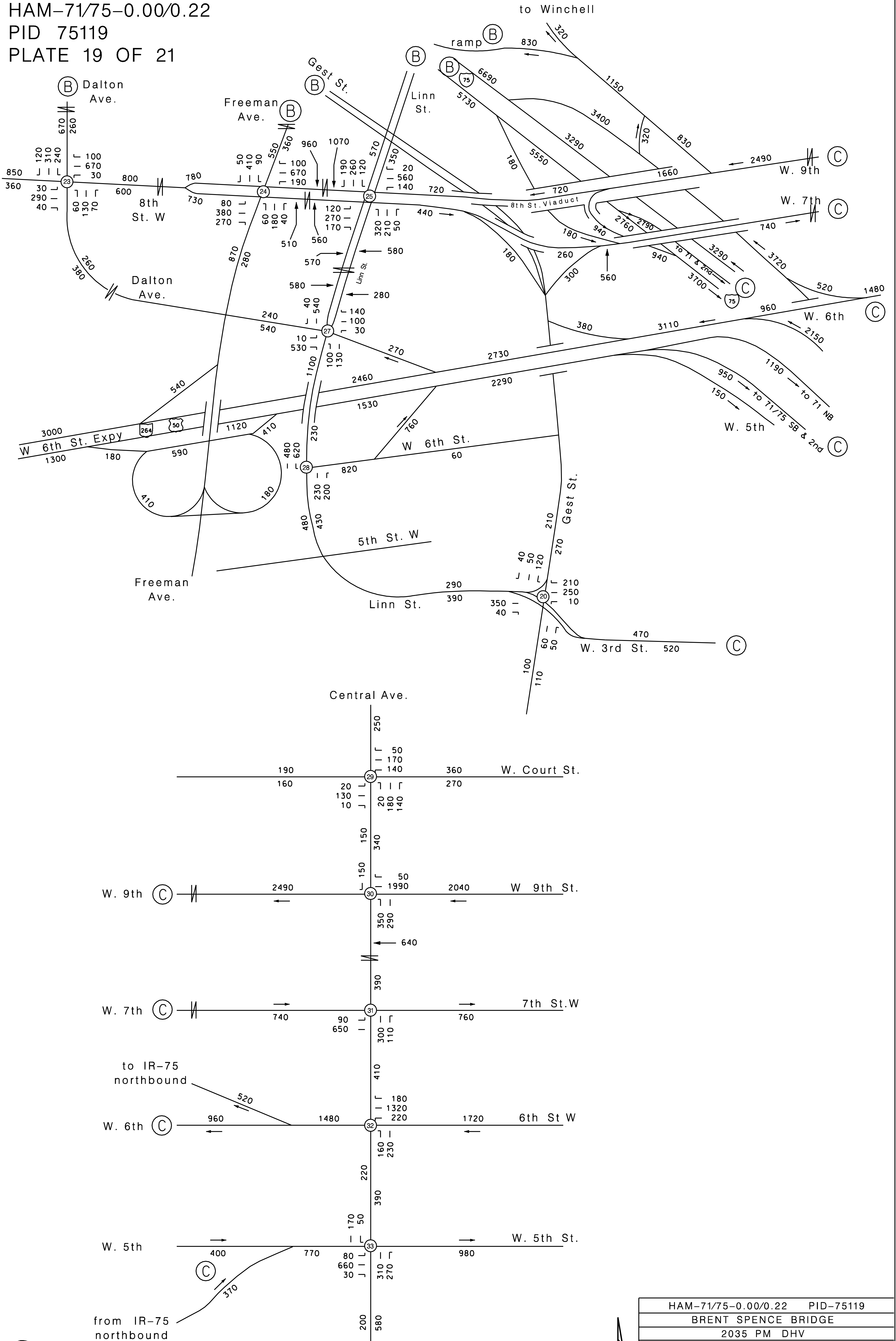
HAM-71/75-0.00/0.22 PID-75119	
BRENT SPENCE BRIDGE	
2035 PM DHV	
OHIO DEPARTMENT OF TRANSPORTATION	
OFFICE OF TECHNICAL SERVICES	
APRIL 10, 2008	NOT TO SCALE

HAM-71/75-0.00/0.22
PID 75119
PLATE 18 OF 21



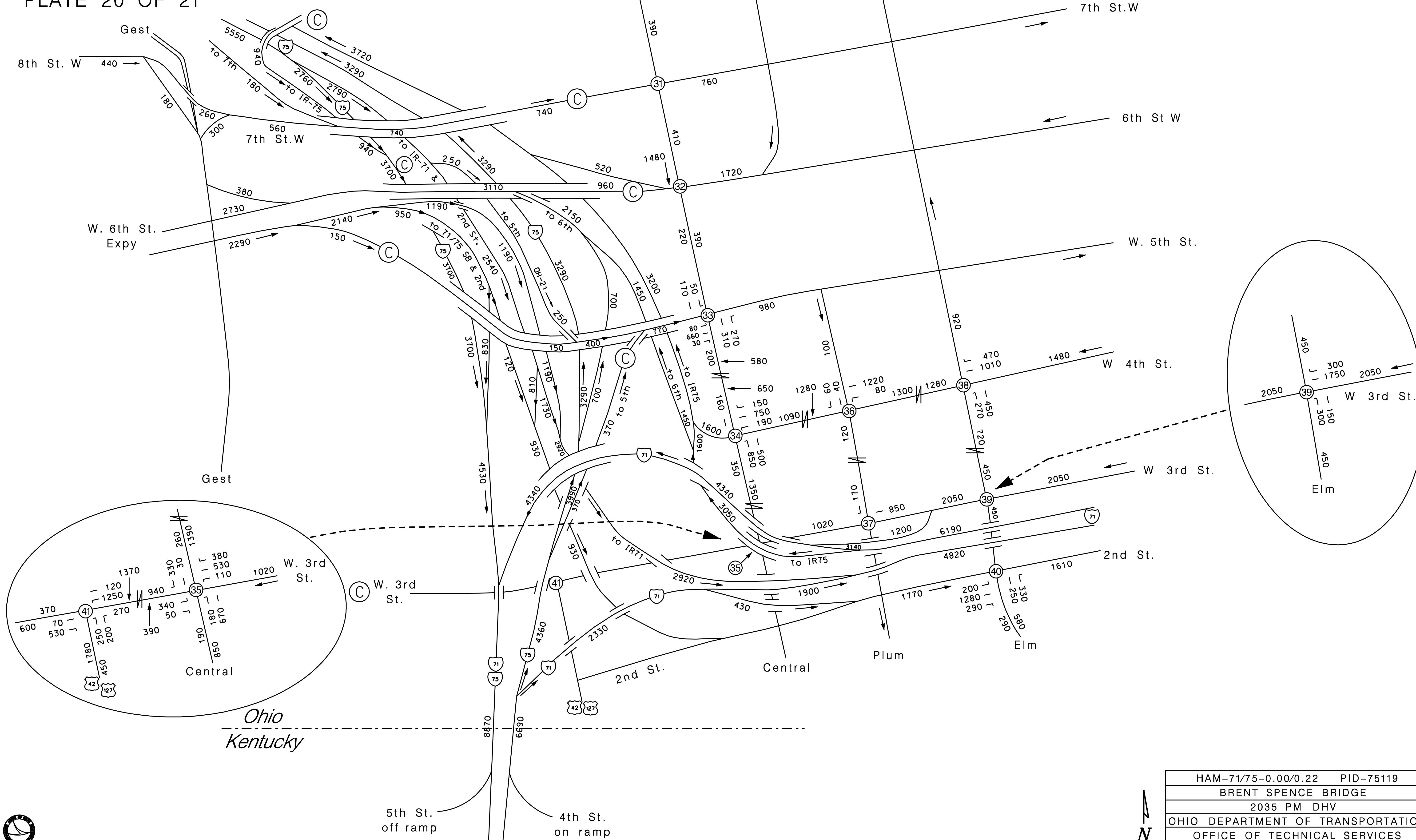
HAM-71/75-0.00/0.22 PID-75119	
BRENT SPENCE BRIDGE	
2035 PM DHV	
OHIO DEPARTMENT OF TRANSPORTATION	
OFFICE OF TECHNICAL SERVICES	
APRIL 10, 2008	NOT TO SCALE

HAM-71/75-0.00/0.22
PID 75119
PLATE 19 OF 21



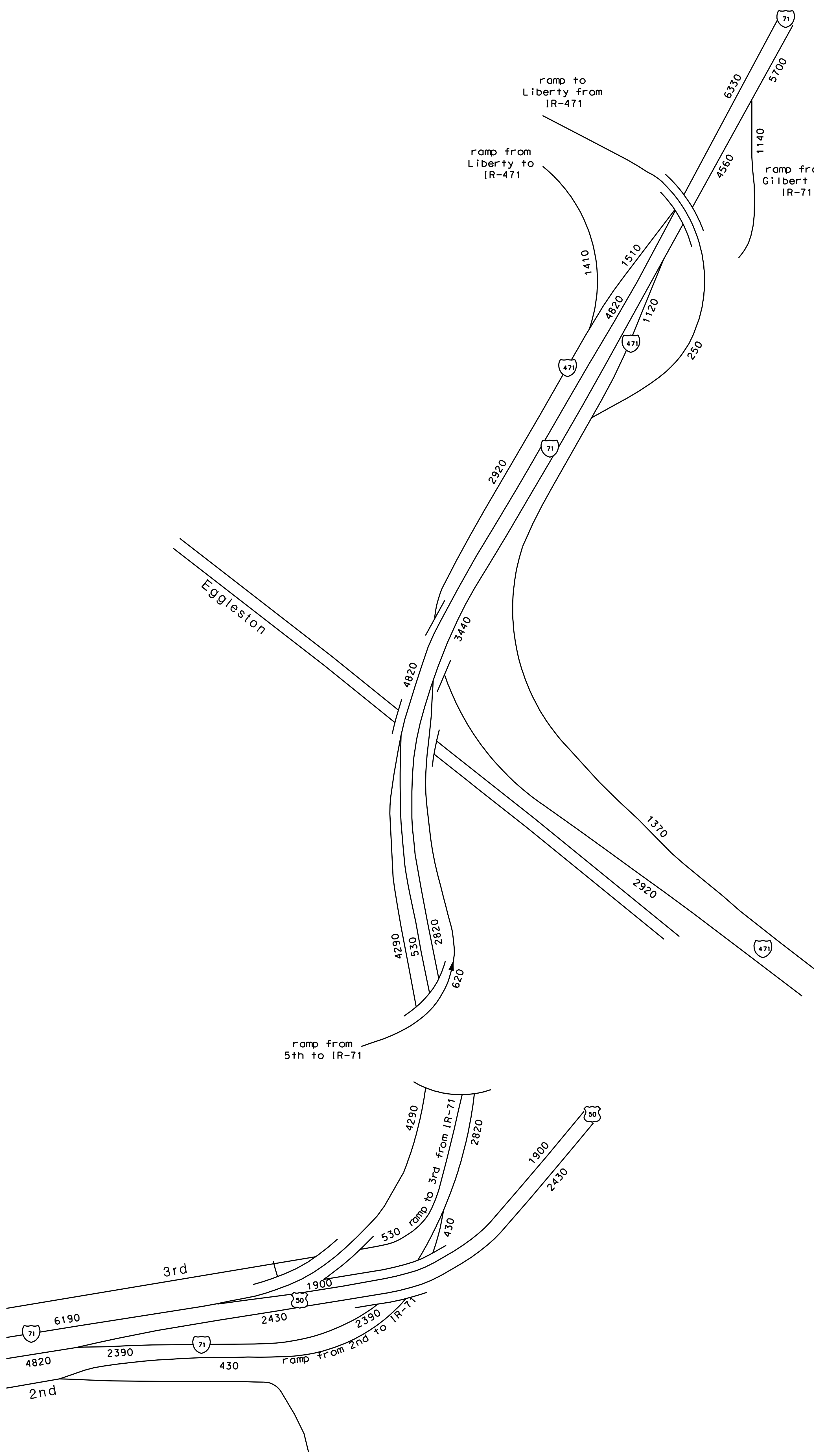
HAM-71/75-0.00/0.22 PID-75119	
BRENT SPENCE BRIDGE	
2035 PM DHV	
OHIO DEPARTMENT OF TRANSPORTATION	
OFFICE OF TECHNICAL SERVICES	
APRIL 10, 2008	NOT TO SCALE

HAM-71/75-0.00/0.22
PID 75119
PLATE 20 OF 21



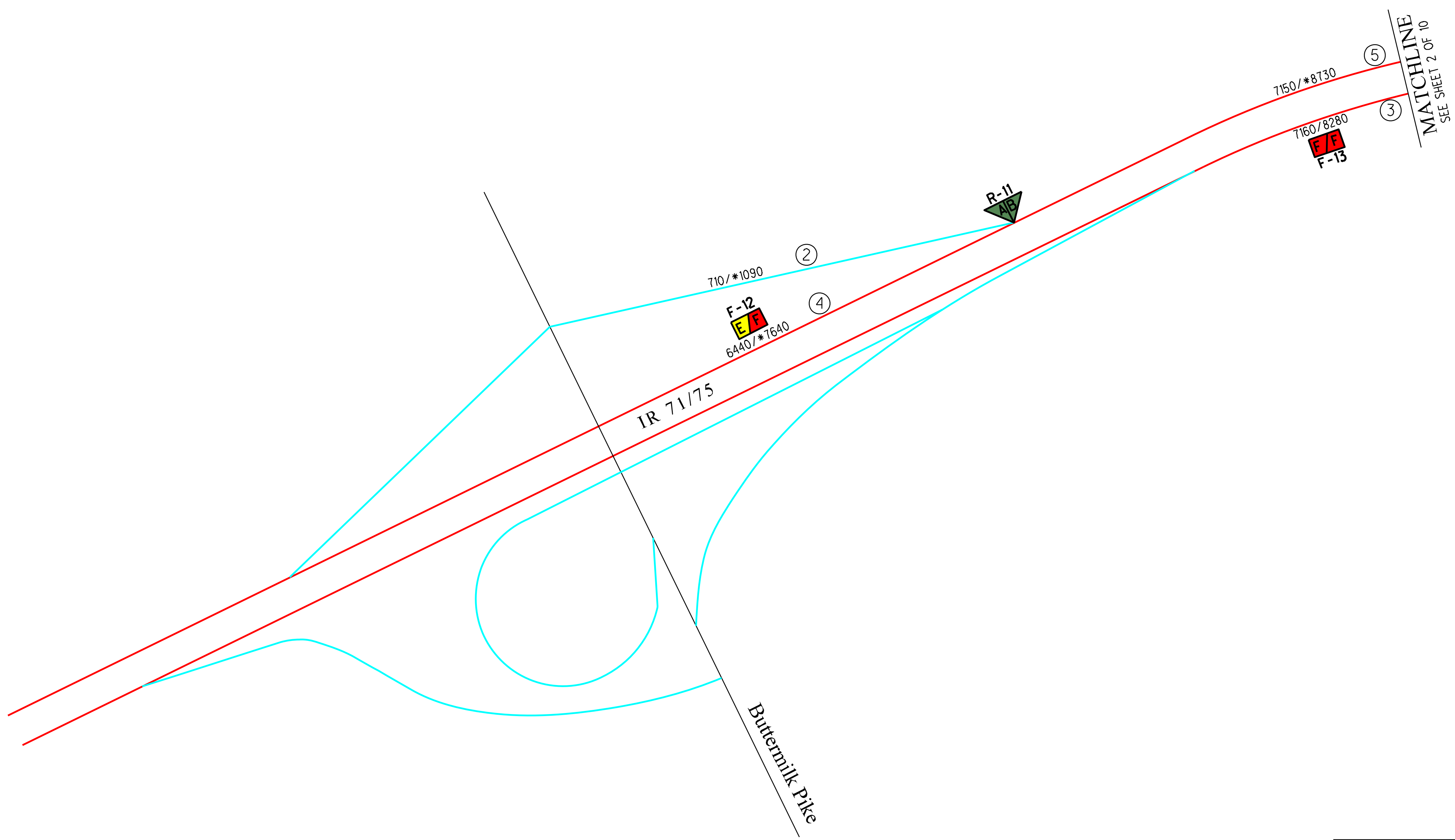
HAM-71/75-0.00/0.22 PID-75119	
BRENT SPENCE BRIDGE	
2035 PM DHV	
OHIO DEPARTMENT OF TRANSPORTATION	
OFFICE OF TECHNICAL SERVICES	
APRIL 10, 2008	NOT TO SCALE

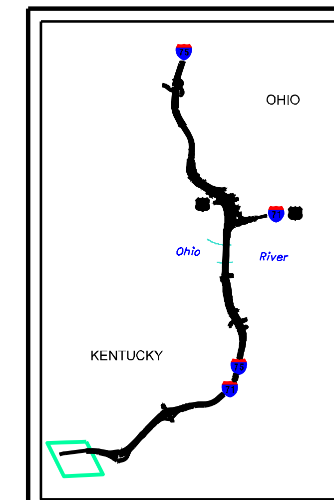
HAM-71/75-0.00/0.22
PID 75119
PLATE 21 OF 21



HAM-71/75-0.00/0.22	PID-75119
BRENT SPENCE BRIDGE	
2035 PM DHV	
OHIO DEPARTMENT OF TRANSPORTATION	
OFFICE OF TECHNICAL SERVICES	
APRIL 10, 2008	NOT TO SCALE

Appendix D
HCS Results



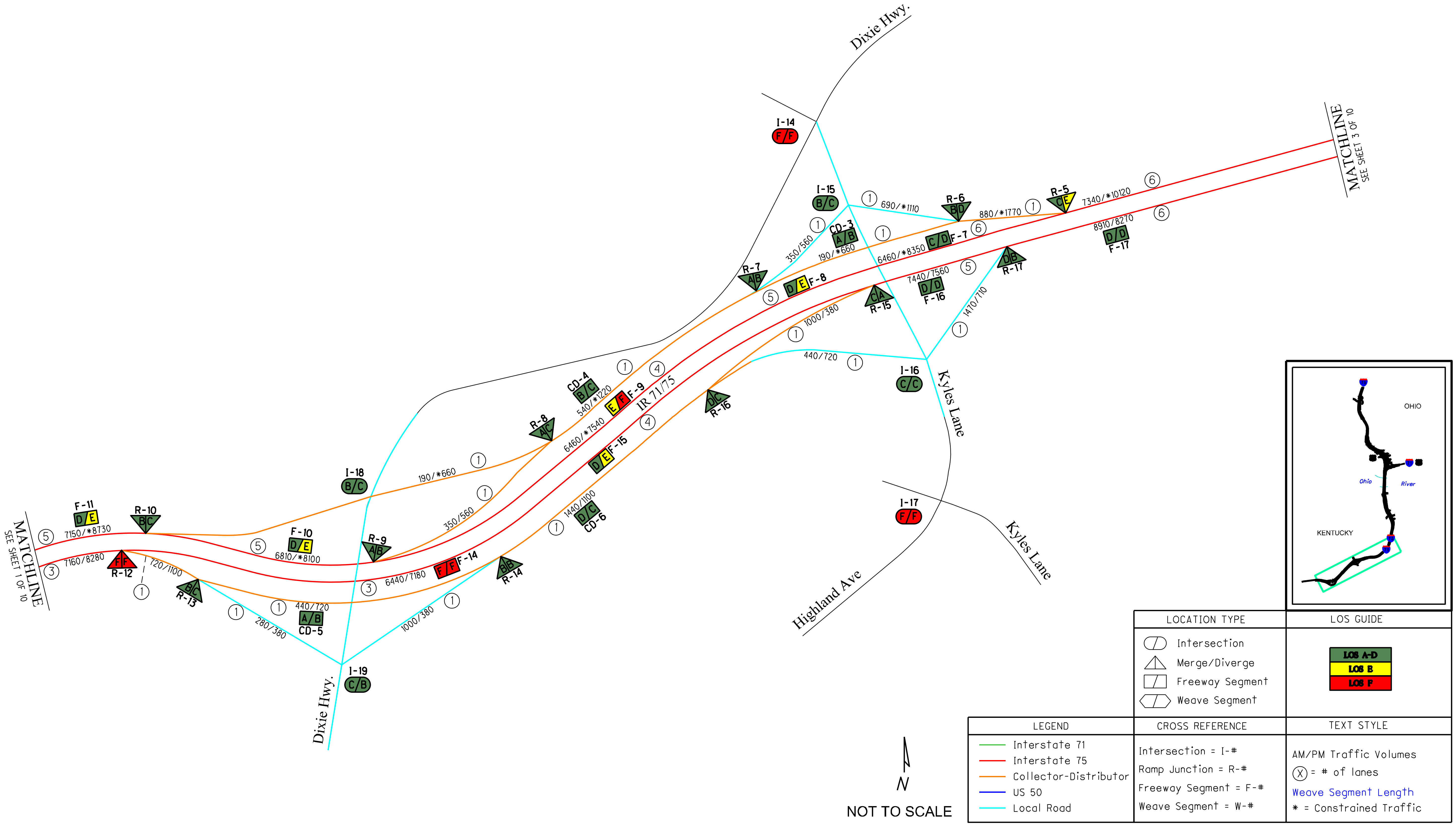


LOCATION TYPE	LOS GUIDE
Intersection	LOS A-D
Merge/Diverge	LOS E
Freeway Segment	LOS F
Weave Segment	

N

NOT TO SCALE

LEGEND	CROSS REFERENCE	TEXT STYLE
Interstate 71	Intersection = I-#	AM/PM Traffic Volumes
Interstate 75	Ramp Junction = R-#	(X) = # of lanes
Collector-Distributor	Freeway Segment = F-#	Weave Segment Length
US 50	Weave Segment = W-#	* = Constrained Traffic
Local Road		

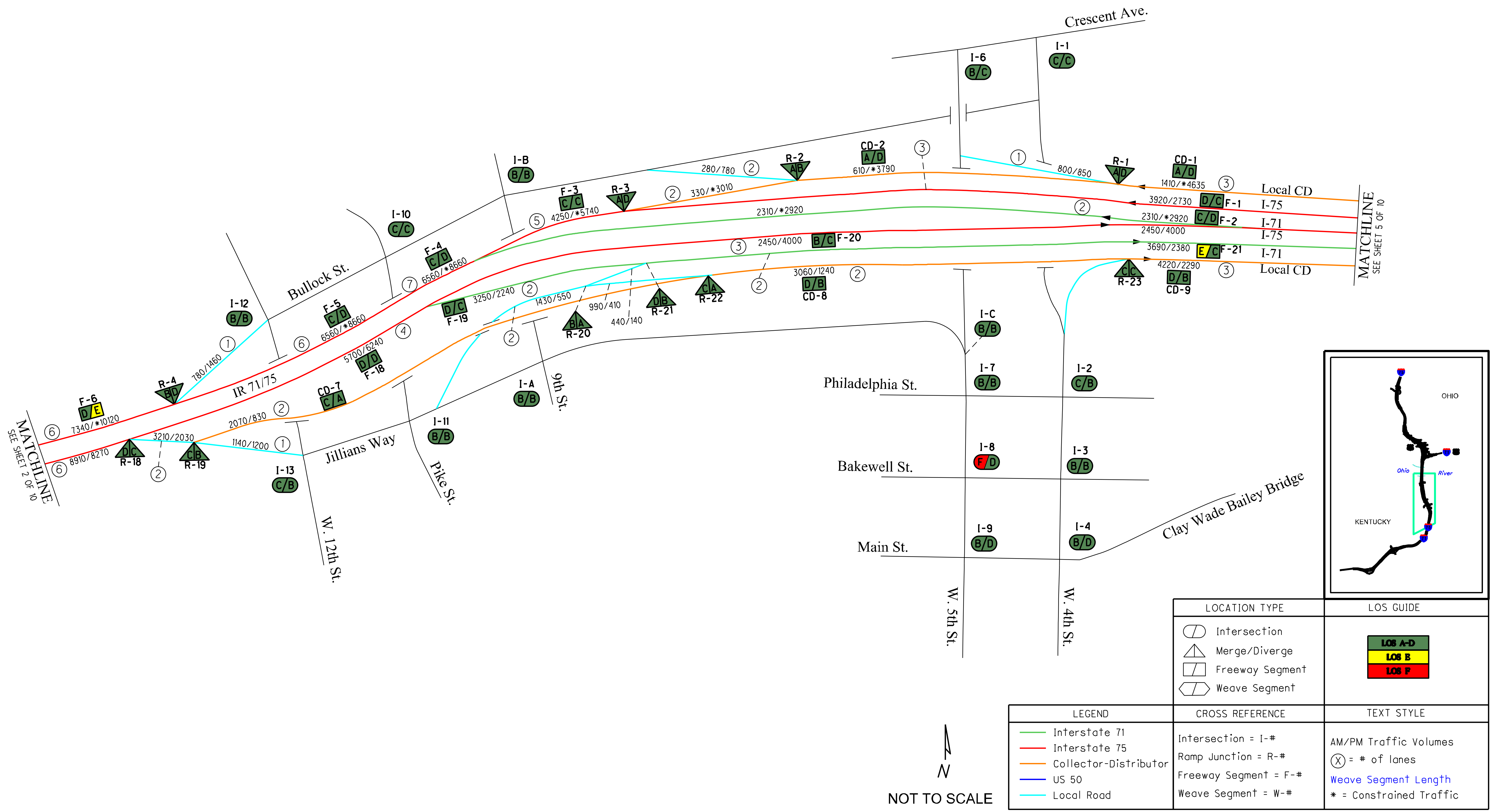


U.S. Department of Transportation
Federal Highway Administration

HCS RESULTS
2035 ALTERNATIVE I

EXHIBIT
2 of 10

Prepared by: PARSONS BRINCKERHOFF

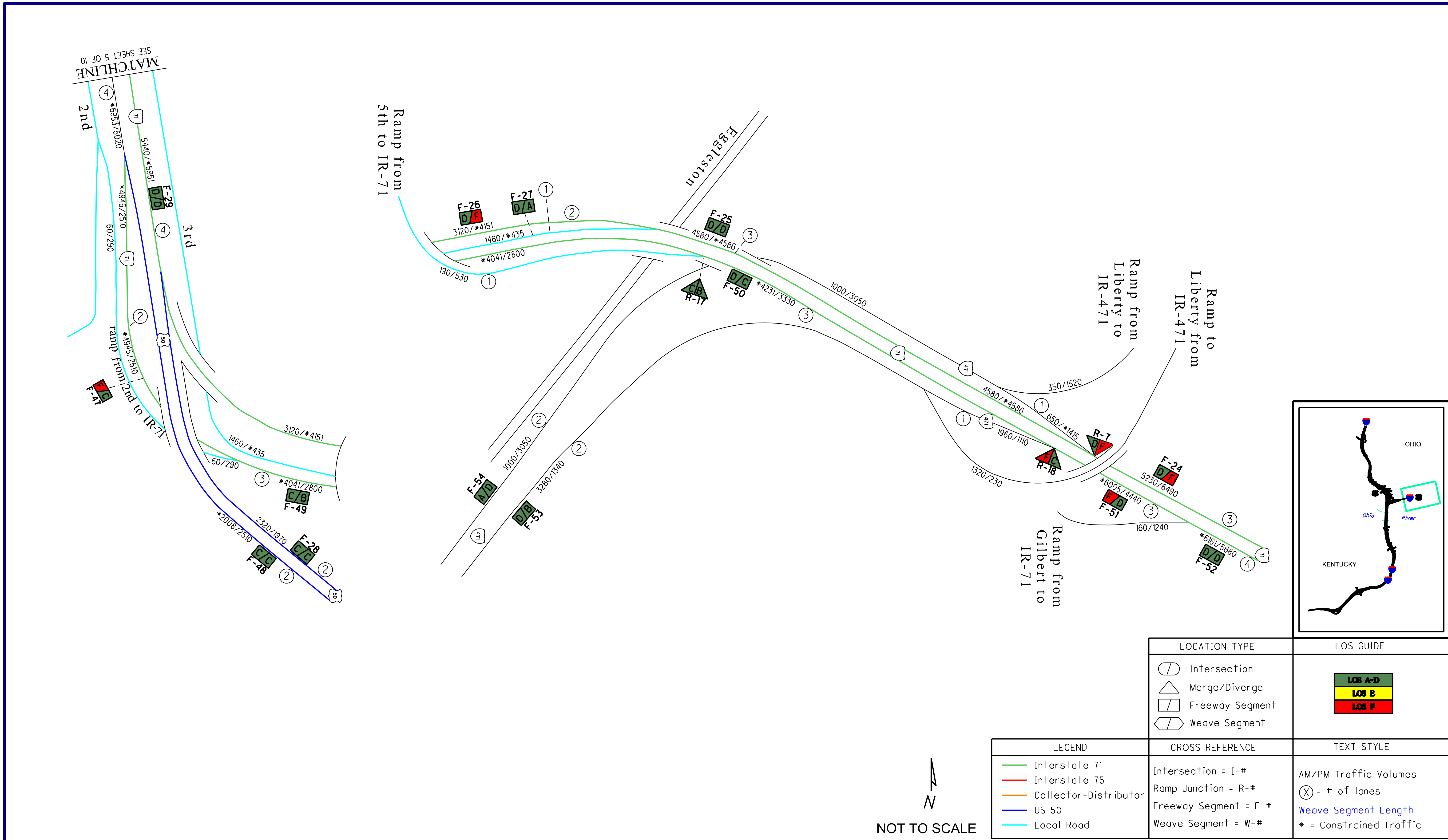


U.S. Department of Transportation
Federal Highway Administration

HCS RESULTS 2035 ALTERNATIVE I

EXHIBIT 3 of 10

Prepared by: PB PARSONS BRINCKERHOFF

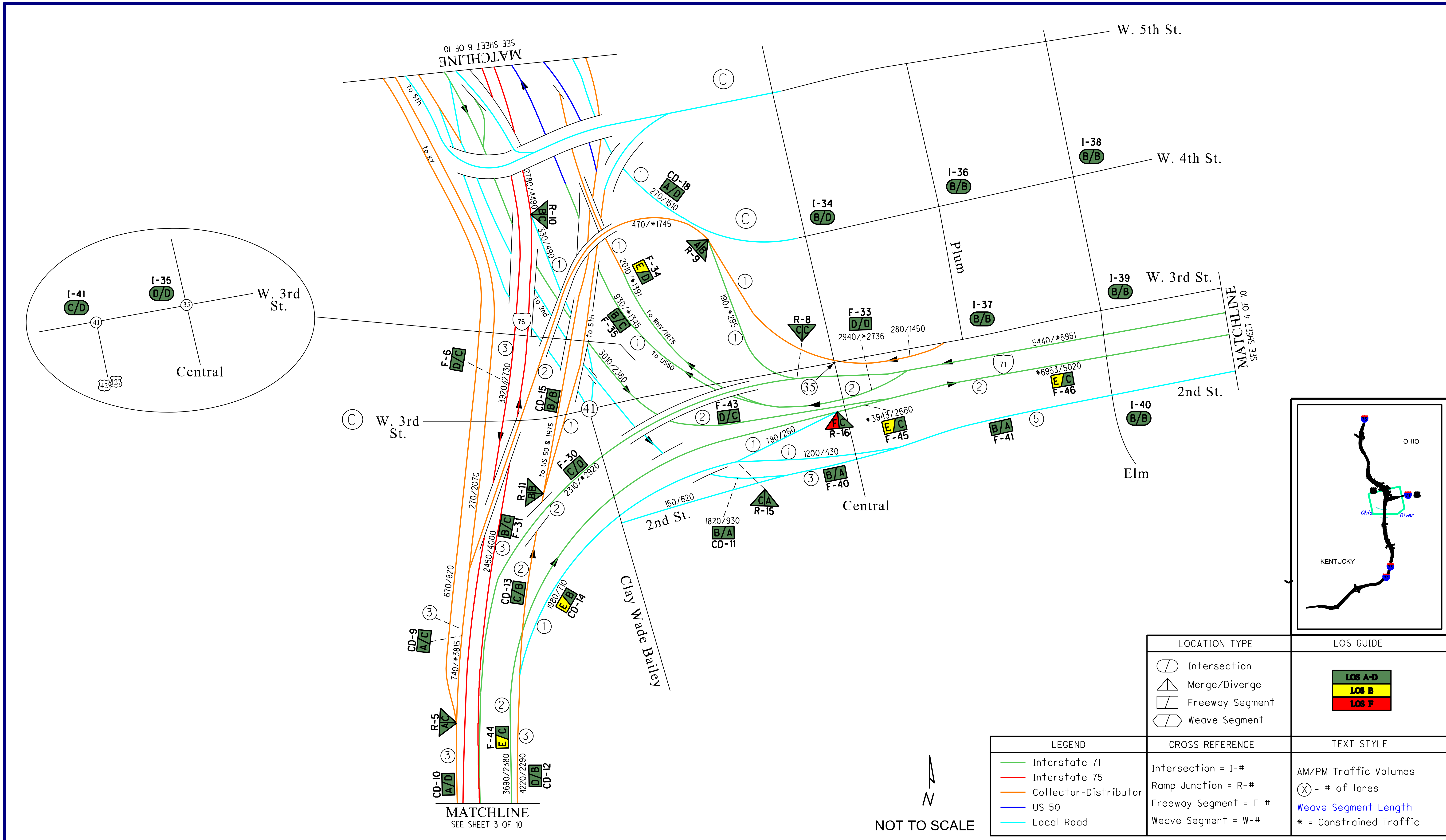


U.S. Department of Transportation
Federal Highway Administration

HCS RESULTS
2035 ALTERNATIVE I

EXHIBIT
4 of 10

Prepared by: PARSONS BRINCKERHOFF

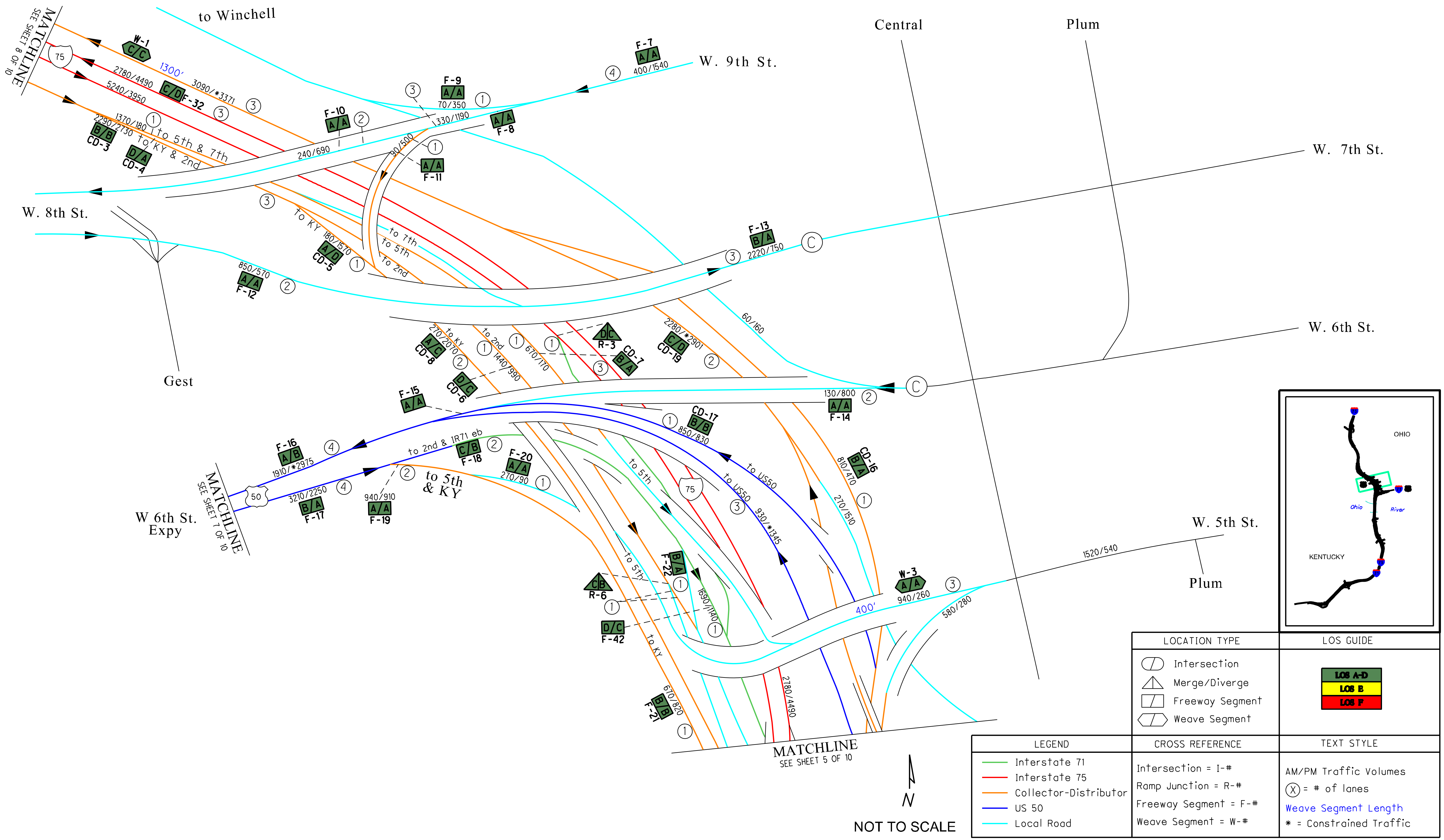


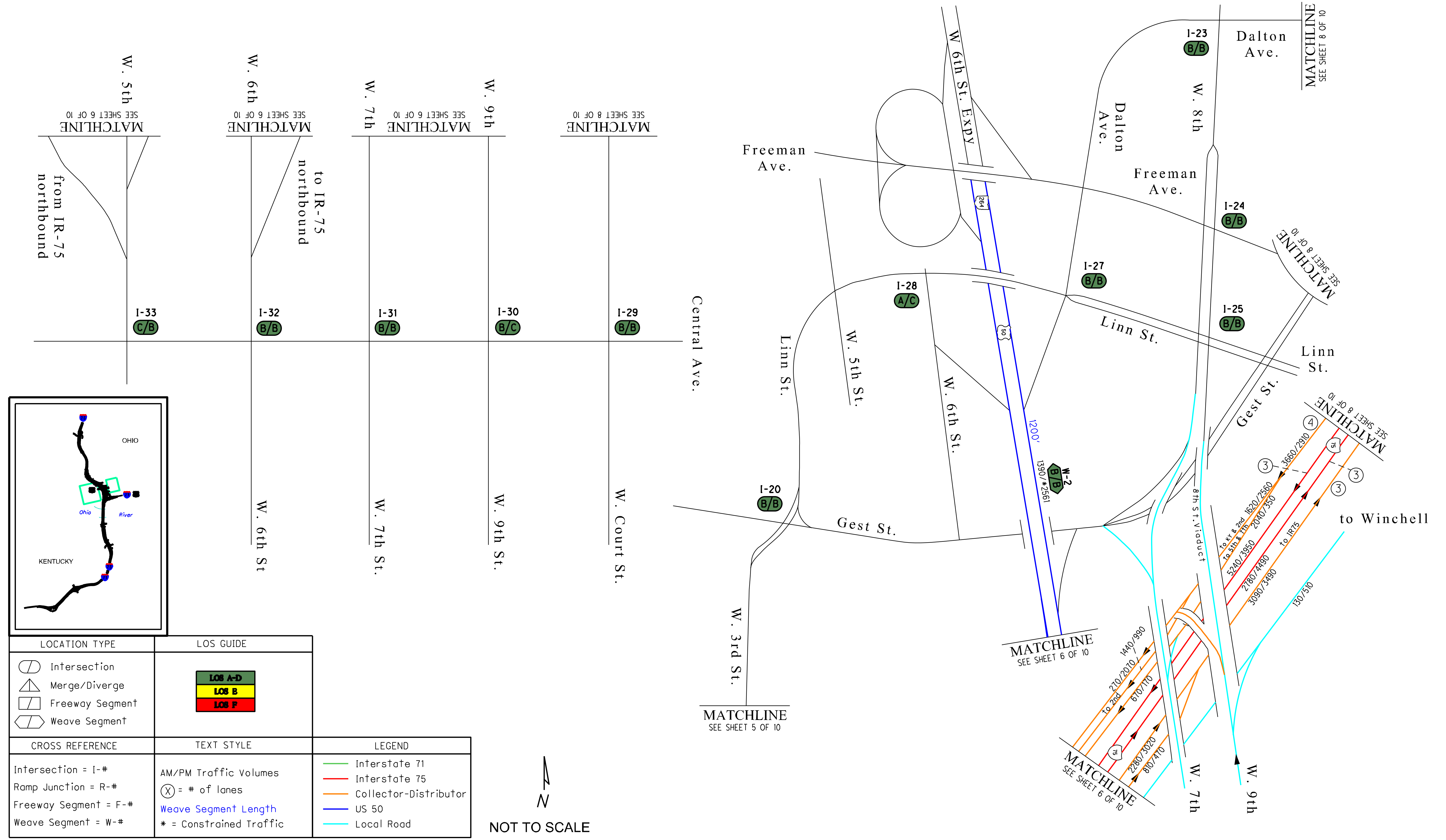
U.S. Department of Transportation
Federal Highway Administration

HCS RESULTS
2035 ALTERNATIVE I

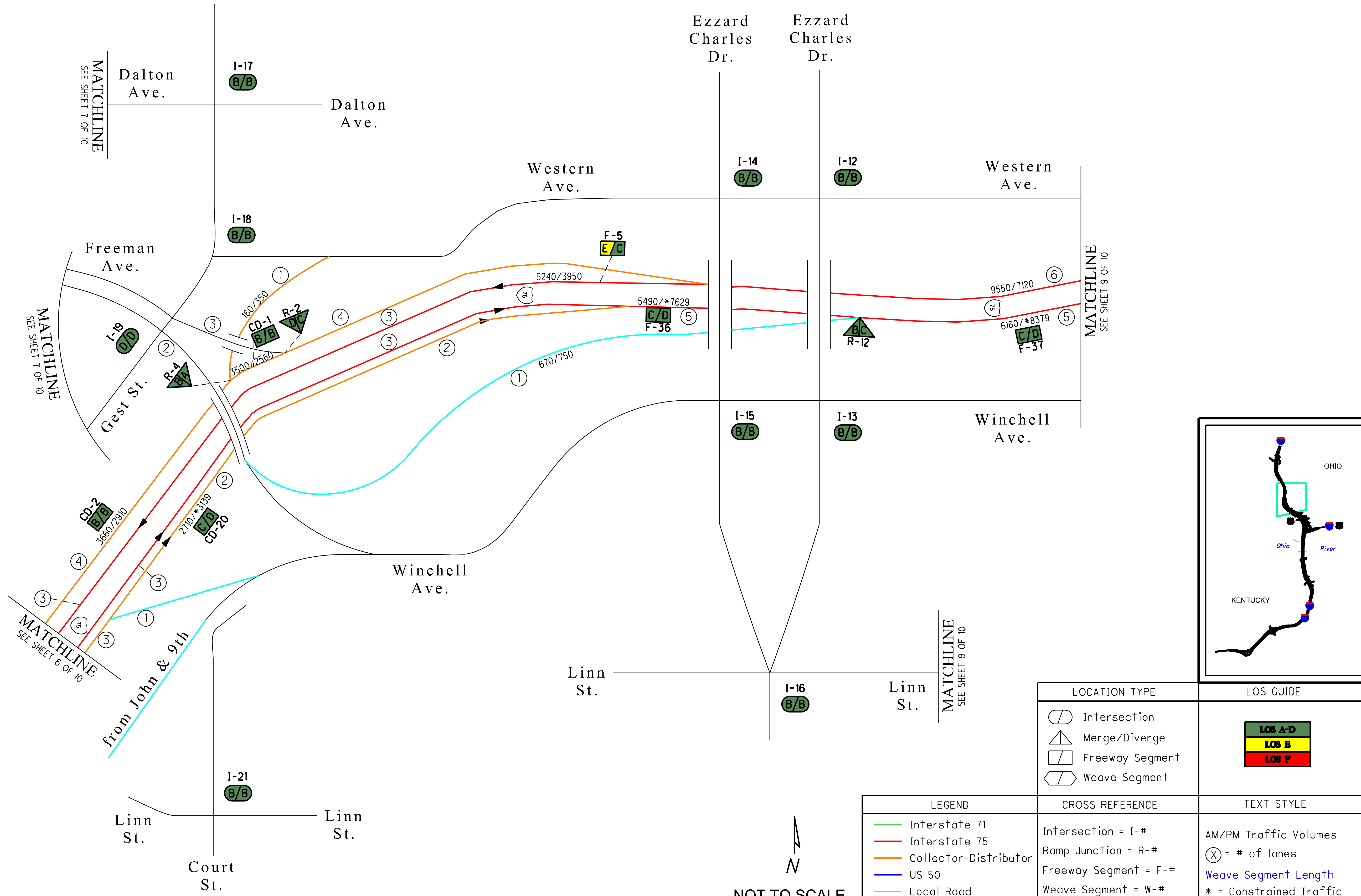
EXHIBIT
5 of 10

Prepared by:
PARSONS BRINCKERHOFF


to Winchell
W. 9th St.
Central
Plum
W. 7th St.
W. 8th St.
Gest
W. 6th St.
W. 5th St.
W 6th St. Expy
MATCHLINE SEE SHEET 8 OF 10
MATCHLINE SEE SHEET 7 OF 10
MATCHLINE SEE SHEET 5 OF 10
1300'
400'
W-1 C/C
C/D F-32
F-7 A/A 400/1540
F-9 A/A 70/350
F-10 A/A 240/690
F-8 A/A 330/1190
F-11 A/A 90/500
CD-3 B/B 2290/2730
CD-4 D/A 1370/180
2780/4490
5240/3950
3090/*3371
to 5th & 7th
to KY & 2nd
to KY
CD-5 A/D 180/1570
to 7th
to 5th
to 2nd
F-12 A/A 850/570
F-13 B/A 2220/750
60/160
R-3 D/C
CD-7 B/A
CD-8 A/C 270/2070
CD-6 D/C
CD-19 C/D 2280/*2901
to 2nd 1440/990
670/170
F-14 A/A 130/800
F-15 A/A
CD-17 B/B 850/830
F-16 A/B 1910/*2975
to 2nd & IR71 eb
C/B F-18
F-20 A/A 270/90
F-17 B/A 3210/2250
F-19 A/A 940/910
to 5th & KY
to US50
930/*1345
CD-16 B/A 810/410
270/1510
W-3 A/A 940/260
580/280
1520/540
to 5th
F-22 B/A 1690/1140
R-6 C/B
F-42 D/C
to KY
F-21 B/B 670/820
2780/4490
75
50
OHIO
KENTUCKY
Ohio River
N
NOT TO SCALE
LOCATION TYPE
Intersection
Merge/Diverge
Freeway Segment
Weave Segment
LOS GUIDE
LOS A-D
LOS E
LOS F
LEGEND
Interstate 71
Interstate 75
Collector-Distributor
US 50
Local Road
CROSS REFERENCE
Intersection = I-#
Ramp Junction = R-#
Freeway Segment = F-#
Weave Segment = W-#
TEXT STYLE
AM/PM Traffic Volumes
(X) = # of lanes
Weave Segment Length
* = Constrained Traffic

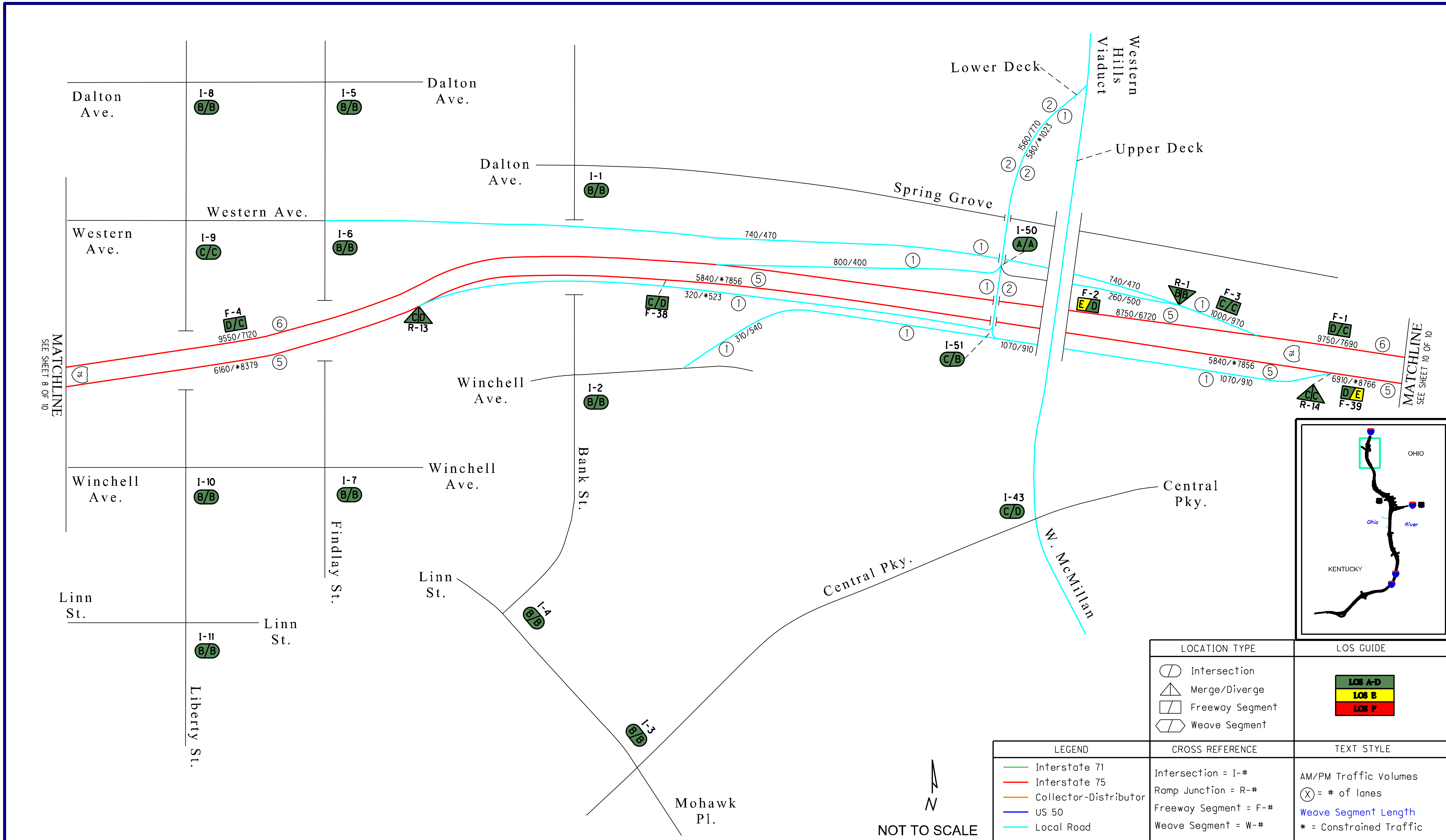


W. 5th
W. 6th
W. 7th
W. 9th
MATCHLINE SEE SHEET 6 OF 10
MATCHLINE SEE SHEET 8 OF 10
from IR-75 northbound
to IR-75 northbound
I-33 C/B
I-32 B/B
I-31 B/B
I-30 B/C
I-29 B/B
Central Ave.
W. 6th St
W. 7th St.
W. 9th St.
W. Court St.
OHIO
KENTUCKY
Ohio River
Freeman Ave.
W 6th St. Expy
Dalton Ave.
W. 8th
I-23 B/B
I-24 B/B
I-25 B/B
I-27 B/B
I-28 A/C
I-20 B/B
W-2 B/B
1200'
1390/*2561
Linn St.
W. 5th St.
W. 6th St.
Gest St.
W. 3rd St.
MATCHLINE SEE SHEET 5 OF 10
MATCHLINE SEE SHEET 6 OF 10
to Winchell
8th St. Viaduct
W. 7th
W. 9th
3660/2910
1620/2560
2040/350
5240/3950
2780/4490
3090/3490
130/510
to KY 8 & 2nd
to 5th & 7th
to IR75
1440/990
2710/2010
to 2nd
610/170
2280/3020
810/470
LOCATION TYPE
Intersection
Merge/Diverge
Freeway Segment
Weave Segment
LOS GUIDE
LOS A-D
LOS B
LOS F
CROSS REFERENCE
Intersection = I-#
Ramp Junction = R-#
Freeway Segment = F-#
Weave Segment = W-#
TEXT STYLE
AM/PM Traffic Volumes
(X) = # of lanes
Weave Segment Length
* = Constrained Traffic
LEGEND
Interstate 71
Interstate 75
Collector-Distributor
US 50
Local Road
N
NOT TO SCALE



LOCATION TYPE	LOS GUIDE
Intersection	LOS A-D
Merge/Diverge	LOS E
Freeway Segment	LOS F
Weave Segment	

LEGEND	CROSS REFERENCE	TEXT STYLE
Interstate 71	Intersection = I-#	AM/PM Traffic Volumes
Interstate 75	Ramp Junction = R-#	(X) = # of lanes
Collector-Distributor	Freeway Segment = F-#	Weave Segment Length
US 50	Weave Segment = W-#	* = Constrained Traffic
Local Road		

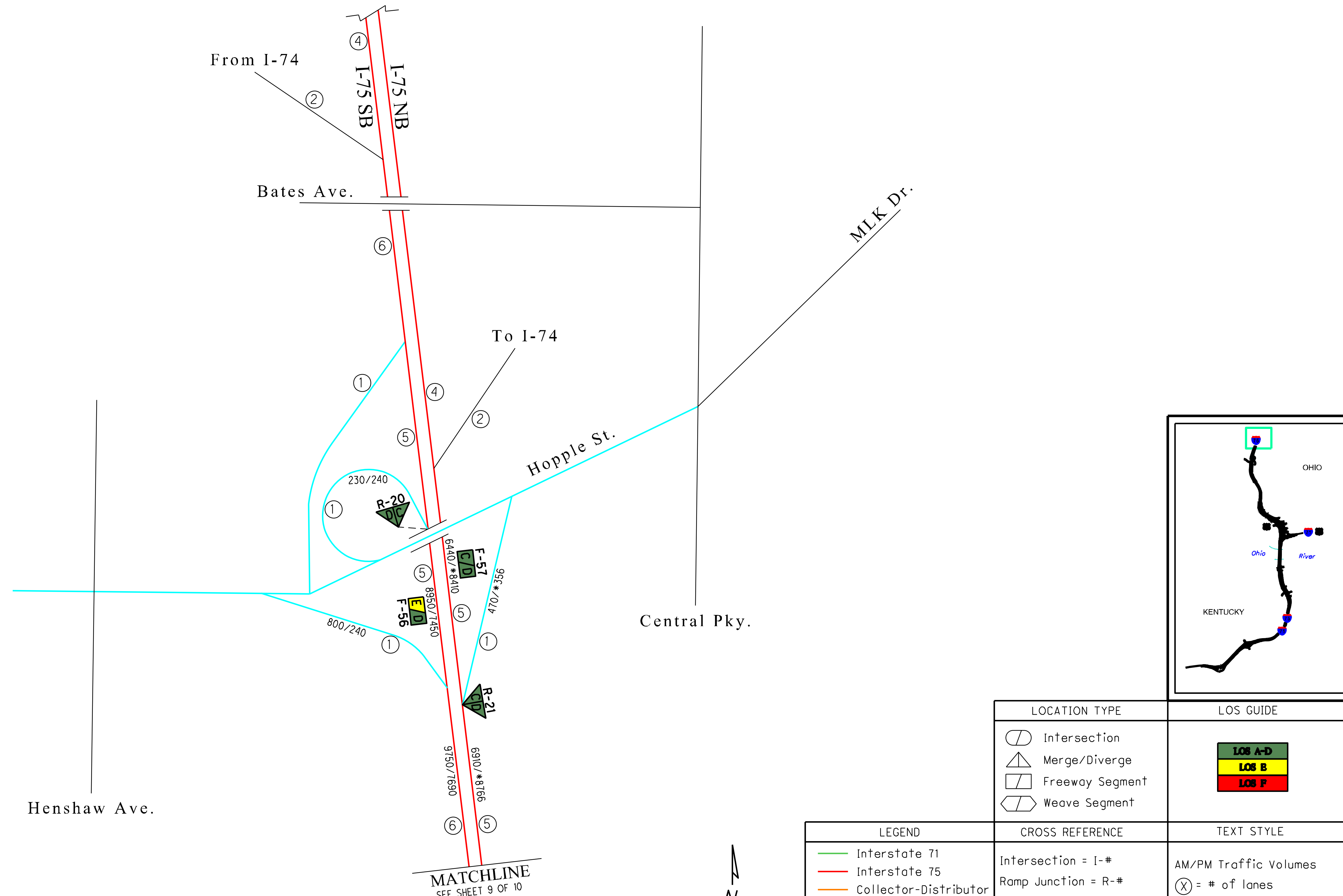


U.S. Department of Transportation
Federal Highway Administration

HCS RESULTS
2035 ALTERNATIVE I

EXHIBIT
9 of 10

Prepared by: PB PARSONS BRINCKERHOFF



NOT TO SCALE

LOCATION TYPE	LOS GUIDE
Intersection	LOS A-D
Merge/Diverge	LOS E
Freeway Segment	LOS F
Weave Segment	

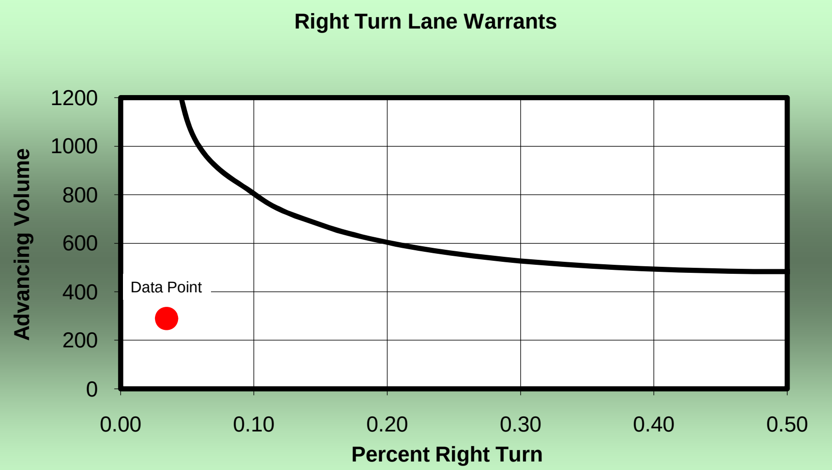
LEGEND	CROSS REFERENCE	TEXT STYLE
Interstate 71	Intersection = I-#	AM/PM Traffic Volumes
Interstate 75	Ramp Junction = R-#	(X) = # of lanes
Collector-Distributor	Freeway Segment = F-#	Weave Segment Length
US 50	Weave Segment = W-#	* = Constrained Traffic
Local Road		

Appendix E
Turn Lane Storage Calculations

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	10	Speed Limit (mph)	35
Advancing Volume (vph)	290		



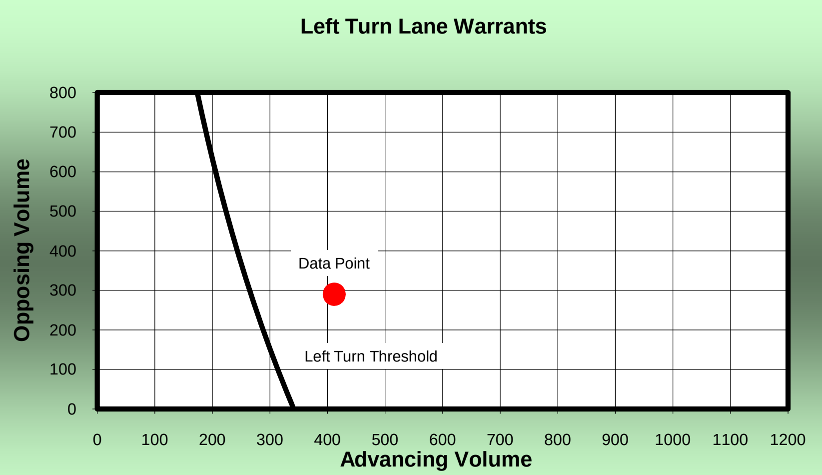
Right Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	200	Speed Limit (mph)	35
Advancing Volume (vph)	410	No. of through lanes	0
Opposing Volume (vph)	290	Percent Heavy Vehicles (decimal percent)	0.02



Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

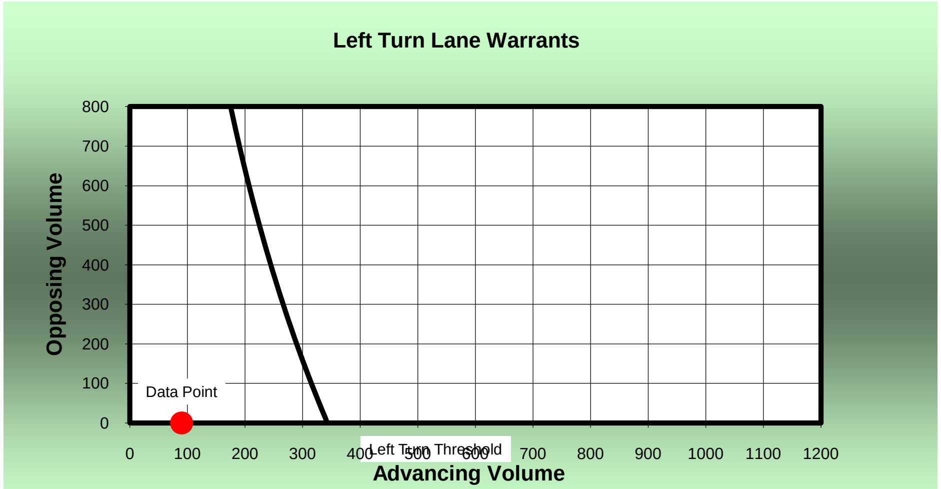
Turn Volume	200	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**125**
Cycle Length	0	Minimum	**125**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)			
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	40	Speed Limit (mph)	35
Advancing Volume (vph)	90	No. of through lanes	0
Opposing Volume (vph)	0	Percent Heavy Vehicles (decimal percent)	0.18



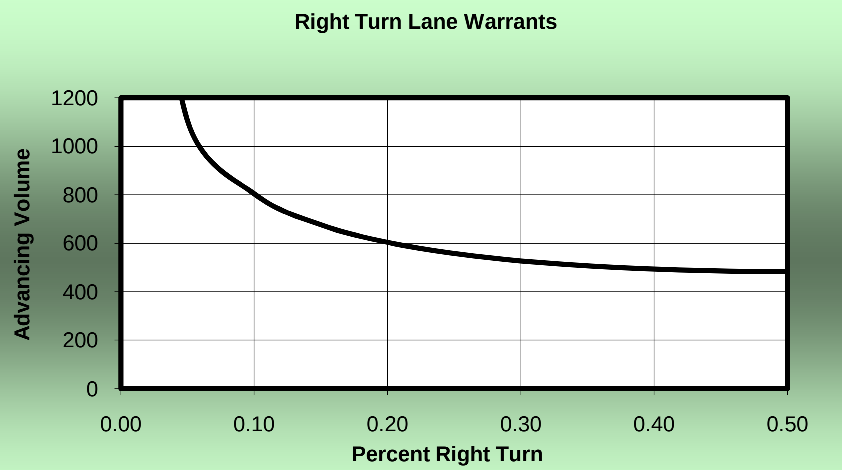
Left Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	50	Speed Limit (mph)	35
Advancing Volume (vph)	90		



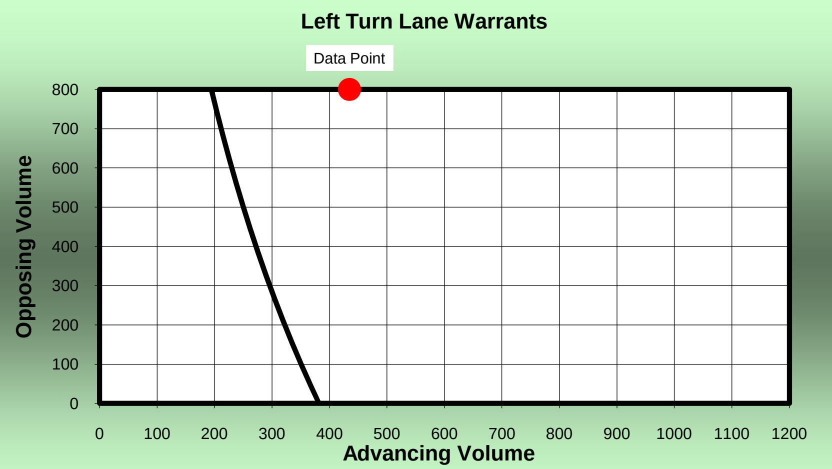
Right Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	120	Speed Limit (mph)	35
Advancing Volume (vph)	430	No. of through lanes	1
Opposing Volume (vph)	810	Percent Heavy Vehicles (decimal percent)	0.02



Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

Input Fields

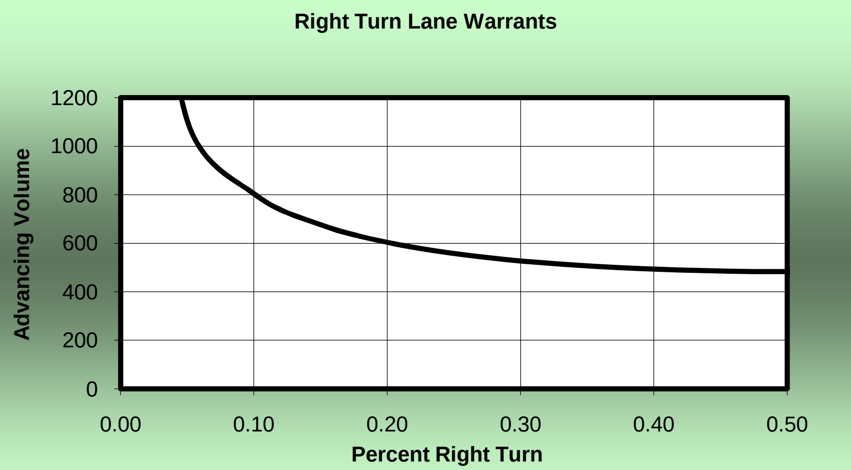
Turn Volume	120	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**150**
Cycle Length *(Enter 0 for Uncontrolled, 60 for Stop Controlled)*	60	Minimum	**125**
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	730	Speed Limit (mph)	35
Advancing Volume (vph)	810		



Right Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

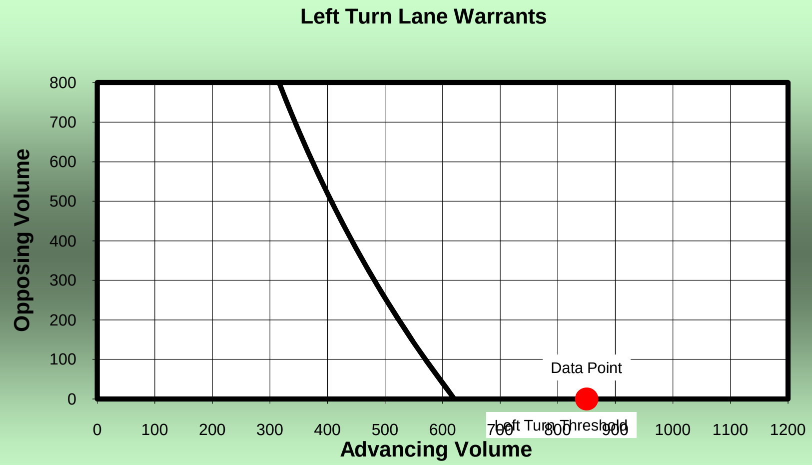
Turn Volume	730	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**650**
Cycle Length	60	Minimum	**500**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)			
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	70	Speed Limit (mph)	35
Advancing Volume (vph)	850	No. of through lanes	2
Opposing Volume (vph)	0	Percent Heavy Vehicles (decimal percent)	0.02



Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	70	Speed Limit (mph)	35
Advancing Volume (vph)	850		

Right Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

Input Fields

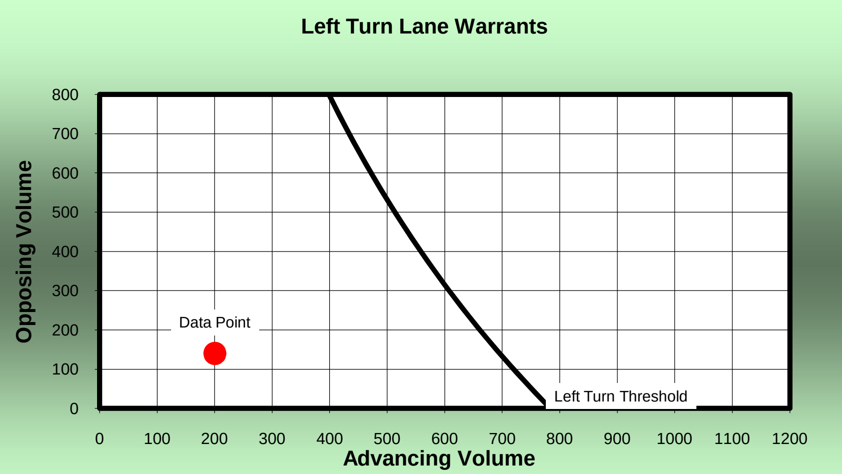
Turn Volume	70	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**125**
Cycle Length	60	Minimum	**125**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)			
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	10	Speed Limit (mph)	35
Advancing Volume (vph)	200	No. of through lanes	1
Opposing Volume (vph)	140	Percent Heavy Vehicles (decimal percent)	0.02



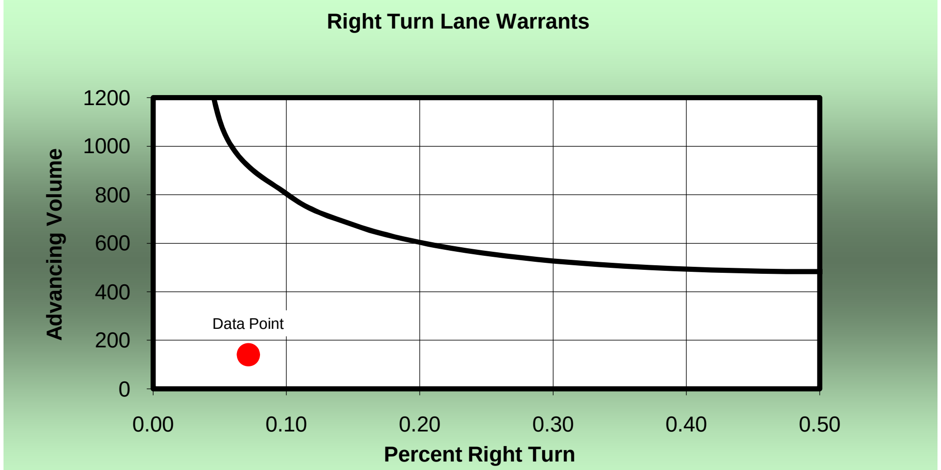
Left Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	10	Speed Limit (mph)	35
Advancing Volume (vph)	140		



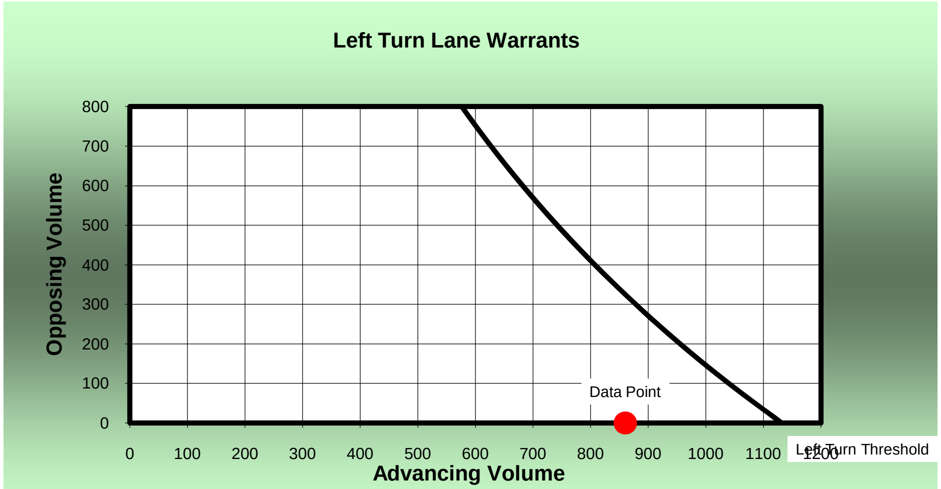
Right Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	20	Speed Limit (mph)	35
Advancing Volume (vph)	860	No. of through lanes	2
Opposing Volume (vph)	0	Percent Heavy Vehicles (decimal percent)	0.02



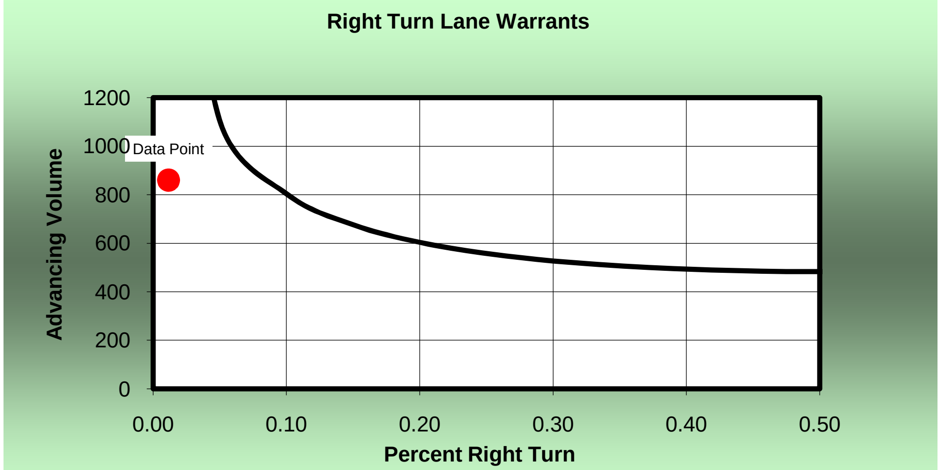
Left Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	10	Speed Limit (mph)	35
Advancing Volume (vph)	860		



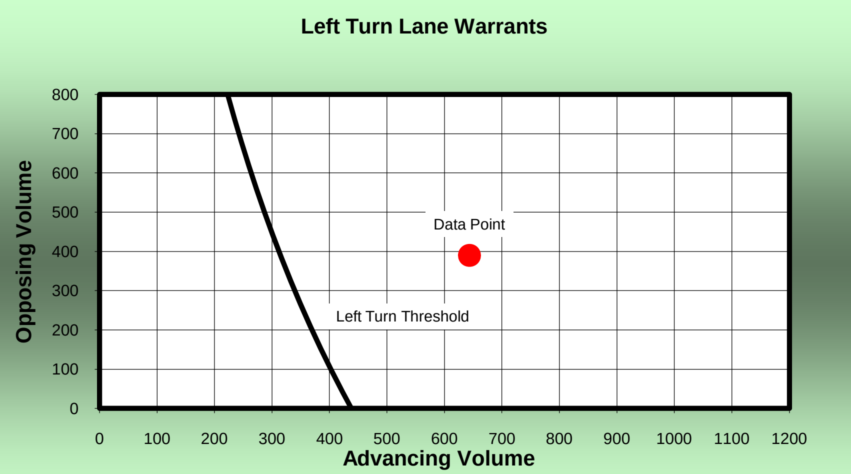
Right Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	120	Speed Limit (mph)	35
Advancing Volume (vph)	640	No. of through lanes	1
Opposing Volume (vph)	390	Percent Heavy Vehicles (decimal percent)	0.02



Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

Input Fields

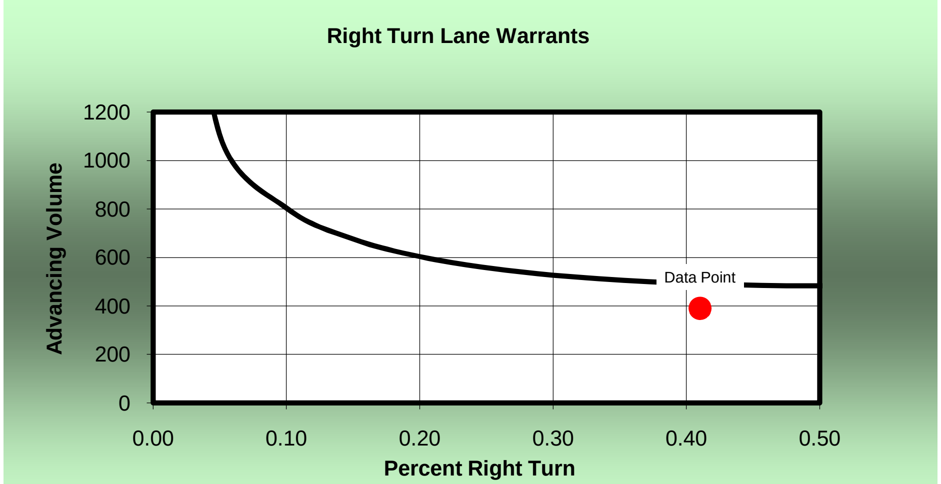
Turn Volume	120	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**150**
Cycle Length *(Enter 0 for Uncontrolled, 60 for Stop Controlled)*	60	Minimum	**125**
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	160	Speed Limit (mph)	35
Advancing Volume (vph)	390		



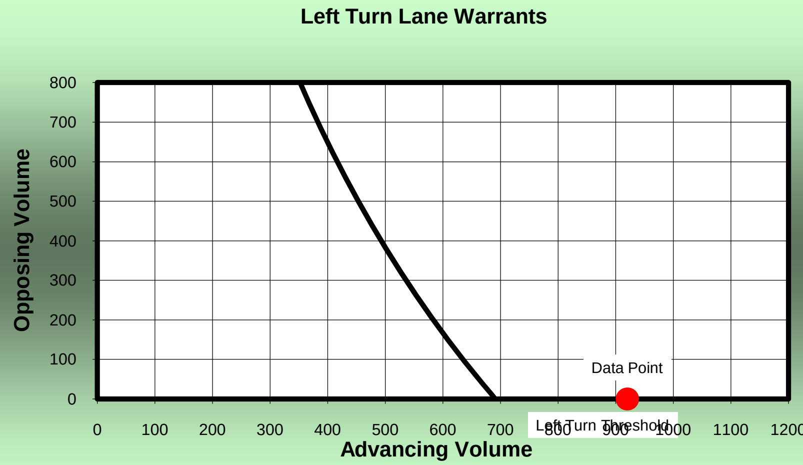
Right Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	60	Speed Limit (mph)	35
Advancing Volume (vph)	920	No. of through lanes	2
Opposing Volume (vph)	0	Percent Heavy Vehicles (decimal percent)	0.02



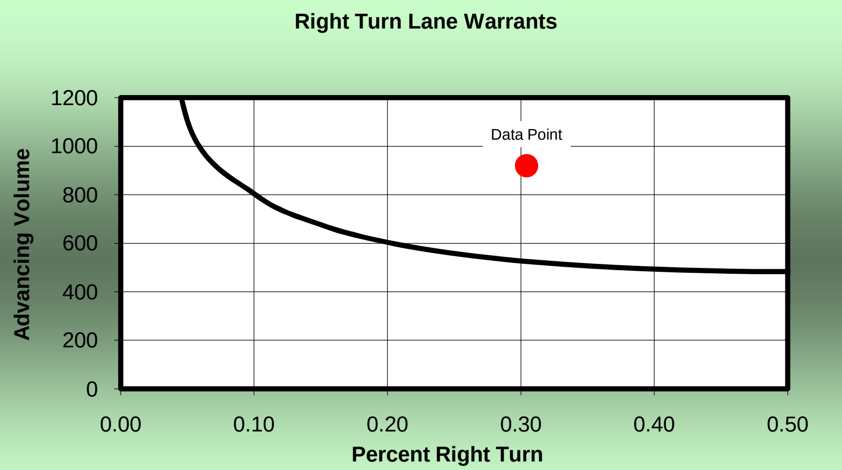
Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	280	Speed Limit (mph)	35
Advancing Volume (vph)	920		



Right Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

Turn Volume	60	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**125**
Cycle Length	60	Minimum	**125**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)			
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

Turn Volume	280	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**275**
Cycle Length	60	Minimum	**225**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)			
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

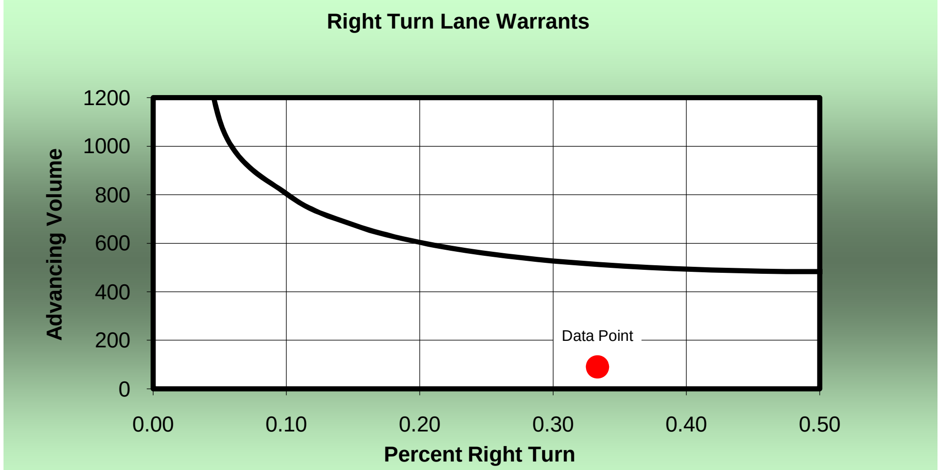
Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph) 30

Speed Limit (mph) 35

Advancing Volume (vph) 90



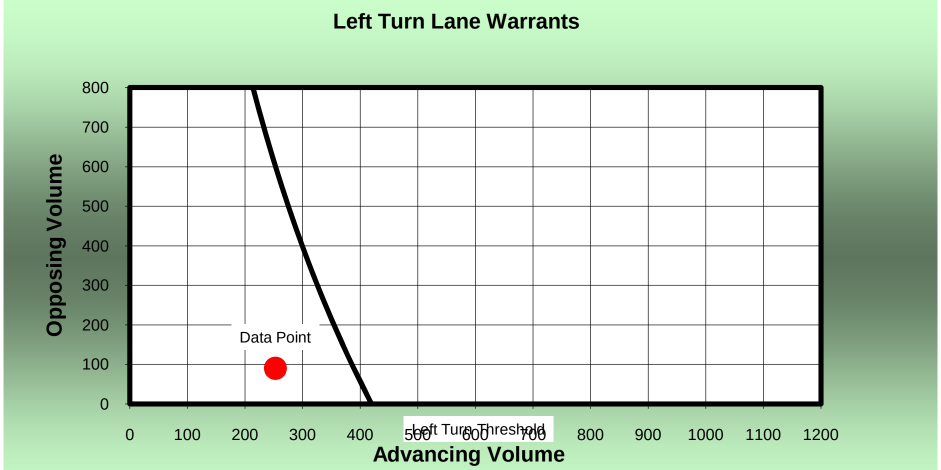
Right Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	200	Speed Limit (mph)	35
Advancing Volume (vph)	250	No. of through lanes	1
Opposing Volume (vph)	90	Percent Heavy Vehicles (decimal percent)	0.18



Left Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	20	Speed Limit (mph)	35
Advancing Volume (vph)	250	No. of through lanes	1
Opposing Volume (vph)	0	Percent Heavy Vehicles (decimal percent)	0.18

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

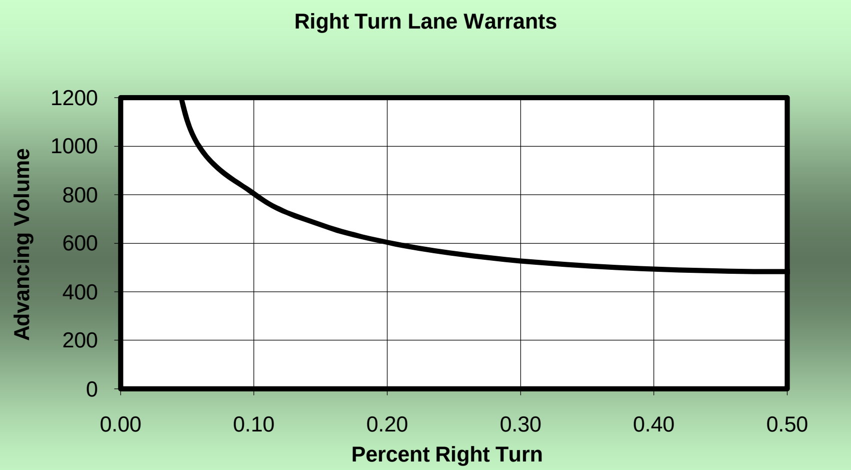
Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph) 230

Advancing Volume (vph) 250

Speed Limit (mph) 35



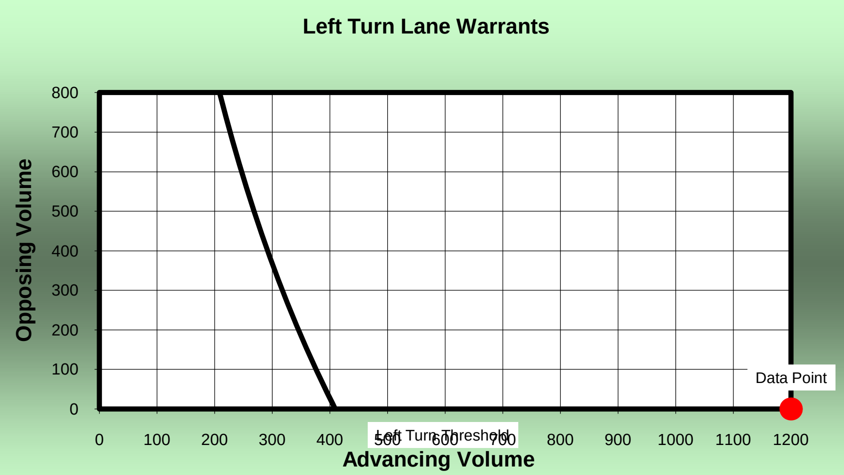
Right Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	300	Speed Limit (mph)	35
Advancing Volume (vph)	1340	No. of through lanes	2
Opposing Volume (vph)	0	Percent Heavy Vehicles (decimal percent)	0.02



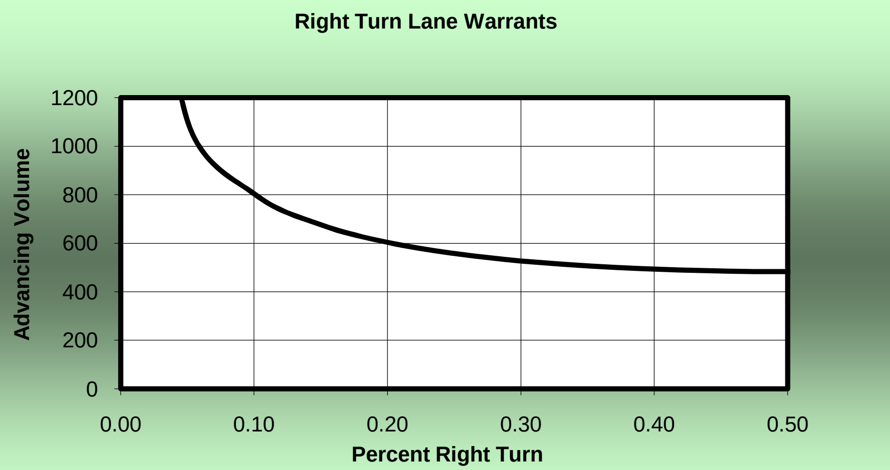
Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	70	Speed Limit (mph)	35
Advancing Volume (vph)	1340		



Right Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

Input Fields

Turn Volume	300	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**300**
Cycle Length	60	Minimum	**250**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)			
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

Turn Volume	70	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**125**
Cycle Length *(Enter 0 for Uncontrolled, 60 for Stop Controlled)*	60	Minimum	**125**
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

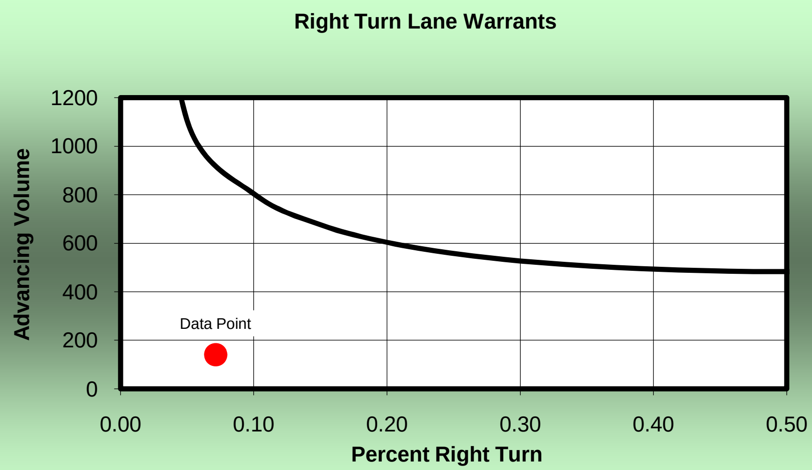
Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph) 10

Advancing Volume (vph) 140

Speed Limit (mph) 35



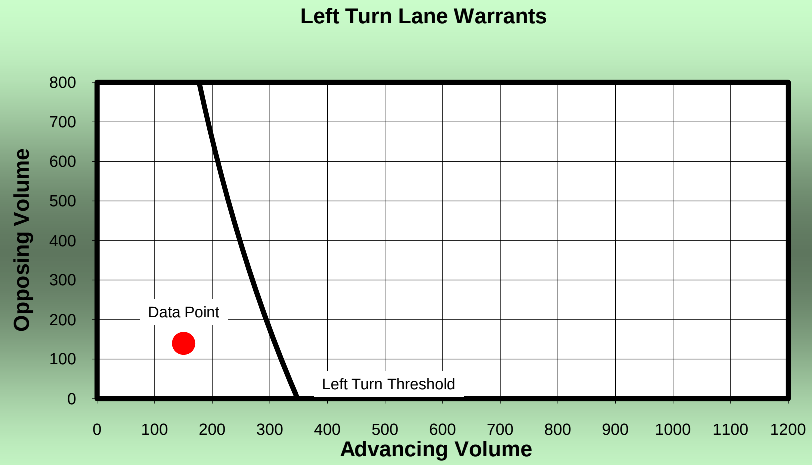
Right Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	90	Speed Limit (mph)	35
Advancing Volume (vph)	150	No. of through lanes	1
Opposing Volume (vph)	140	Percent Heavy Vehicles (decimal percent)	0.02



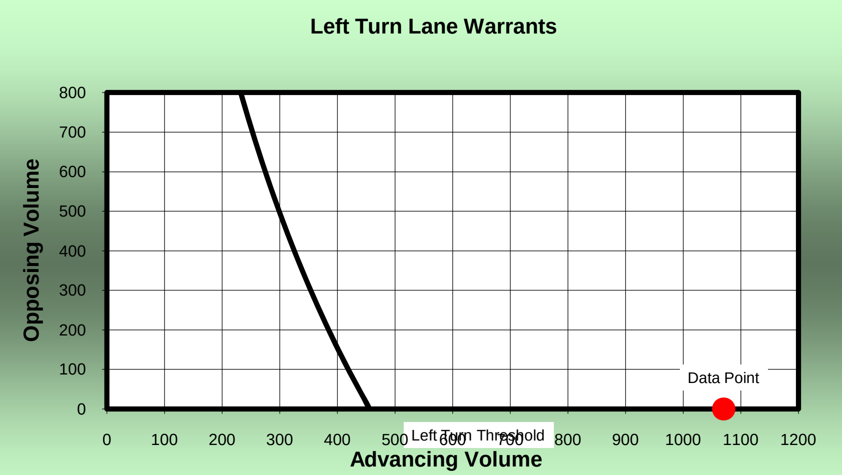
Left Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	180	Speed Limit (mph)	35
Advancing Volume (vph)	1070	No. of through lanes	2
Opposing Volume (vph)	0	Percent Heavy Vehicles (decimal percent)	0.02



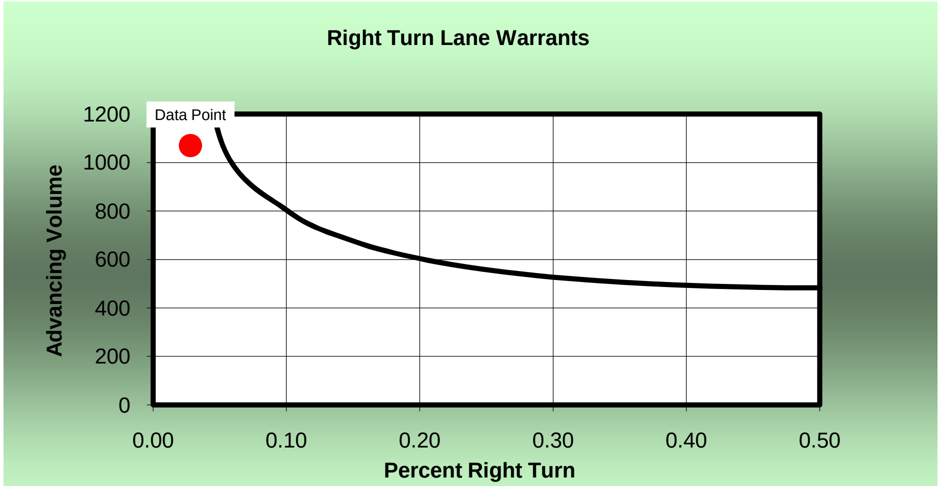
Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	30	Speed Limit (mph)	35
Advancing Volume (vph)	1070		



Right Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

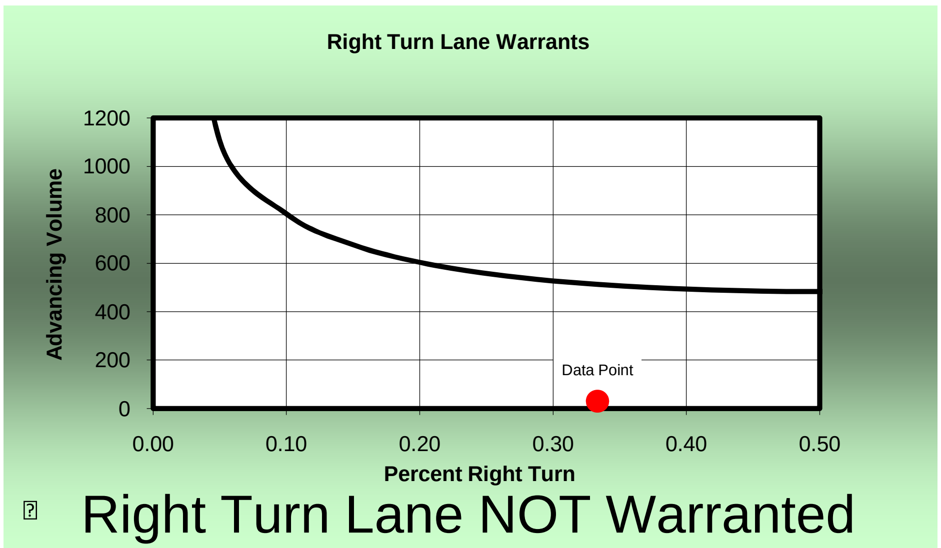
Turn Volume	180	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**125**
Cycle Length	0	Minimum	**125**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)			
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	10	Speed Limit (mph)	35
Advancing Volume (vph)	30		

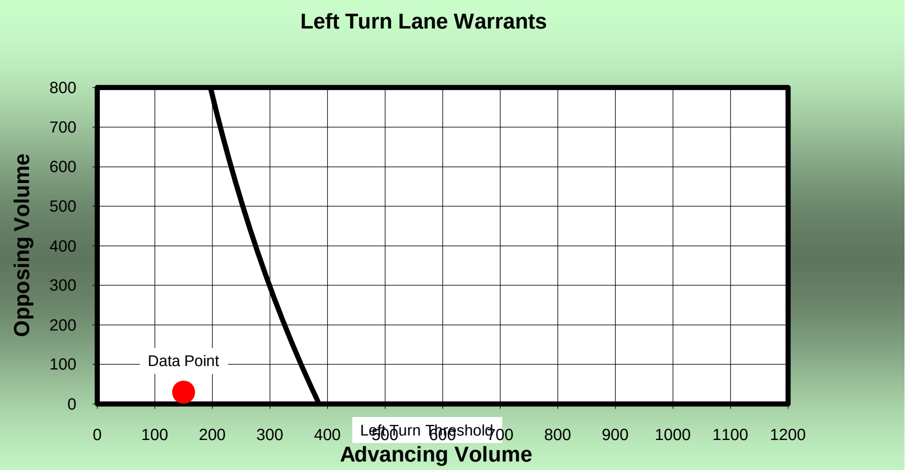


Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	110	Speed Limit (mph)	35
Advancing Volume (vph)	150	No. of through lanes	1
Opposing Volume (vph)	30	Percent Heavy Vehicles (decimal percent)	0.02



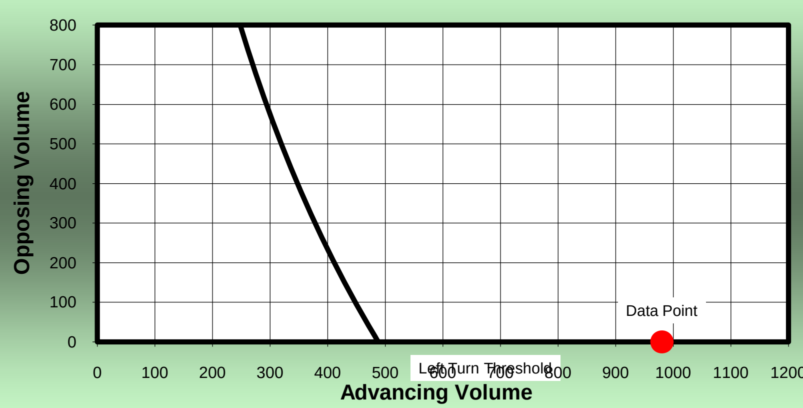
Left Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	140	Speed Limit (mph)	35
Advancing Volume (vph)	980	No. of through lanes	2
Opposing Volume (vph)	0	Percent Heavy Vehicles (decimal percent)	0.02



Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

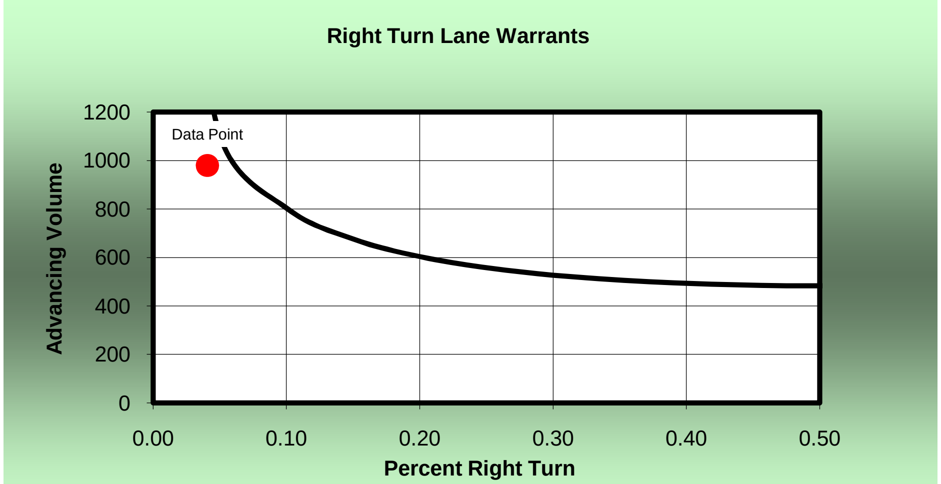
Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph) 40

Advancing Volume (vph) 980

Speed Limit (mph) 35



Right Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

Input Fields

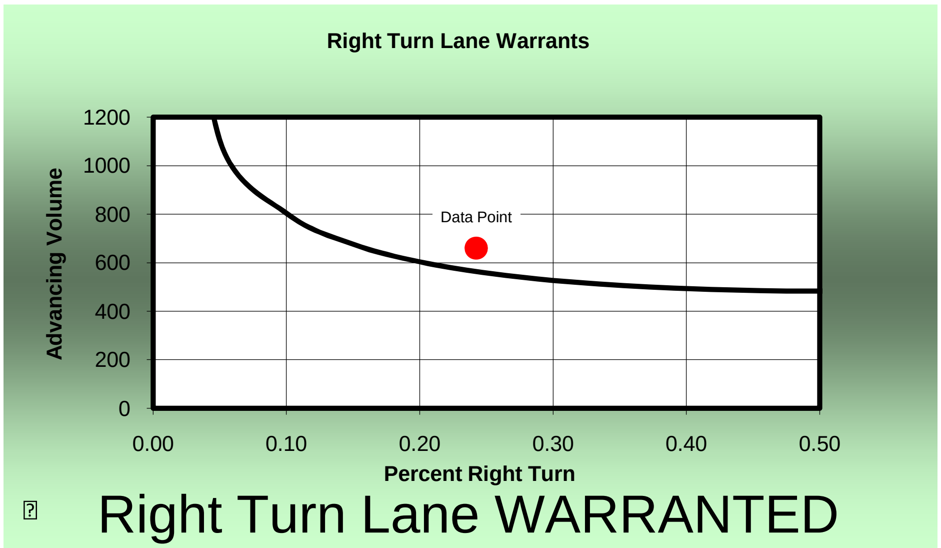
Turn Volume	140	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**175**
Cycle Length	60	Minimum	**150**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)			
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	160	Speed Limit (mph)	35
Advancing Volume (vph)	660		



Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

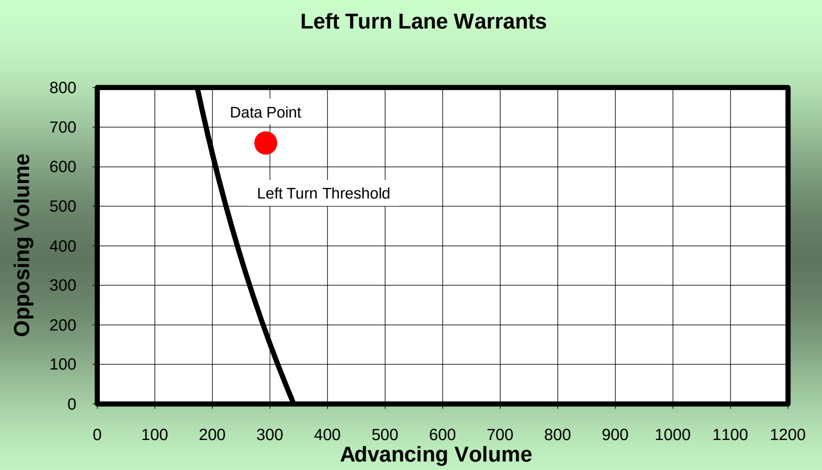
Turn Volume	160		Calculated Turn Lane Length (ft)	
Speed Limit	35		Desirable	**175**
Cycle Length *(Enter 0 for Uncontrolled, 60 for Stop Controlled)*	60		Minimum	**150**
Approach Percent Grade (G)	0			
Is this a Rural Arterial (Y or N)	N			

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	150	Speed Limit (mph)	35
Advancing Volume (vph)	290	No. of through lanes	1
Opposing Volume (vph)	660	Percent Heavy Vehicles (decimal percent)	0.02



Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

Input Fields

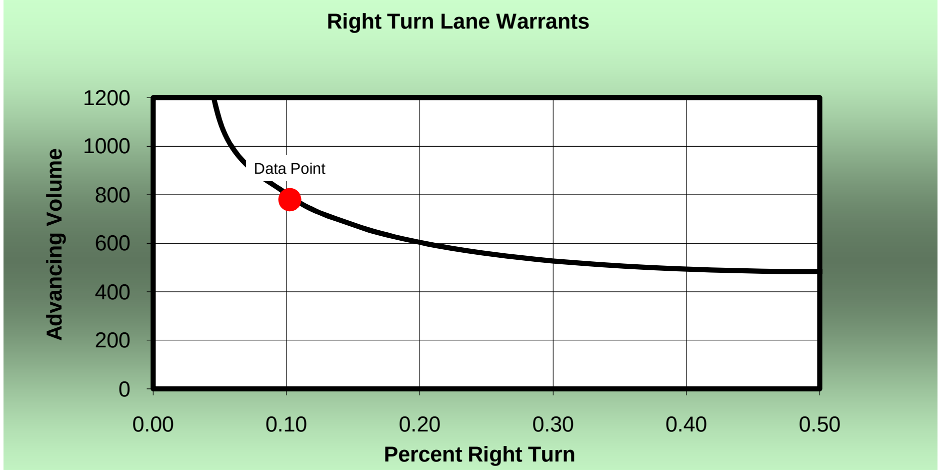
Turn Volume	150	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**175**
Cycle Length *(Enter 0 for Uncontrolled, 60 for Stop Controlled)*	60	Minimum	**150**
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	80	Speed Limit (mph)	35
Advancing Volume (vph)	780		



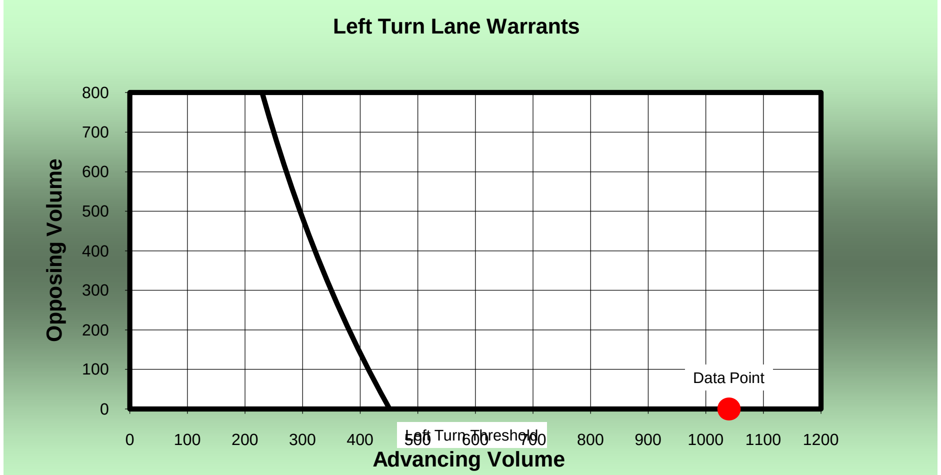
Right Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	180	Speed Limit (mph)	35
Advancing Volume (vph)	1040	No. of through lanes	3
Opposing Volume (vph)	0	Percent Heavy Vehicles (decimal percent)	0.02



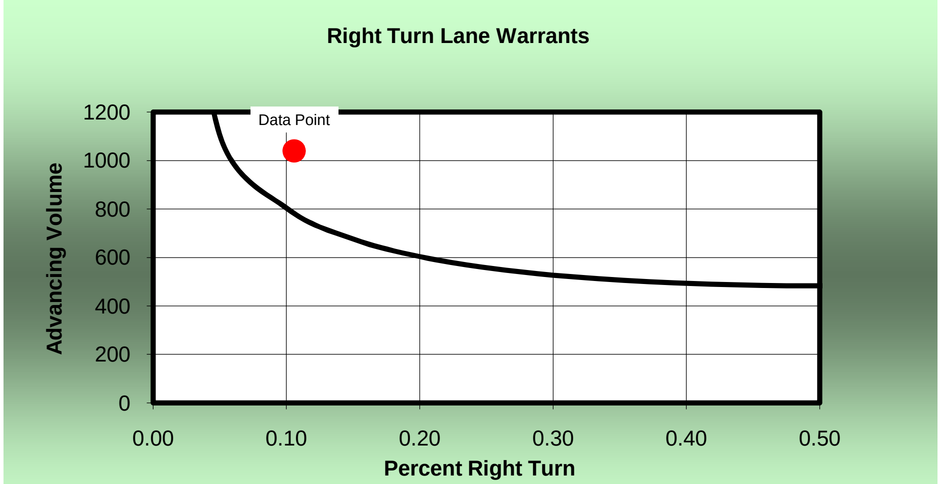
Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	110	Speed Limit (mph)	35
Advancing Volume (vph)	1040		



Right Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

Input Fields

Turn Volume	180	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**200**
Cycle Length	60	Minimum	**175**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)			
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

Input Fields

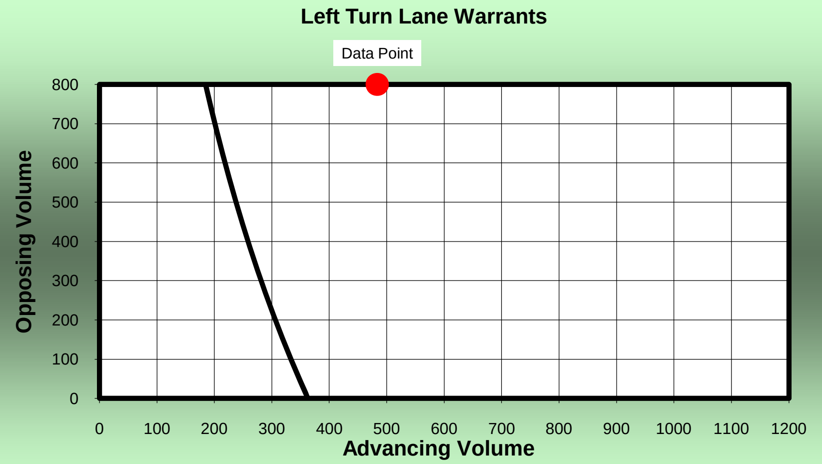
Input	Value		Calculated Turn Lane Length (ft)	
Turn Volume	110			
Speed Limit	35		Desirable	**150**
Cycle Length	60		Minimum	**125**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)				
Approach Percent Grade (G)	0			
Is this a Rural Arterial (Y or N)	N			

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	160	Speed Limit (mph)	35
Advancing Volume (vph)	480	No. of through lanes	2
Opposing Volume (vph)	1060	Percent Heavy Vehicles (decimal percent)	0.02



Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

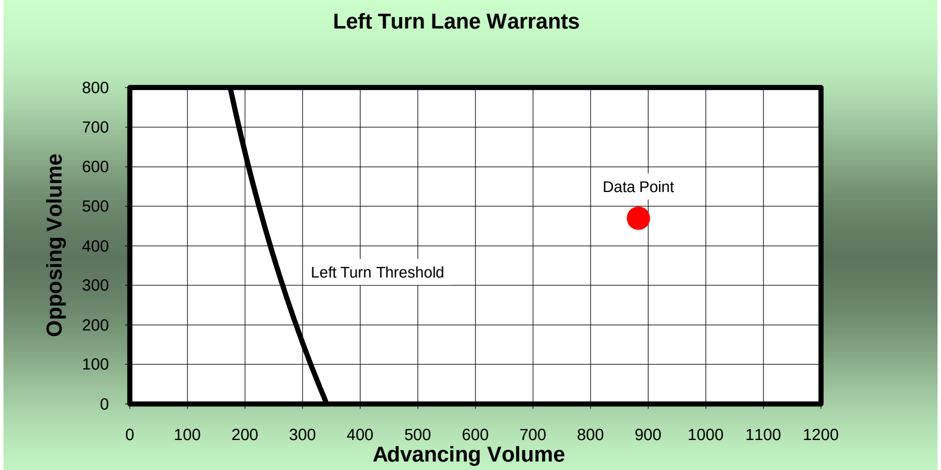
Turn Volume	160	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**175**
Cycle Length *(Enter 0 for Uncontrolled, 60 for Stop Controlled)*	60	Minimum	**150**
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	410	Speed Limit (mph)	35
Advancing Volume (vph)	880	No. of through lanes	2
Opposing Volume (vph)	470	Percent Heavy Vehicles (decimal percent)	0.02



Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

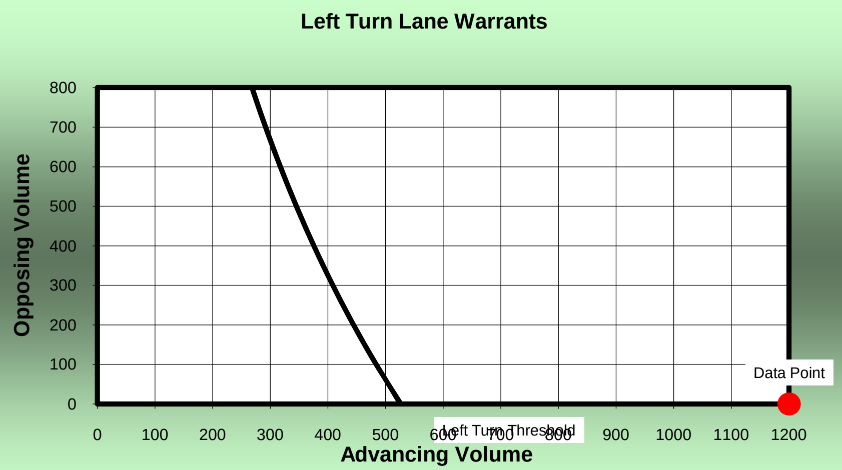
Turn Volume	410	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**400**
Cycle Length *(Enter 0 for Uncontrolled, 60 for Stop Controlled)*	60	Minimum	**300**
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	200	Speed Limit (mph)	35
Advancing Volume (vph)	1680	No. of through lanes	3
Opposing Volume (vph)	0	Percent Heavy Vehicles (decimal percent)	0.02



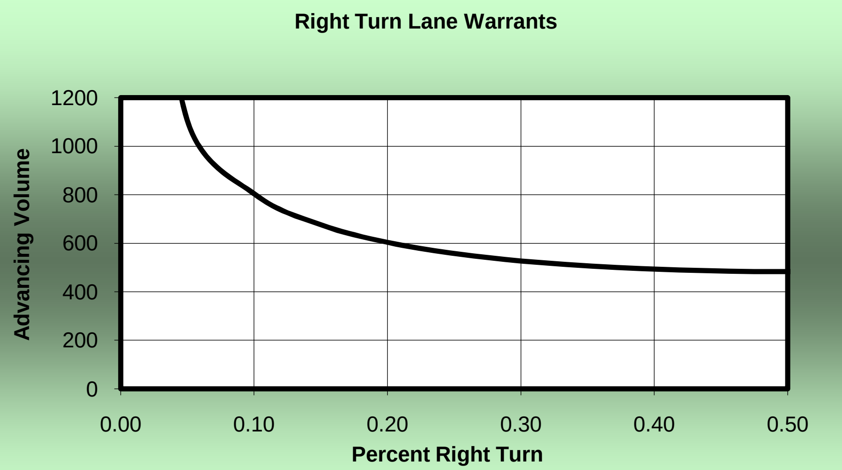
Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	360	Speed Limit (mph)	35
Advancing Volume (vph)	1730		



Right Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

Input Fields

Turn Volume	200	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**225**
Cycle Length *(Enter 0 for Uncontrolled, 60 for Stop Controlled)*	60	Minimum	**175**
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

Input Fields

Turn Volume	360		Calculated Turn Lane Length (ft)	
Speed Limit	35		Desirable	**350**
Cycle Length	60		Minimum	**275**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)				
Approach Percent Grade (G)	0			
Is this a Rural Arterial (Y or N)	N			

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

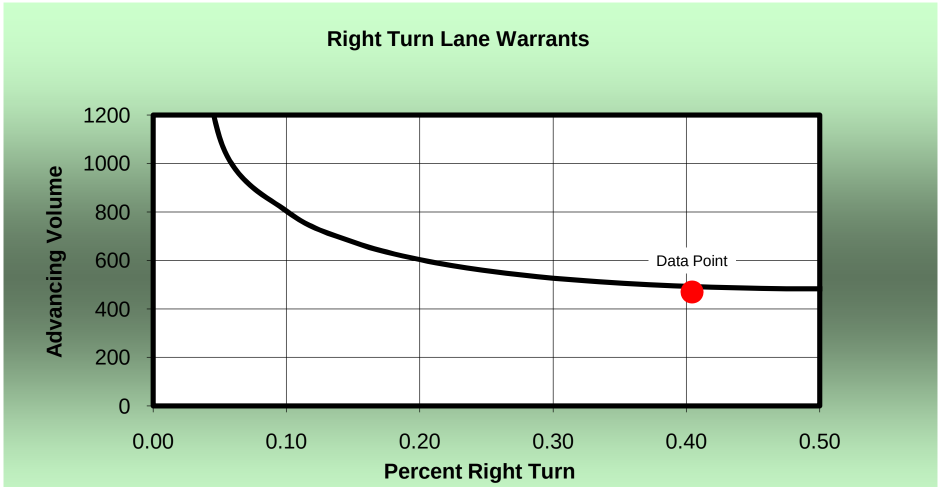
Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph) 190

Speed Limit (mph) 35

Advancing Volume (vph) 470



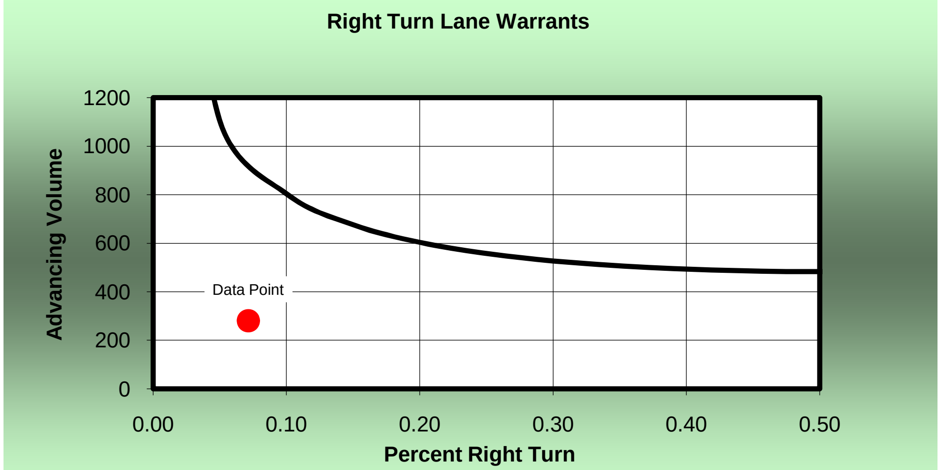
Right Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	20	Speed Limit (mph)	35
Advancing Volume (vph)	280		



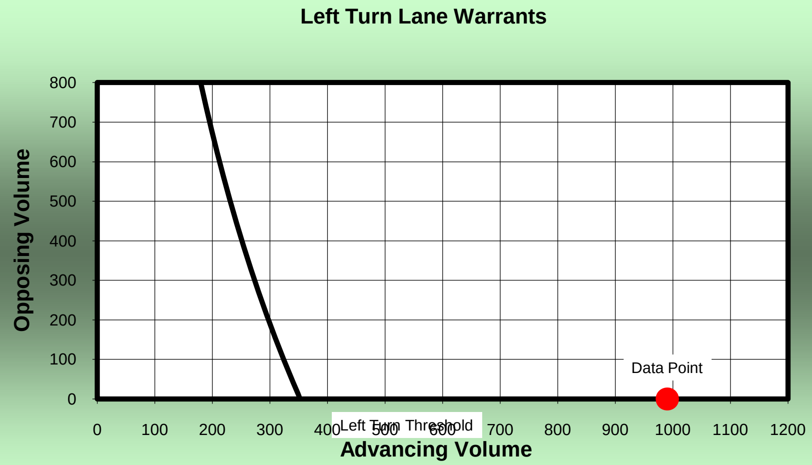
Right Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	370	Speed Limit (mph)	35
Advancing Volume (vph)	990	No. of through lanes	1
Opposing Volume (vph)	0	Percent Heavy Vehicles (decimal percent)	0.02



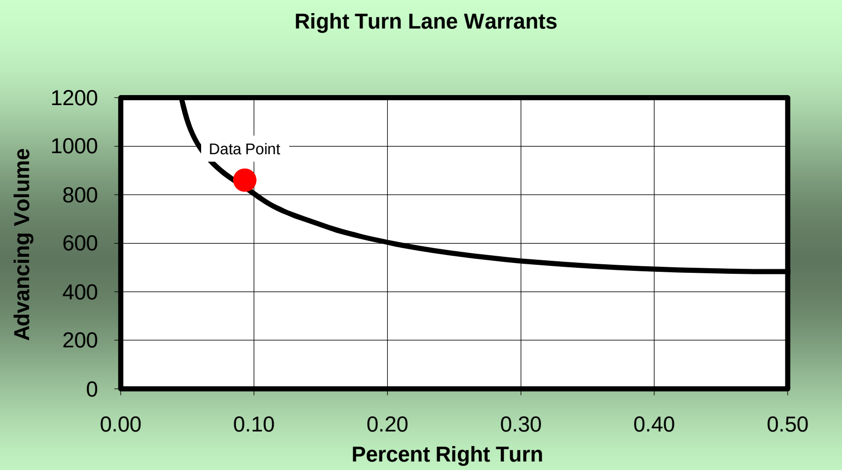
Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	80	Speed Limit (mph)	35
Advancing Volume (vph)	860		



Right Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

Turn Volume	370	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**350**
Cycle Length *(Enter 0 for Uncontrolled, 60 for Stop Controlled)*	60	Minimum	**275**
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

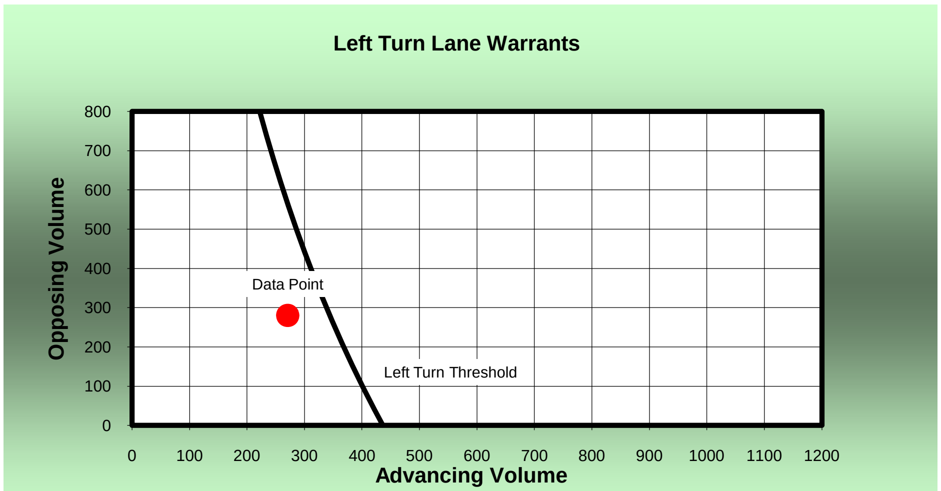
Turn Volume	80	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**125**
Cycle Length	60	Minimum	**125**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)			
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

<u>Input Fields</u>

Left Turn Volume (vph)	220	Speed Limit (mph)	35
Advancing Volume (vph)	270	No. of through lanes	1
Opposing Volume (vph)	280	Percent Heavy Vehicles (decimal percent)	0.02



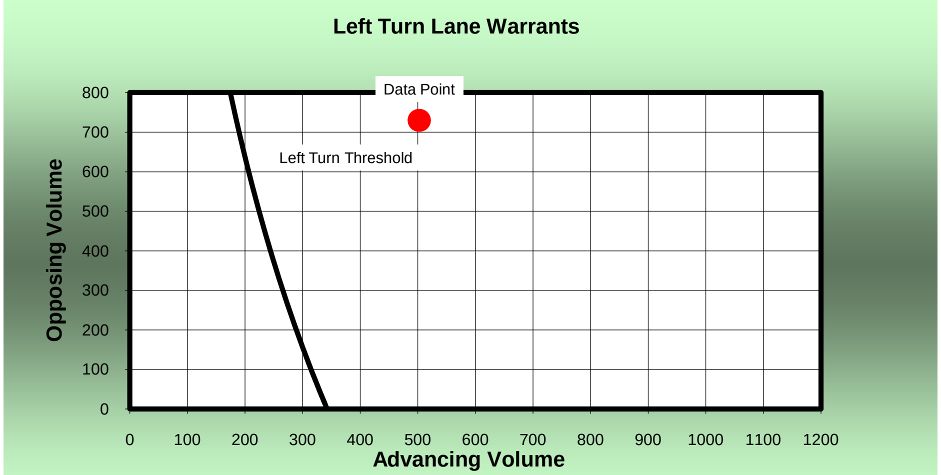
Left Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	230	Speed Limit (mph)	35
Advancing Volume (vph)	500	No. of through lanes	2
Opposing Volume (vph)	730	Percent Heavy Vehicles (decimal percent)	0.02



Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

Input Fields

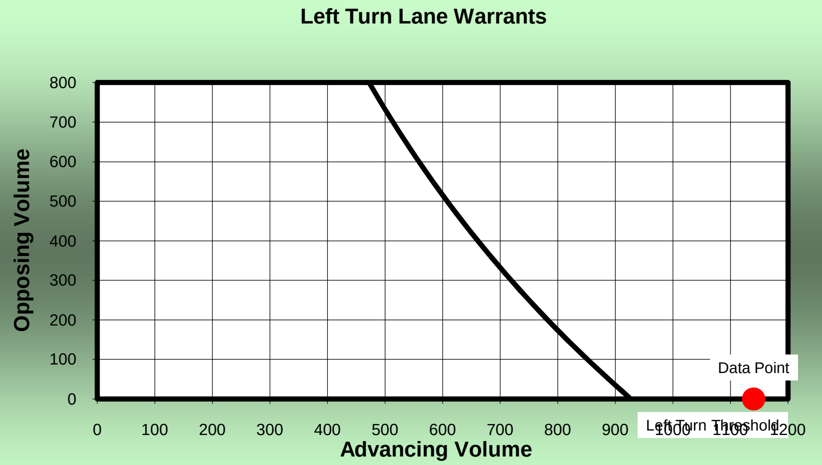
Turn Volume	230	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**250**
Cycle Length *(Enter 0 for Uncontrolled, 60 for Stop Controlled)*	60	Minimum	**200**
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	40	Speed Limit (mph)	35
Advancing Volume (vph)	1140	No. of through lanes	3
Opposing Volume (vph)	0	Percent Heavy Vehicles (decimal percent)	0.02



Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

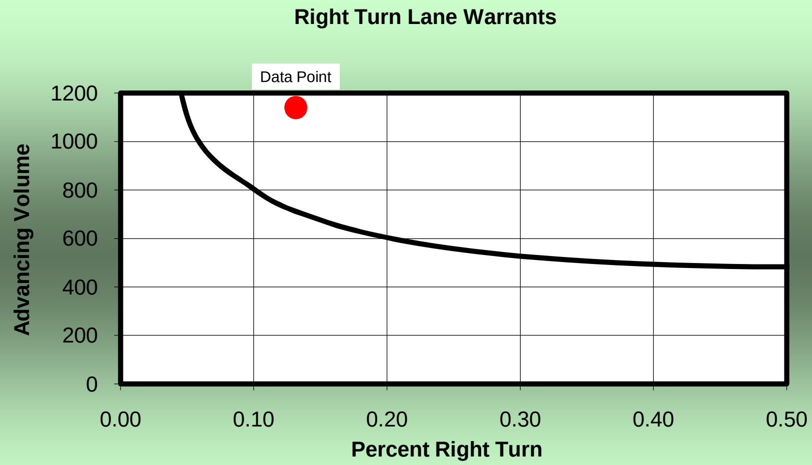
Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph) 150

Speed Limit (mph) 35

Advancing Volume (vph) 1140



Right Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

Input Fields

Turn Volume	40	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**125**
Cycle Length	60	Minimum	**125**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)			
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

Input Fields

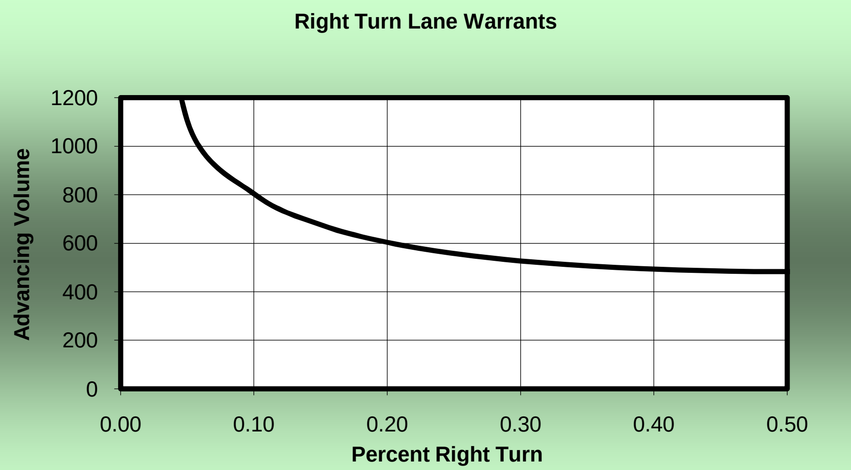
Turn Volume	150	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**175**
Cycle Length *(Enter 0 for Uncontrolled, 60 for Stop Controlled)*	60	Minimum	**150**
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	550	Speed Limit (mph)	35
Advancing Volume (vph)	780		



Right Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

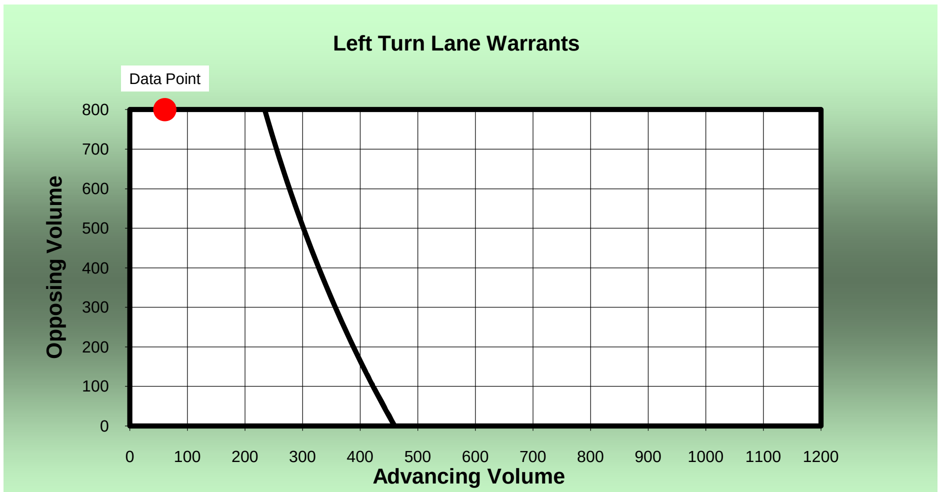
Turn Volume	550	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**500**
Cycle Length *(Enter 0 for Uncontrolled, 60 for Stop Controlled)*	60	Minimum	**400**
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

<u>Input Fields</u>

Left Turn Volume (vph)	10	Speed Limit (mph)	35
Advancing Volume (vph)	60	No. of through lanes	1
Opposing Volume (vph)	880	Percent Heavy Vehicles (decimal percent)	0.02



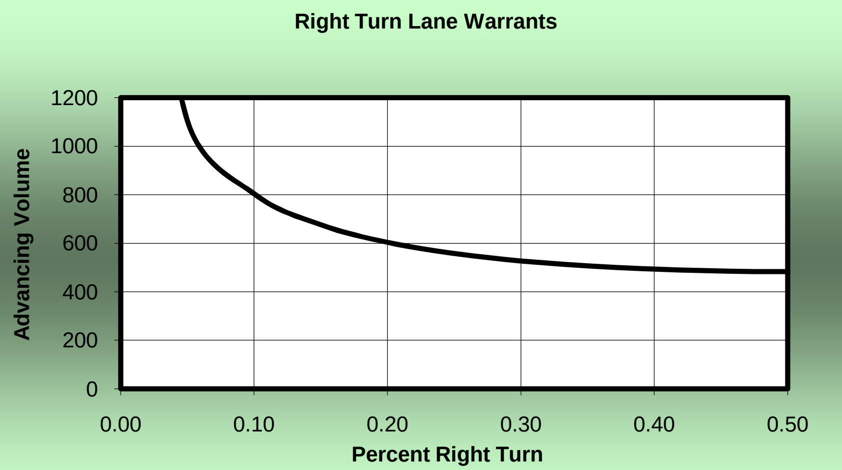
Left Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	40	Speed Limit (mph)	35
Advancing Volume (vph)	60		



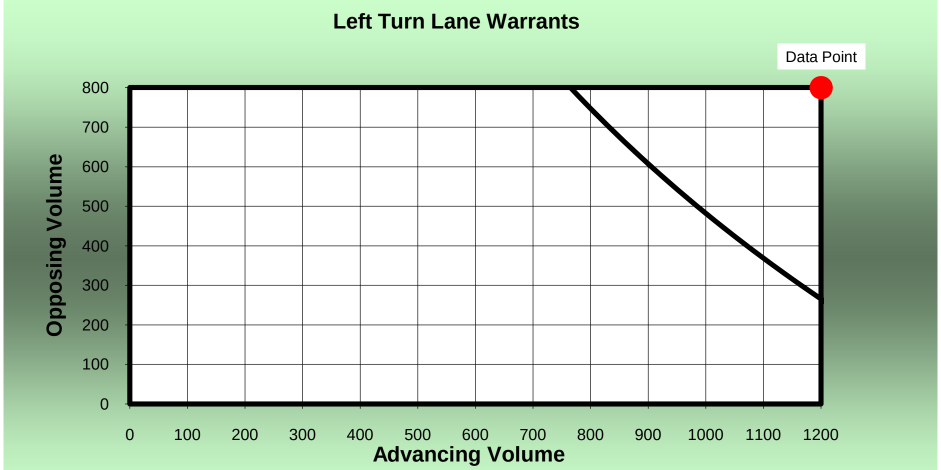
Right Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	20	Speed Limit (mph)	35
Advancing Volume (vph)	1520	No. of through lanes	2
Opposing Volume (vph)	1020	Percent Heavy Vehicles (decimal percent)	0.02



Left Turn Lane WARRANTED

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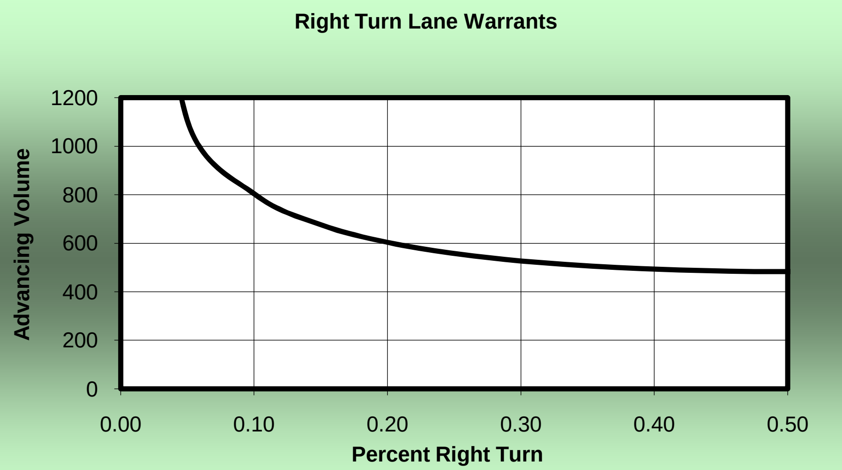
Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph) 280

Advancing Volume (vph) 1520

Speed Limit (mph) 35



Right Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

Input	Value
Turn Volume	20
Speed Limit	35
Cycle Length *(Enter 0 for Uncontrolled, 60 for Stop Controlled)*	90
Approach Percent Grade (G)	0
Is this a Rural Arterial (Y or N)	N

Calculated Turn Lane Length (ft)

Desirable	**125**
Minimum	**125**

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

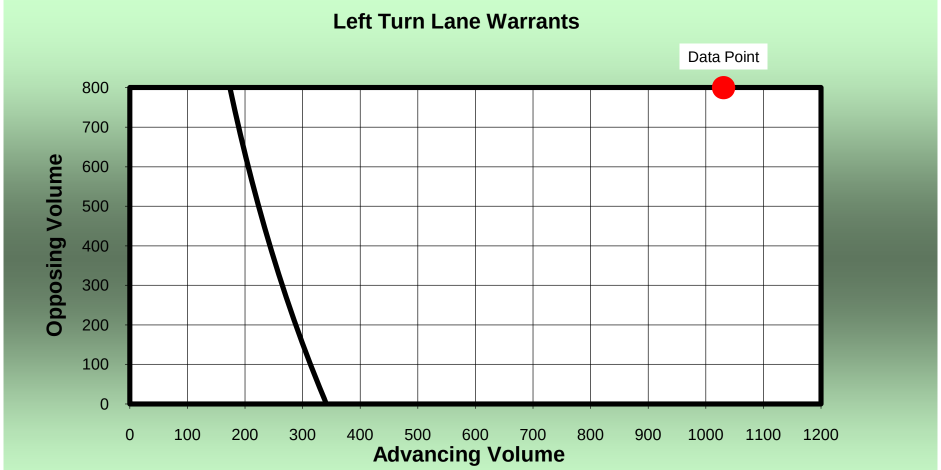
Turn Volume	280	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**400**
Cycle Length	90	Minimum	**325**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)			
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	520	Speed Limit (mph)	35
Advancing Volume (vph)	1020	No. of through lanes	2
Opposing Volume (vph)	1520	Percent Heavy Vehicles (decimal percent)	0.02



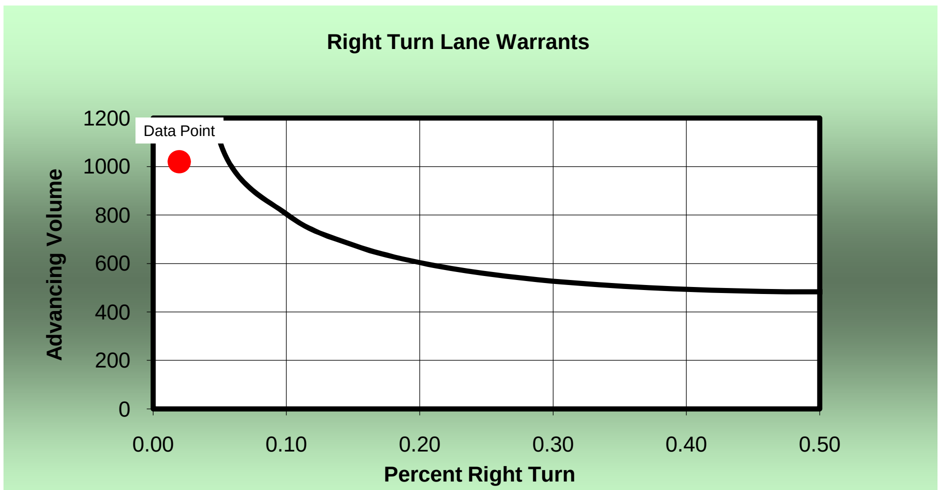
Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

<u>Input Fields</u>

Right Turn Volume (vph)	20	Speed Limit (mph)	35
Advancing Volume (vph)	1020		



Right Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

Input Fields

Input	Value		Calculated Turn Lane Length (ft)	
Turn Volume	520			
Speed Limit	35		Desirable	**700**
Cycle Length *(Enter 0 for Uncontrolled, 60 for Stop Controlled)*	90		Minimum	**550**
Approach Percent Grade (G)	0			
Is this a Rural Arterial (Y or N)	N			

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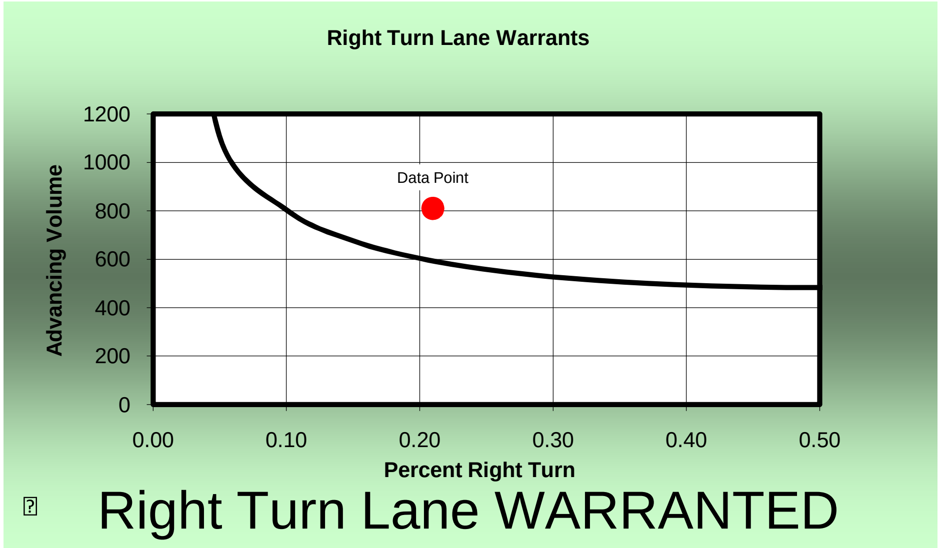
Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph) 170

Speed Limit (mph) 35

Advancing Volume (vph) 810



Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

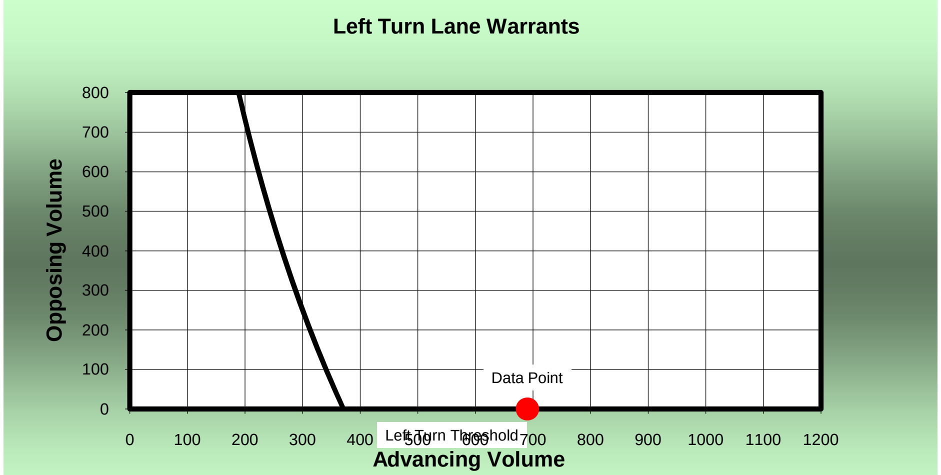
Turn Volume	170	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**275**
Cycle Length *(Enter 0 for Uncontrolled, 60 for Stop Controlled)*	90	Minimum	**200**
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	480	Speed Limit (mph)	35
Advancing Volume (vph)	690	No. of through lanes	0
Opposing Volume (vph)	0	Percent Heavy Vehicles (decimal percent)	0.02



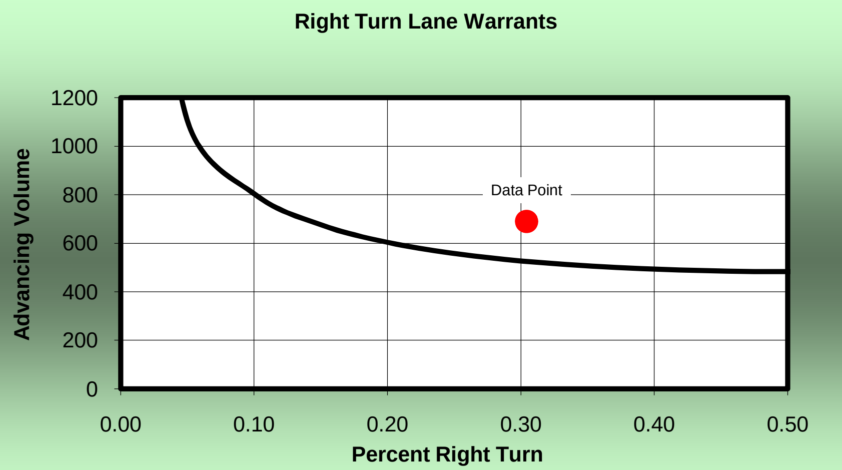
Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	210	Speed Limit (mph)	35
Advancing Volume (vph)	690		



Right Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

Turn Volume	480	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**650**
Cycle Length *(Enter 0 for Uncontrolled, 60 for Stop Controlled)*	90	Minimum	**500**
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

Input Fields

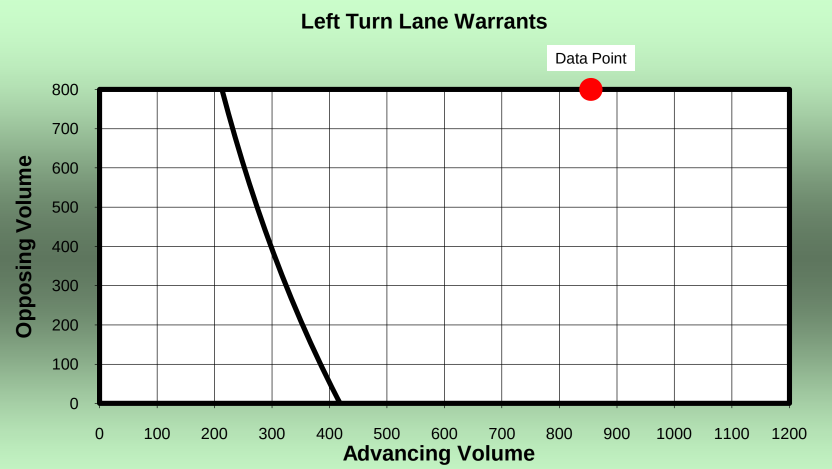
Turn Volume	210	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**325**
Cycle Length	90	Minimum	**250**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)			
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

<u>Input Fields</u>

Left Turn Volume (vph)	180	Speed Limit (mph)	35
Advancing Volume (vph)	850	No. of through lanes	2
Opposing Volume (vph)	810	Percent Heavy Vehicles (decimal percent)	0.02



Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

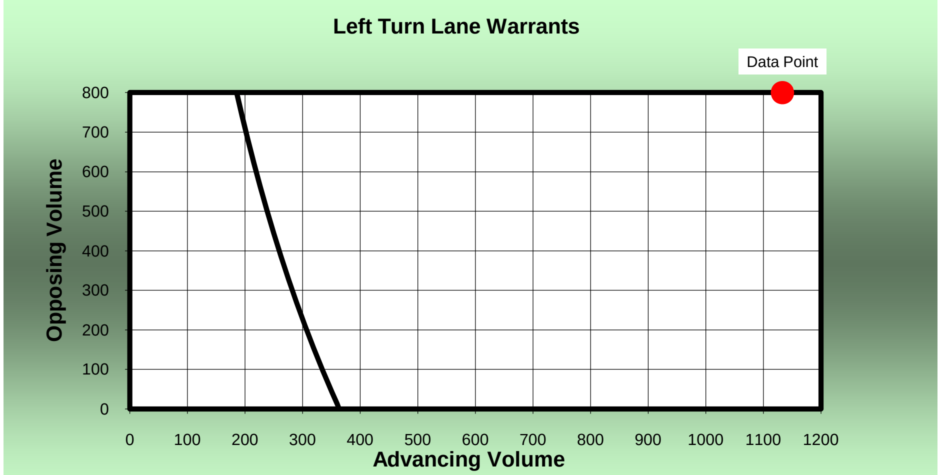
Turn Volume	180	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**275**
Cycle Length *(Enter 0 for Uncontrolled, 60 for Stop Controlled)*	90	Minimum	**225**
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	370	Speed Limit (mph)	35
Advancing Volume (vph)	1120	No. of through lanes	2
Opposing Volume (vph)	1660	Percent Heavy Vehicles (decimal percent)	0.02



Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

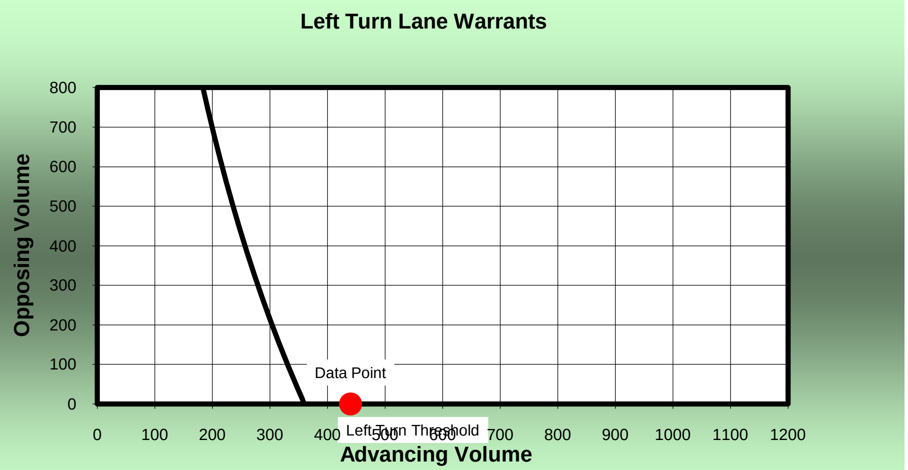
Turn Volume	370	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**525**
Cycle Length	90	Minimum	**400**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)			
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	290	Speed Limit (mph)	35
Advancing Volume (vph)	440	No. of through lanes	0
Opposing Volume (vph)	0	Percent Heavy Vehicles (decimal percent)	0.02



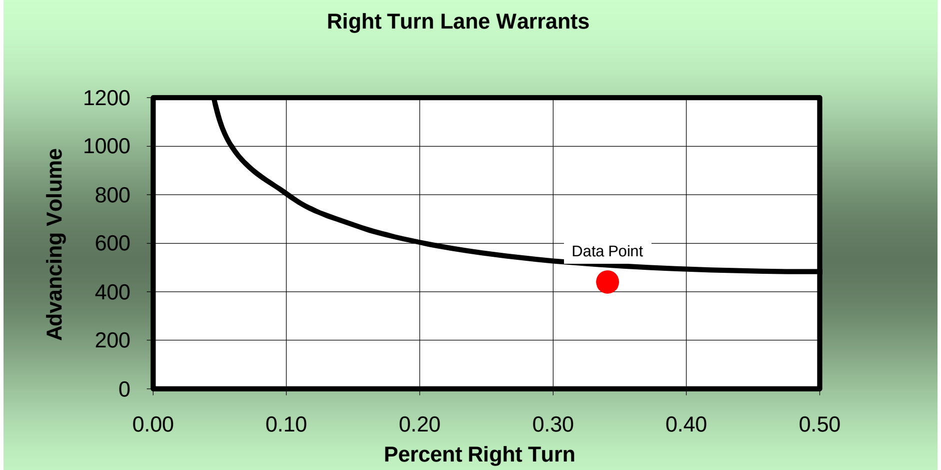
Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	150	Speed Limit (mph)	35
Advancing Volume (vph)	440		



Right Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

Input Fields

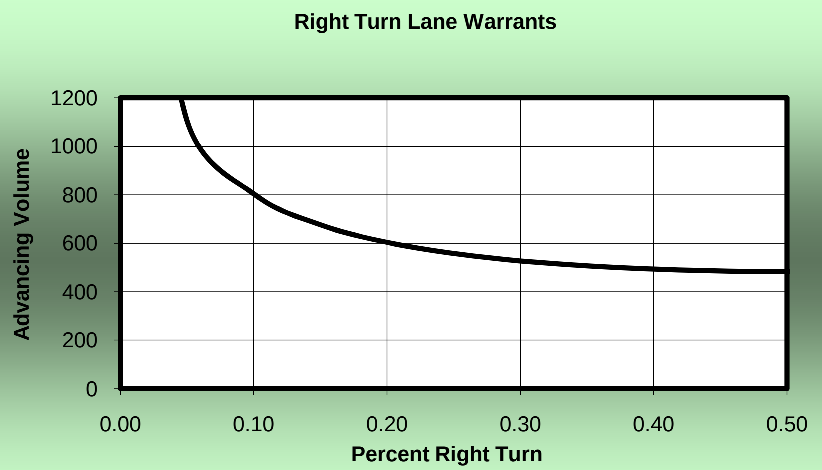
Turn Volume	290		Calculated Turn Lane Length (ft)	
Speed Limit	35		Desirable	**425**
Cycle Length	90		Minimum	**325**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)				
Approach Percent Grade (G)	0			
Is this a Rural Arterial (Y or N)	N			

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	1100	Speed Limit (mph)	35
Advancing Volume (vph)	1660		



Right Turn Lane WARRANTED

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Turn Lane Length

<u>Input Fields</u>

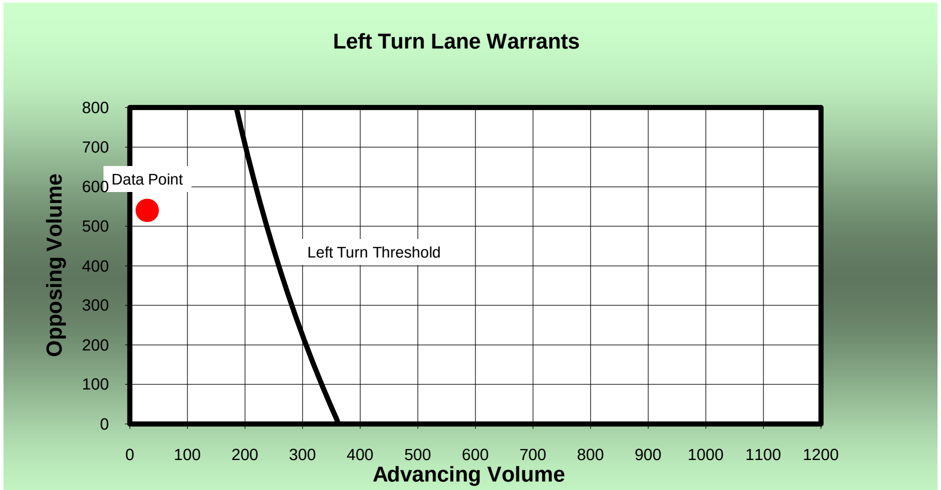
Turn Volume	1100	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**1425**
Cycle Length	90	Minimum	**1075**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)			
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	10	Speed Limit (mph)	35
Advancing Volume (vph)	30	No. of through lanes	1
Opposing Volume (vph)	540	Percent Heavy Vehicles (decimal percent)	0.02



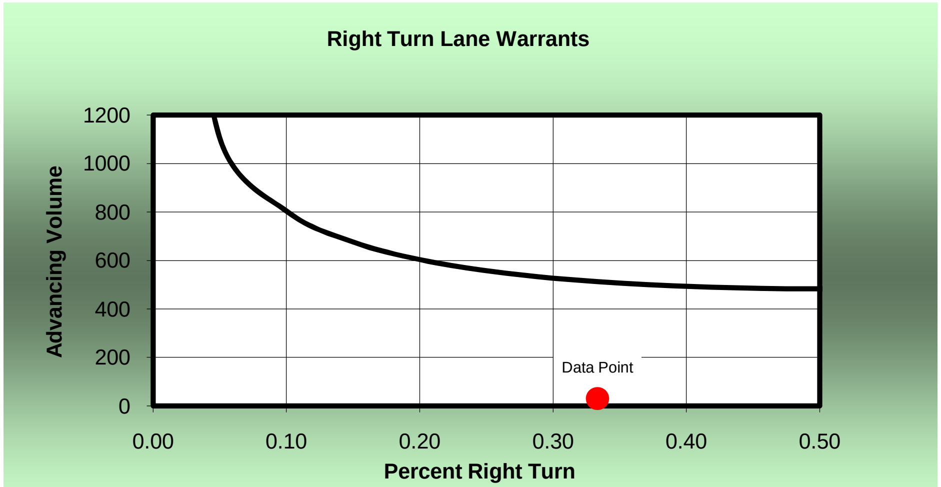
Left Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	10	Speed Limit (mph)	35
Advancing Volume (vph)	30		



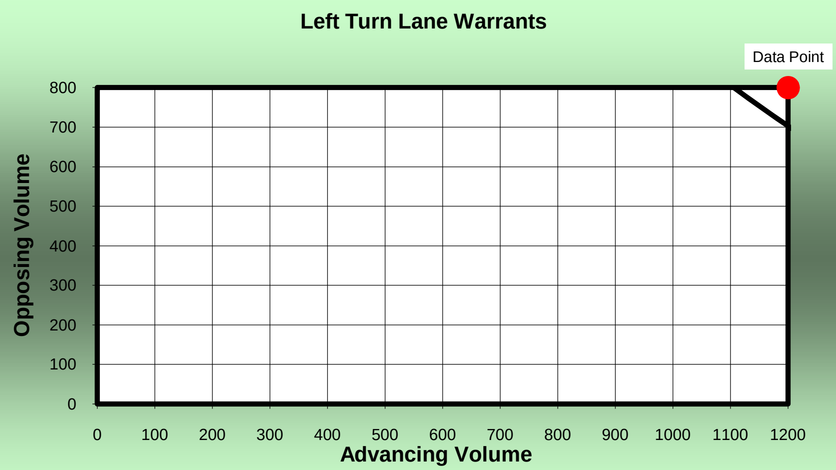
Right Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	10	Speed Limit (mph)	35
Advancing Volume (vph)	1590	No. of through lanes	1
Opposing Volume (vph)	900	Percent Heavy Vehicles (decimal percent)	0.02



Left Turn Lane WARRANTED

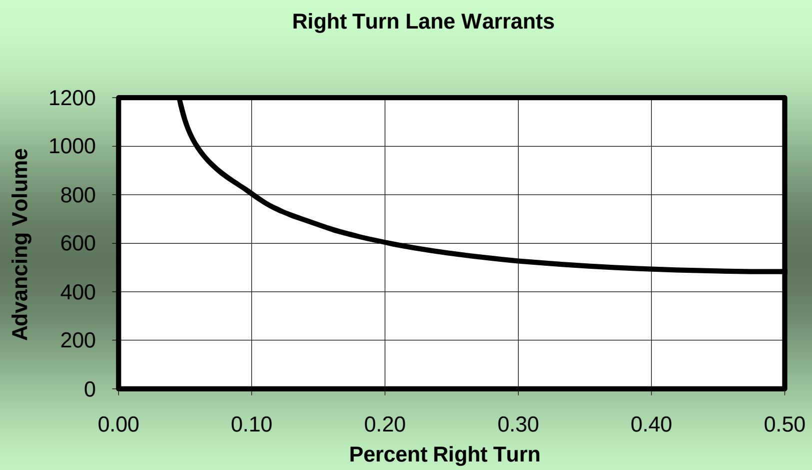
Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph) 260 | Speed Limit (mph) 35

Advancing Volume (vph) 1590



Right Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

Input Fields

Turn Volume	10	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**125**
Cycle Length	90	Minimum	**125**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)			
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

Input Fields

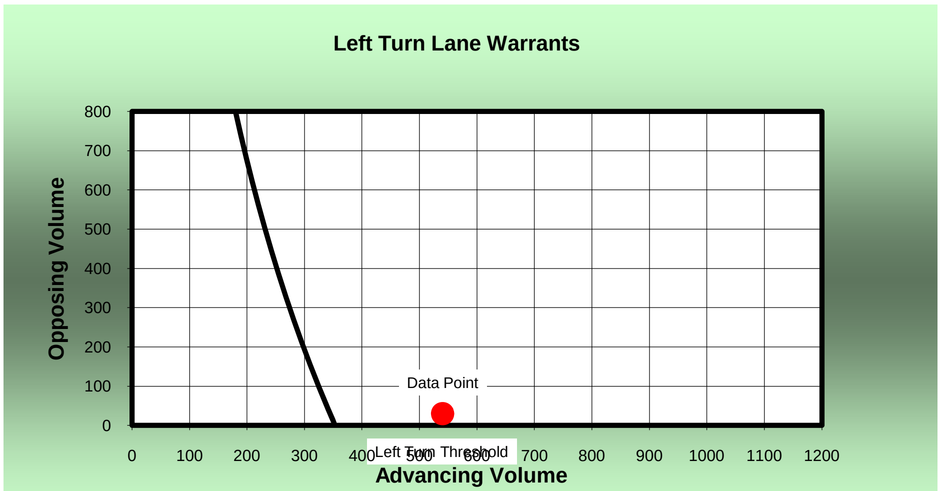
Turn Volume	260	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**375**
Cycle Length	90	Minimum	**300**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)			
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	200	Speed Limit (mph)	35
Advancing Volume (vph)	540	No. of through lanes	1
Opposing Volume (vph)	30	Percent Heavy Vehicles (decimal percent)	0.02



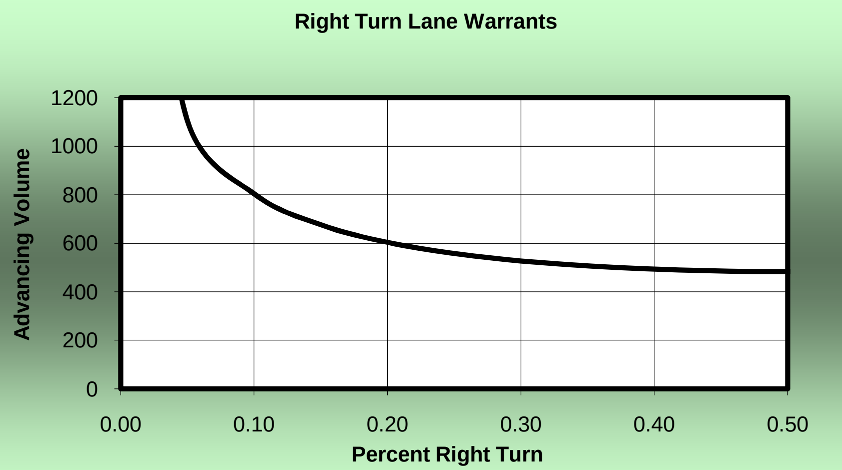
Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	330	Speed Limit (mph)	35
Advancing Volume (vph)	540		



Right Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

Turn Volume	200	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**300**
Cycle Length	90	Minimum	**250**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)			
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

Input Fields

Turn Volume	330	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**475**
Cycle Length	90	Minimum	**350**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)			
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

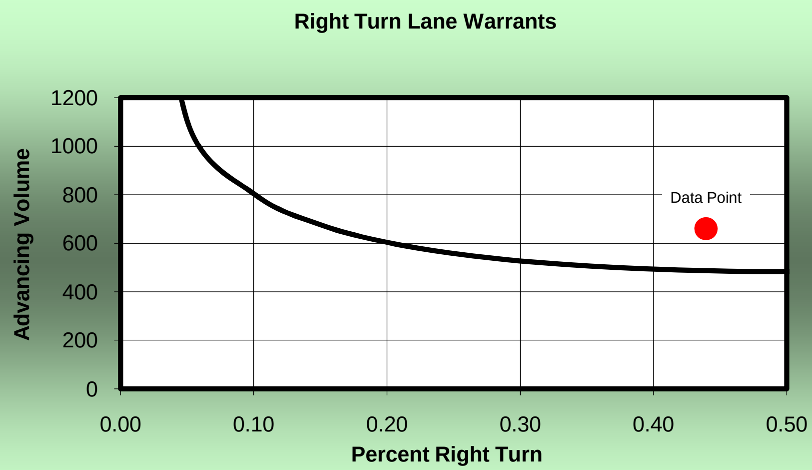
Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph) 290

Speed Limit (mph) 35

Advancing Volume (vph) 660



Right Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

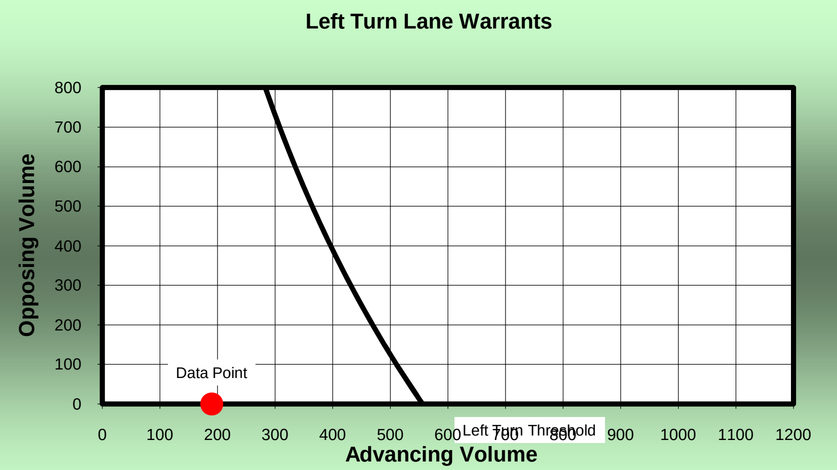
Turn Volume	290	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**325**
Cycle Length *(Enter 0 for Uncontrolled, 60 for Stop Controlled)*	70	Minimum	**250**
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	170	Speed Limit (mph)	35
Advancing Volume (vph)	190	No. of through lanes	0
Opposing Volume (vph)	0	Percent Heavy Vehicles (decimal percent)	0.02



Left Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

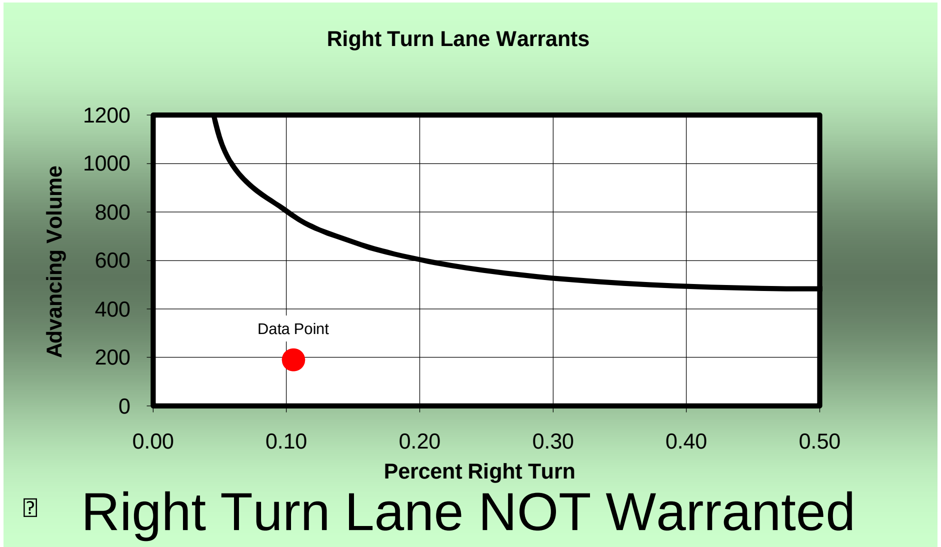
Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph) 20

Advancing Volume (vph) 190

Speed Limit (mph) 35

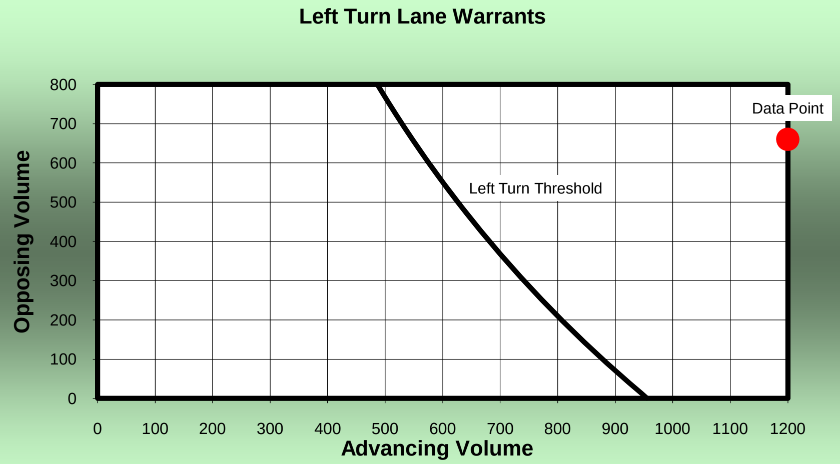


Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	50	Speed Limit (mph)	35
Advancing Volume (vph)	1510	No. of through lanes	2
Opposing Volume (vph)	660	Percent Heavy Vehicles (decimal percent)	0.02



Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

Input Fields

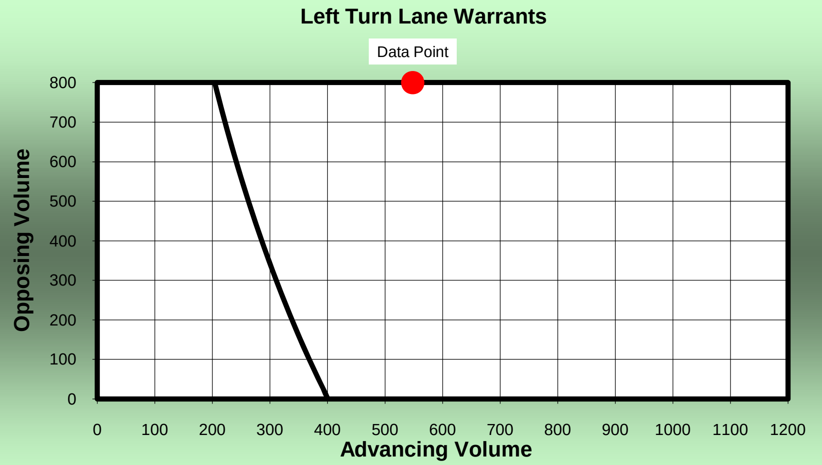
Turn Volume	50	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**125**
Cycle Length	70	Minimum	**125**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)			
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	130	Speed Limit (mph)	35
Advancing Volume (vph)	540	No. of through lanes	2
Opposing Volume (vph)	2110	Percent Heavy Vehicles (decimal percent)	0.02



Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

Input Fields

Input	Value
Turn Volume	130
Speed Limit	35
Cycle Length *(Enter 0 for Uncontrolled, 60 for Stop Controlled)*	70
Approach Percent Grade (G)	0
Is this a Rural Arterial (Y or N)	N

Calculated Turn Lane Length (ft)

Desirable	**175**
Minimum	**150**

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

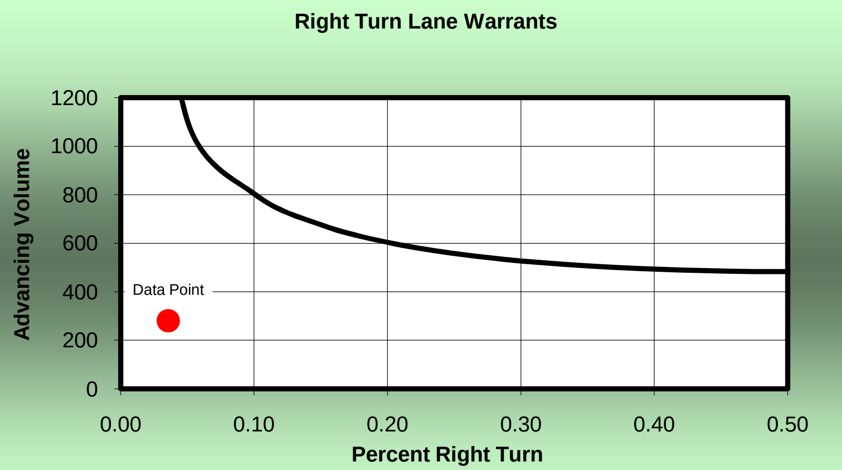
Left Turn Volume (vph)	270	Speed Limit (mph)	35
Advancing Volume (vph)	280	No. of through lanes	0
Opposing Volume (vph)	0	Percent Heavy Vehicles (decimal percent)	0.02

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	10	Speed Limit (mph)	35
Advancing Volume (vph)	280		



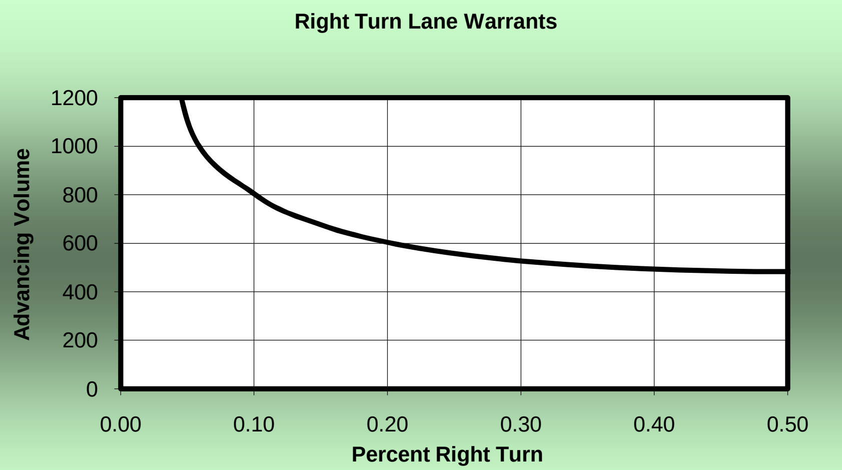
Right Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	870	Speed Limit (mph)	35
Advancing Volume (vph)	2110		



Right Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

Input Fields

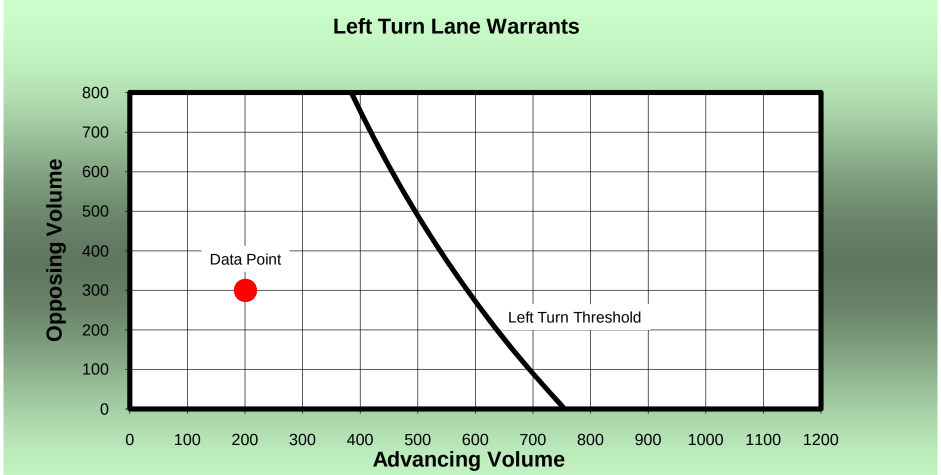
Turn Volume	870		Calculated Turn Lane Length (ft)	
Speed Limit	35		Desirable	**125**
Cycle Length	0		Minimum	**125**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)				
Approach Percent Grade (G)	0			
Is this a Rural Arterial (Y or N)	N			

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	190	Speed Limit (mph)	35
Advancing Volume (vph)	200	No. of through lanes	1
Opposing Volume (vph)	300	Percent Heavy Vehicles (decimal percent)	0.02



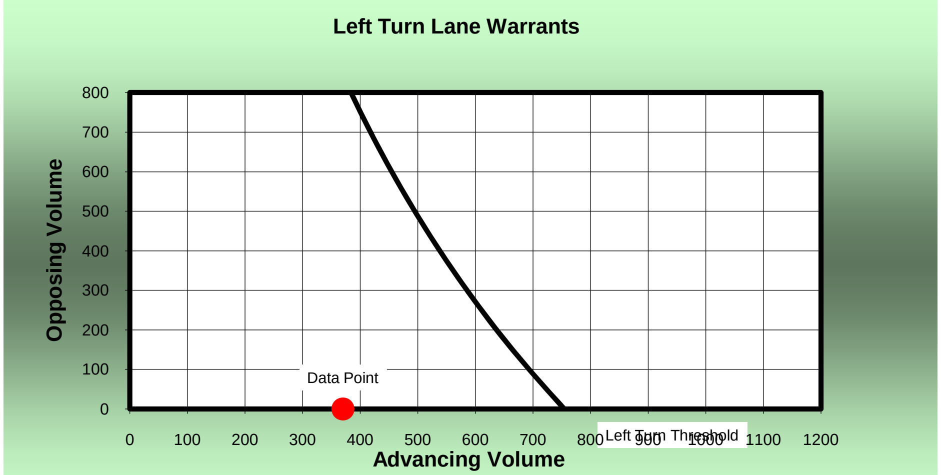
Left Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

<u>Input Fields</u>

Left Turn Volume (vph)	20	Speed Limit (mph)	35
Advancing Volume (vph)	370	No. of through lanes	2
Opposing Volume (vph)	0	Percent Heavy Vehicles (decimal percent)	0.02



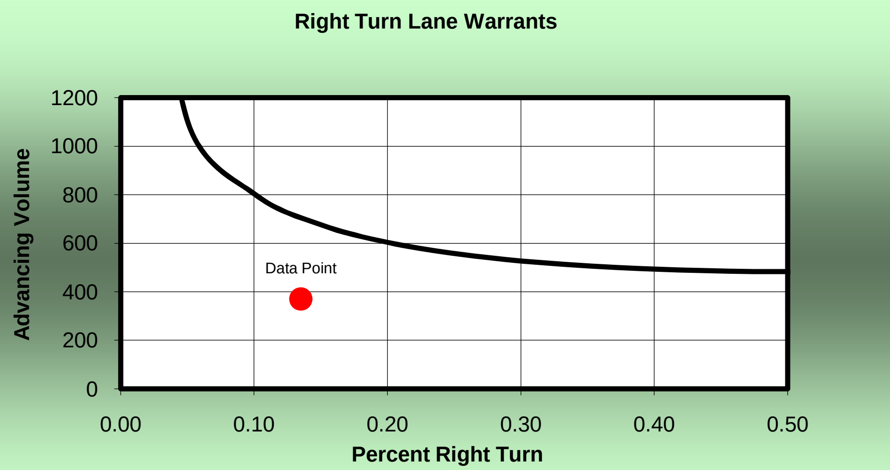
Left Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	50	Speed Limit (mph)	35
Advancing Volume (vph)	370		



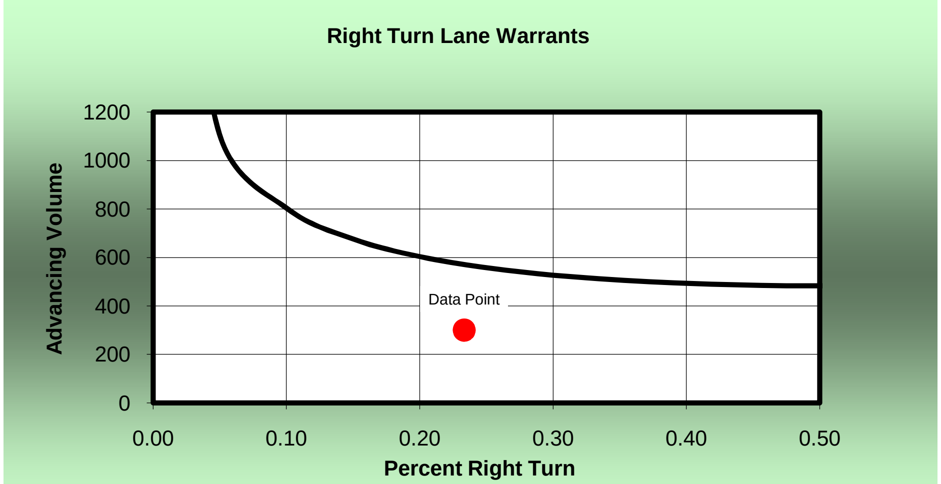
Right Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	70	Speed Limit (mph)	35
Advancing Volume (vph)	300		



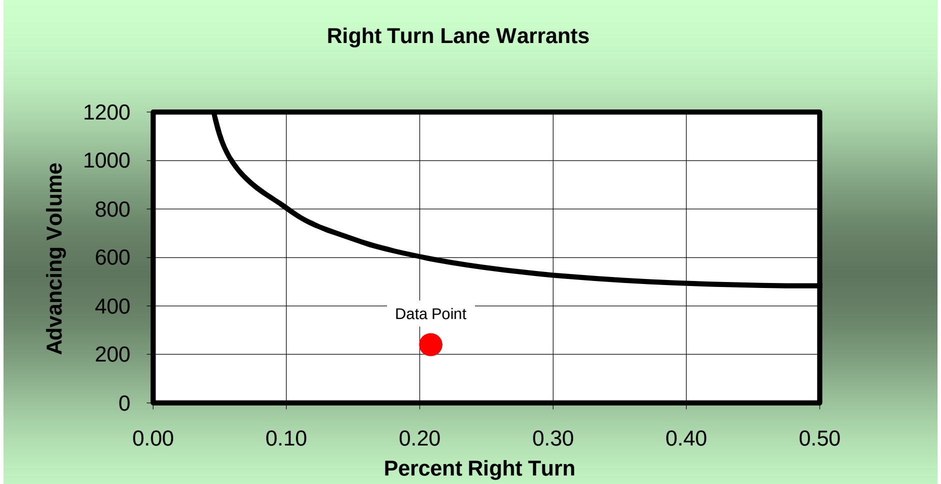
Right Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	50	Speed Limit (mph)	35
Advancing Volume (vph)	240		



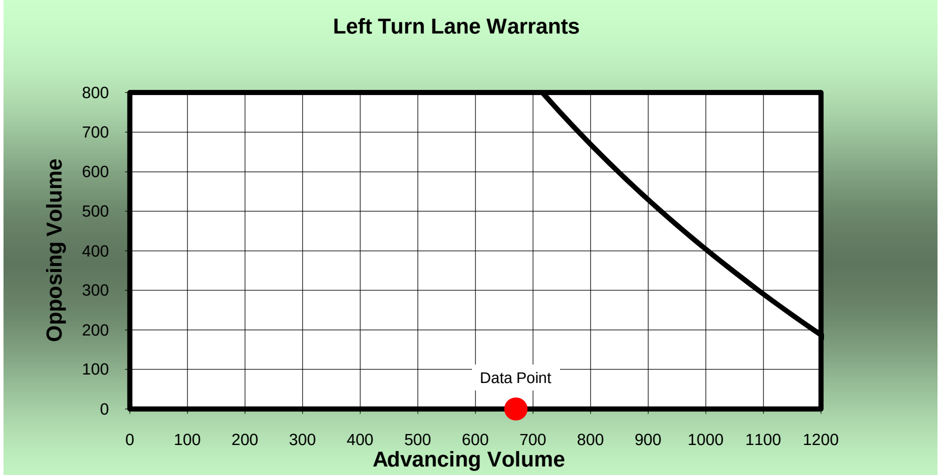
Right Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	10	Speed Limit (mph)	35
Advancing Volume (vph)	670	No. of through lanes	3
Opposing Volume (vph)	0	Percent Heavy Vehicles (decimal percent)	0.02



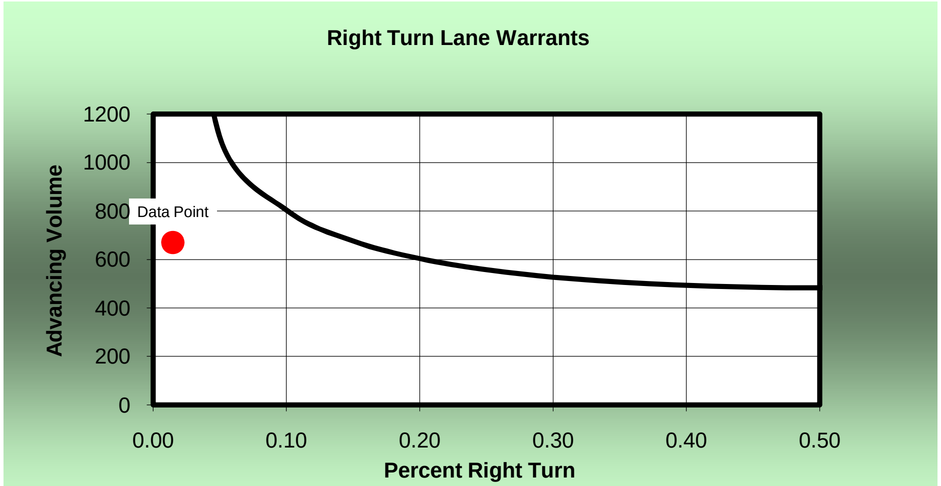
Left Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	10		35
Advancing Volume (vph)	670		



Right Turn Lane NOT Warranted

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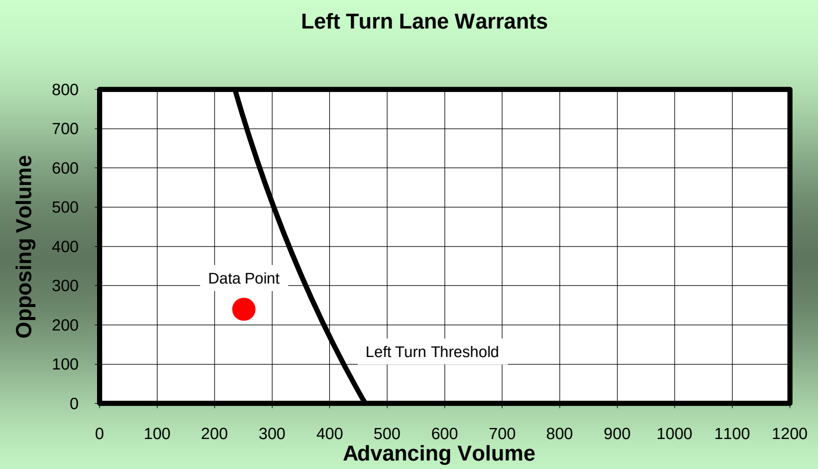
Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	210	Speed Limit (mph)	35
Advancing Volume (vph)	250	No. of through lanes	1
Opposing Volume (vph)	240	Percent Heavy Vehicles (decimal percent)	0.02



Left Turn Lane NOT Warranted

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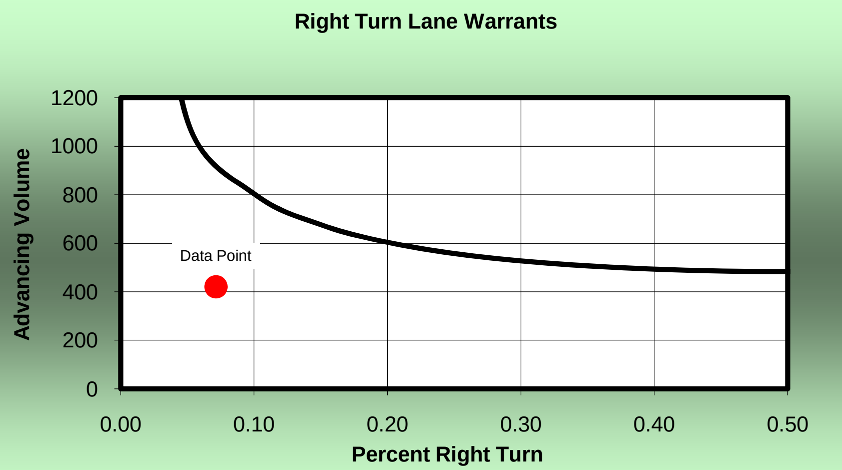
Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	30	Speed Limit (mph)	35
Advancing Volume (vph)	420		



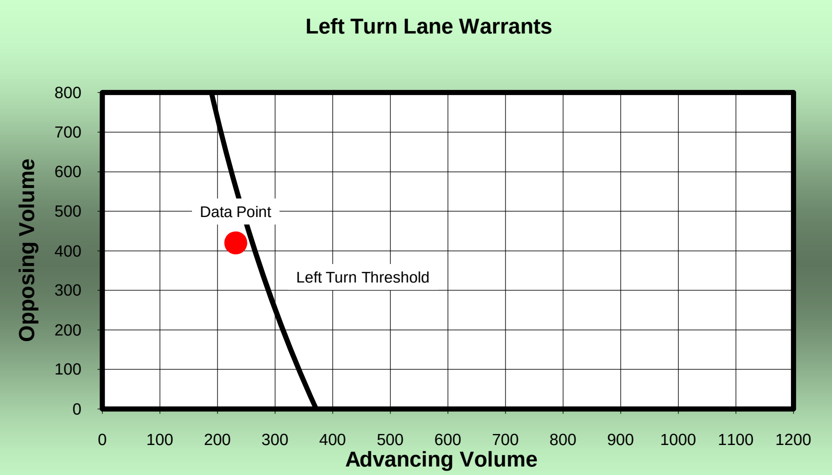
Right Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	70	Speed Limit (mph)	35
Advancing Volume (vph)	220	No. of through lanes	0
Opposing Volume (vph)	420	Percent Heavy Vehicles (decimal percent)	0.18



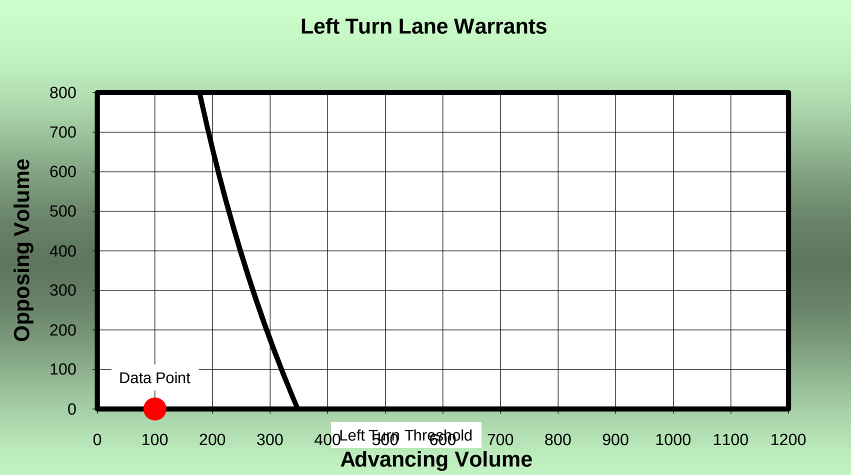
Left Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	60	Speed Limit (mph)	35
Advancing Volume (vph)	100	No. of through lanes	0
Opposing Volume (vph)	0	Percent Heavy Vehicles (decimal percent)	0.18



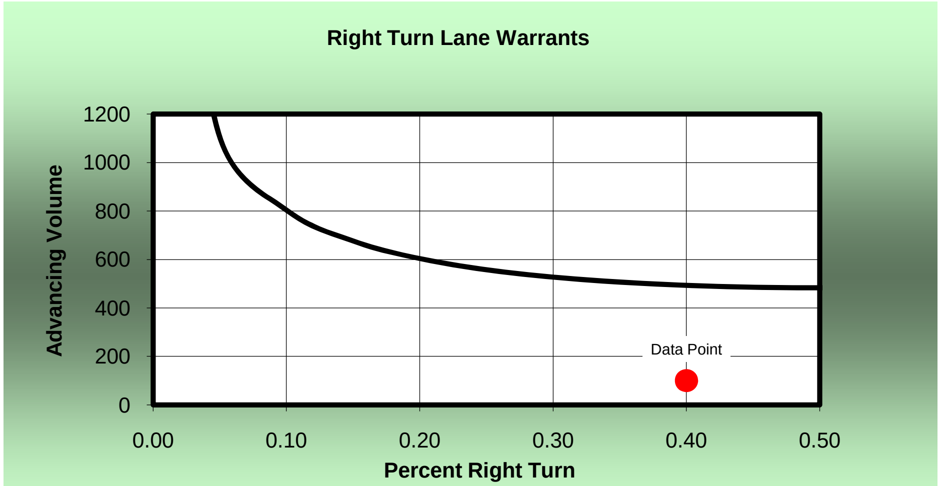
Left Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	40	Speed Limit (mph)	35
Advancing Volume (vph)	100		



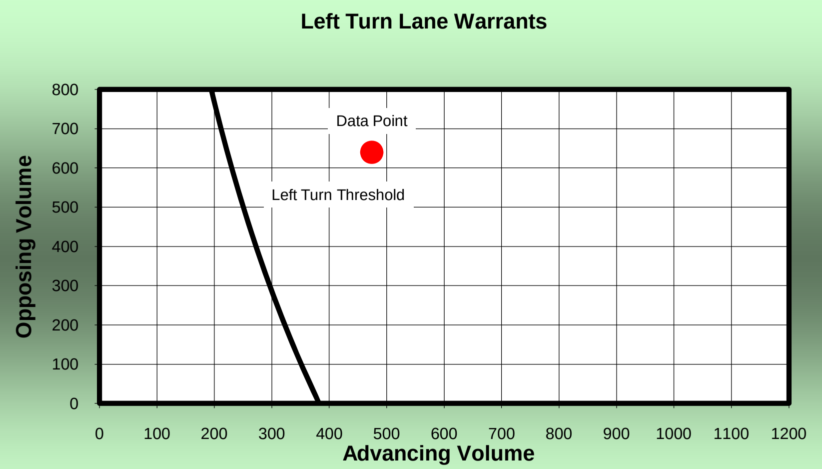
Right Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	130	Speed Limit (mph)	35
Advancing Volume (vph)	470	No. of through lanes	1
Opposing Volume (vph)	640	Percent Heavy Vehicles (decimal percent)	0.02



Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

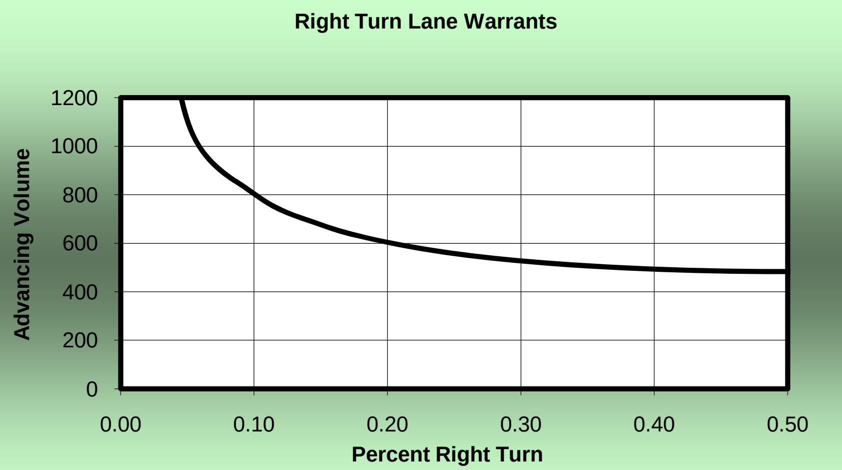
Turn Volume	130	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**150**
Cycle Length	60	Minimum	**125**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)			
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	520	Speed Limit (mph)	35
Advancing Volume (vph)	640		



Right Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

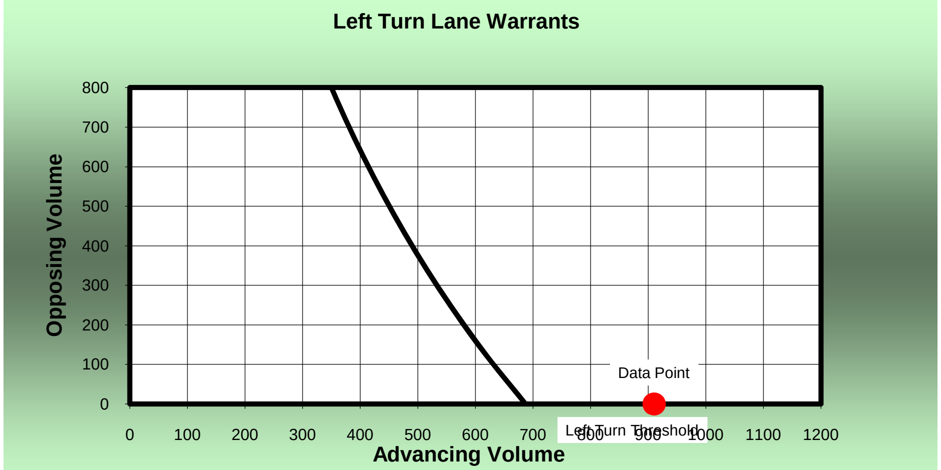
Turn Volume	520	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**475**
Cycle Length	60	Minimum	**375**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)			
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	60	Speed Limit (mph)	35
Advancing Volume (vph)	910	No. of through lanes	2
Opposing Volume (vph)	0	Percent Heavy Vehicles (decimal percent)	0.02



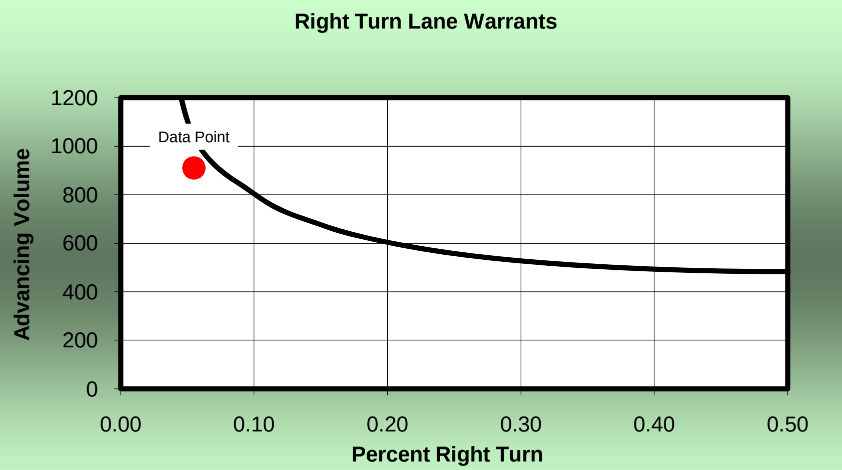
Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	50	Speed Limit (mph)	35
Advancing Volume (vph)	910		



Right Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

Input Fields

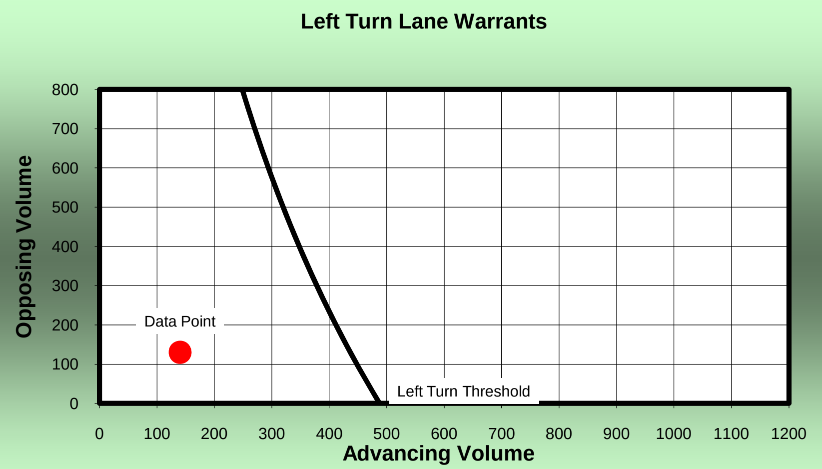
Turn Volume	60	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**125**
Cycle Length *(Enter 0 for Uncontrolled, 60 for Stop Controlled)*	60	Minimum	**125**
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	20	Speed Limit (mph)	35
Advancing Volume (vph)	140	No. of through lanes	1
Opposing Volume (vph)	130	Percent Heavy Vehicles (decimal percent)	0.02



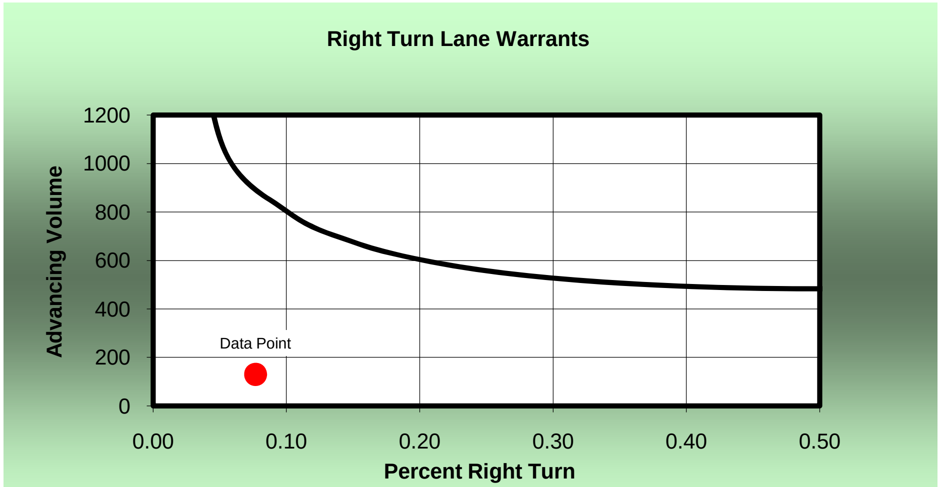
Left Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	10	Speed Limit (mph)	35
Advancing Volume (vph)	130		



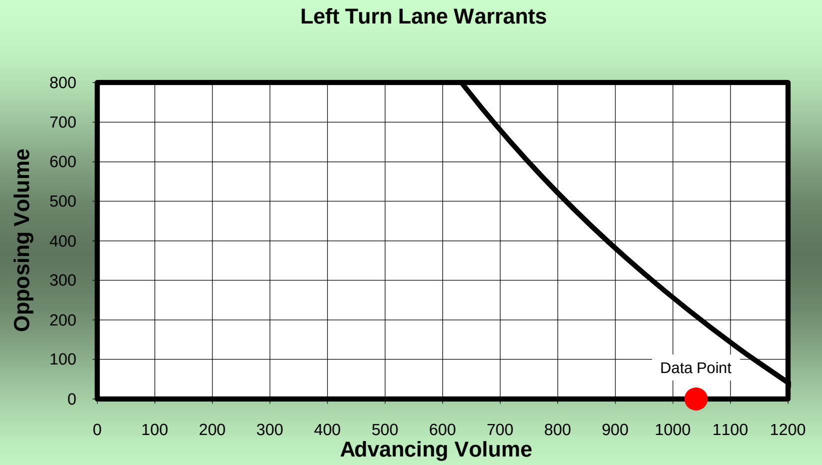
Right Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	20	Speed Limit (mph)	35
Advancing Volume (vph)	1040	No. of through lanes	2
Opposing Volume (vph)	0	Percent Heavy Vehicles (decimal percent)	0.02



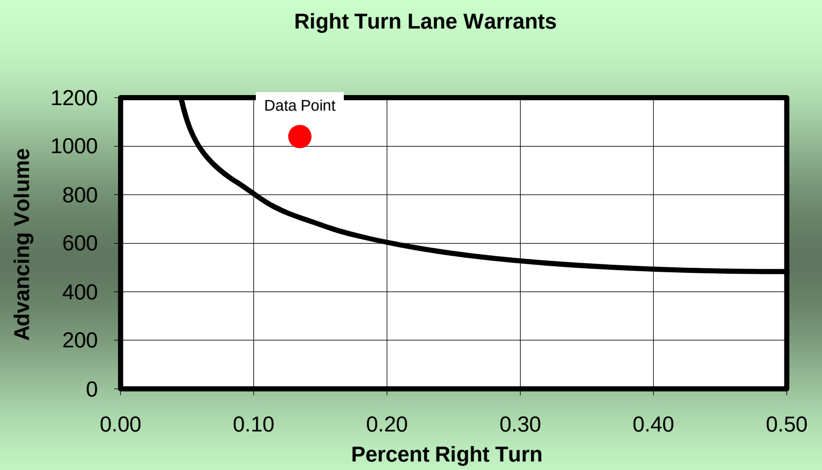
Left Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	140	Speed Limit (mph)	35
Advancing Volume (vph)	1040		



Right Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

Input Fields

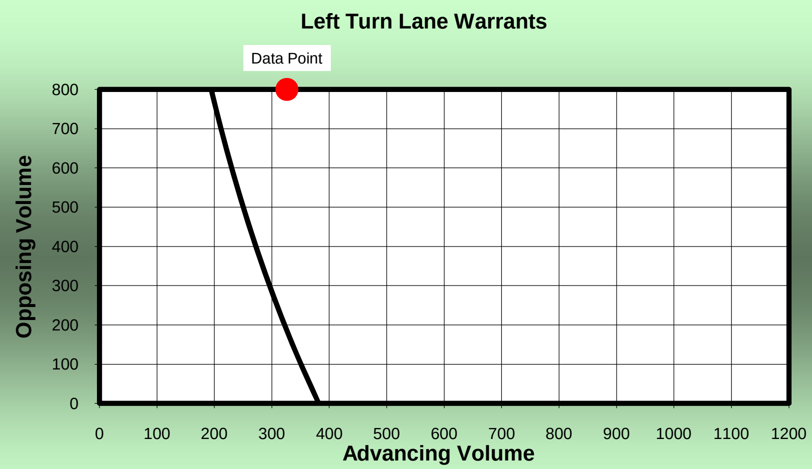
Input	Value		Calculated Turn Lane Length (ft)	
Turn Volume	140			
Speed Limit	35		Desirable	**175**
Cycle Length *(Enter 0 for Uncontrolled, 60 for Stop Controlled)*	60		Minimum	**150**
Approach Percent Grade (G)	0			
Is this a Rural Arterial (Y or N)	N			

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	90	Speed Limit (mph)	35
Advancing Volume (vph)	320	No. of through lanes	1
Opposing Volume (vph)	1410	Percent Heavy Vehicles (decimal percent)	0.02



Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

Input Fields

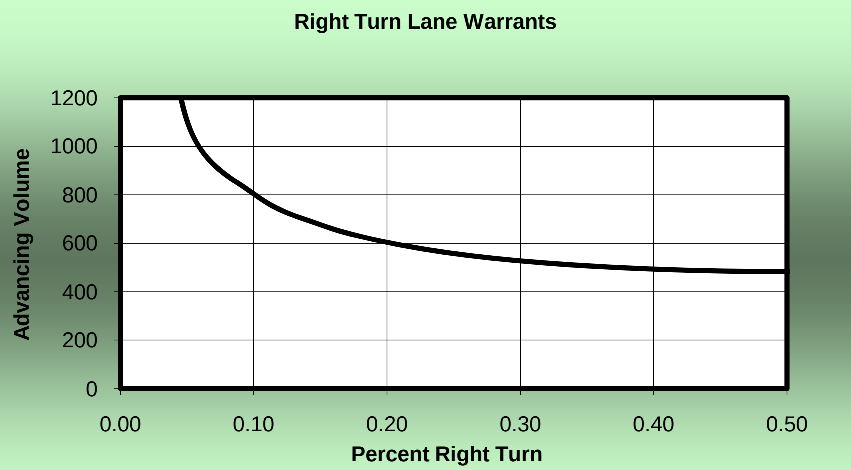
Turn Volume	90	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**125**
Cycle Length *(Enter 0 for Uncontrolled, 60 for Stop Controlled)*	60	Minimum	**125**
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	300	Speed Limit (mph)	35
Advancing Volume (vph)	1410		



Right Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

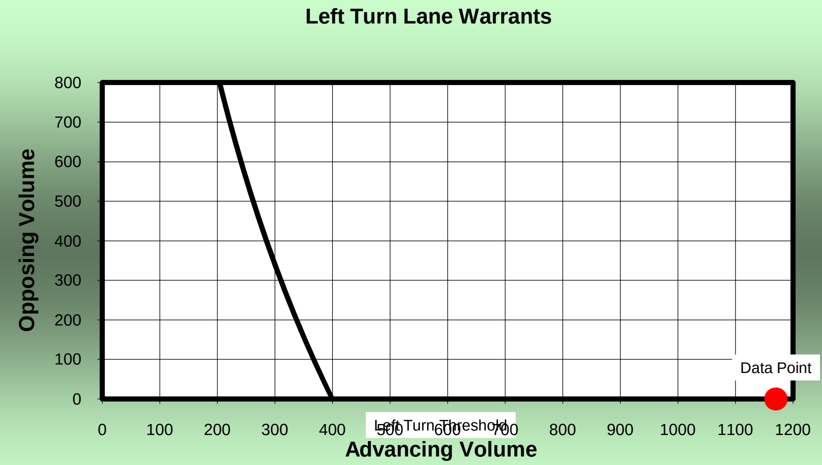
Turn Volume	300	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**300**
Cycle Length	60	Minimum	**250**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)			
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	280	Speed Limit (mph)	35
Advancing Volume (vph)	1170	No. of through lanes	2
Opposing Volume (vph)	0	Percent Heavy Vehicles (decimal percent)	0.02



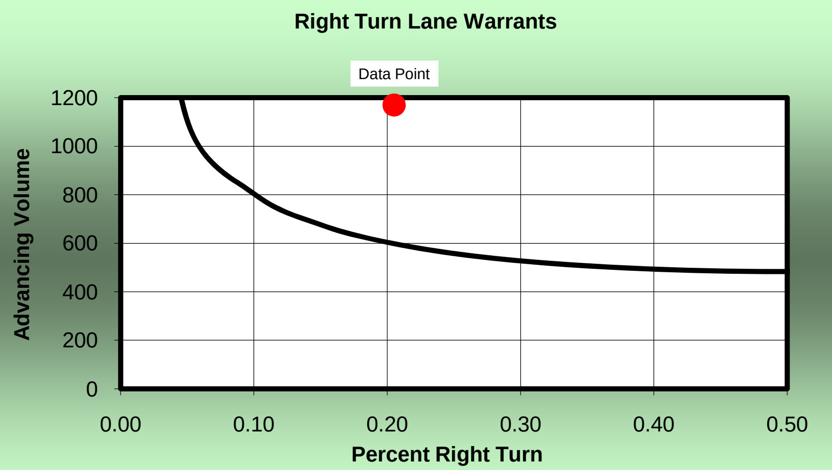
Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	240	Speed Limit (mph)	35
Advancing Volume (vph)	1170		



Right Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

Turn Volume	280	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**275**
Cycle Length	60	Minimum	**225**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)			
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

Input Fields

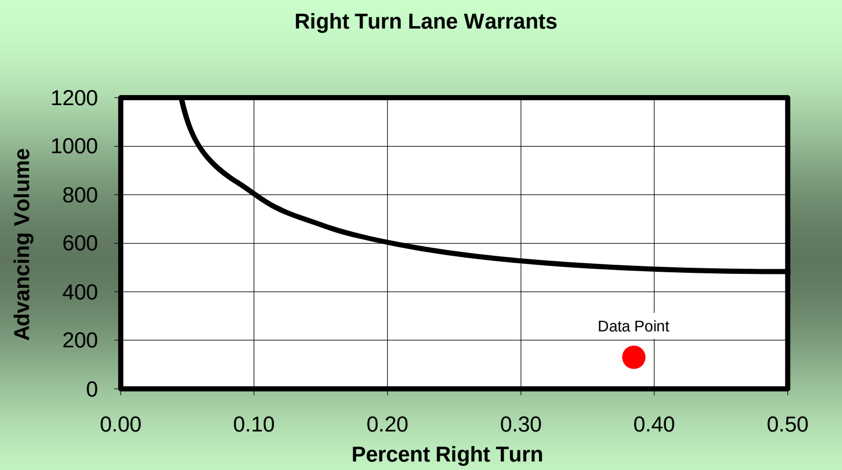
Turn Volume	240	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**125**
Cycle Length	0	Minimum	**125**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)			
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	50	Speed Limit (mph)	35
Advancing Volume (vph)	130		



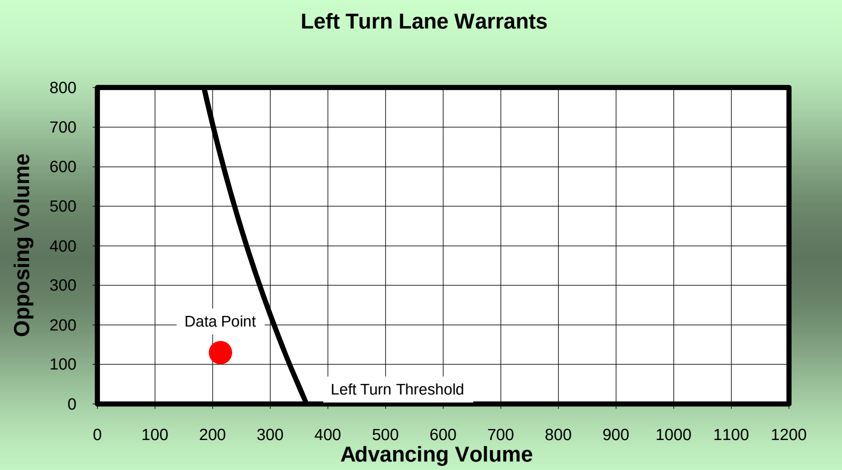
Right Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	70	Speed Limit (mph)	35
Advancing Volume (vph)	210	No. of through lanes	1
Opposing Volume (vph)	130	Percent Heavy Vehicles (decimal percent)	0.18



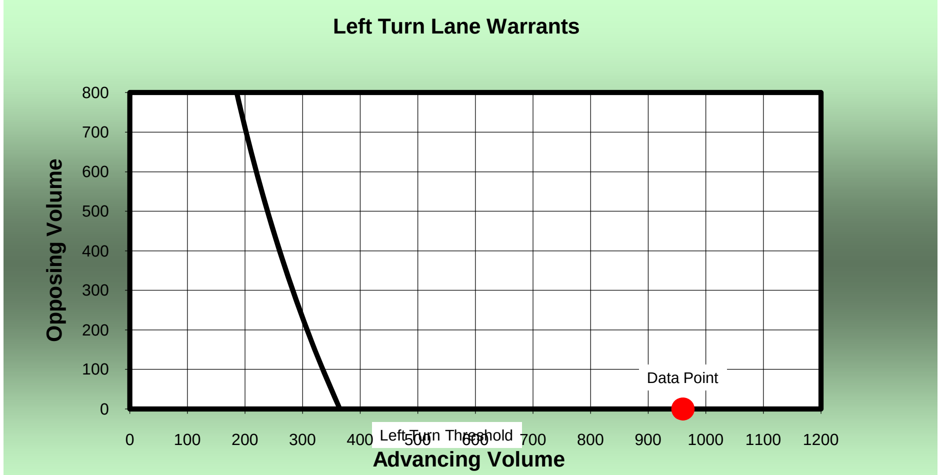
Left Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	310	Speed Limit (mph)	35
Advancing Volume (vph)	960	No. of through lanes	2
Opposing Volume (vph)	0	Percent Heavy Vehicles (decimal percent)	0.02



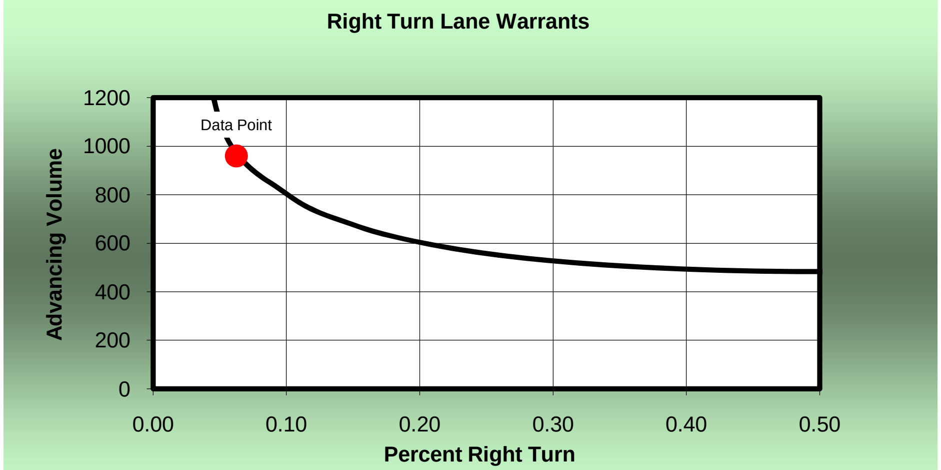
Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	60	Speed Limit (mph)	35
Advancing Volume (vph)	960		



Right Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

Turn Volume	310	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**300**
Cycle Length	60	Minimum	**250**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)			
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

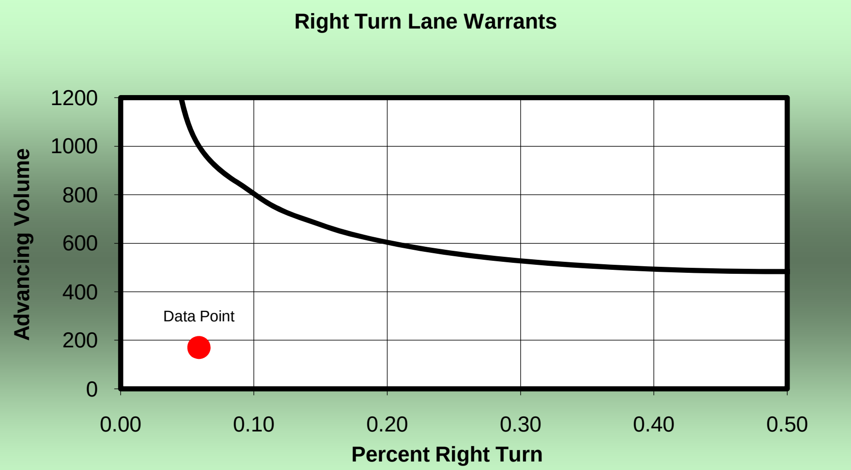
Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph) 10

Speed Limit (mph) 35

Advancing Volume (vph) 170



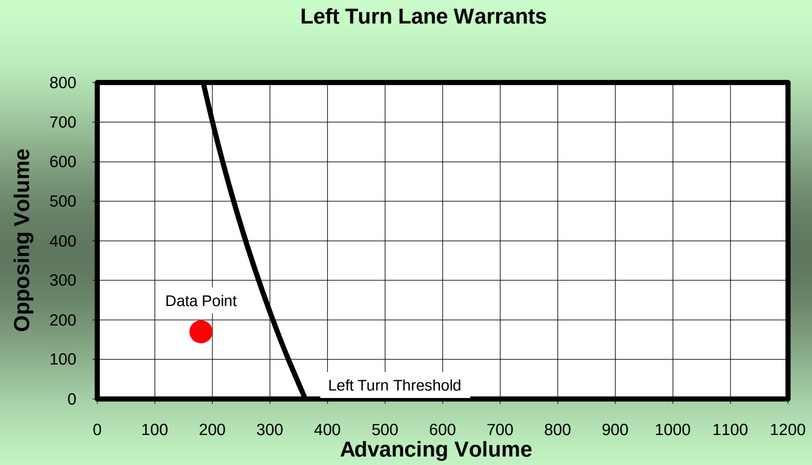
Right Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	120	Speed Limit (mph)	35
Advancing Volume (vph)	180	No. of through lanes	1
Opposing Volume (vph)	170	Percent Heavy Vehicles (decimal percent)	0.02



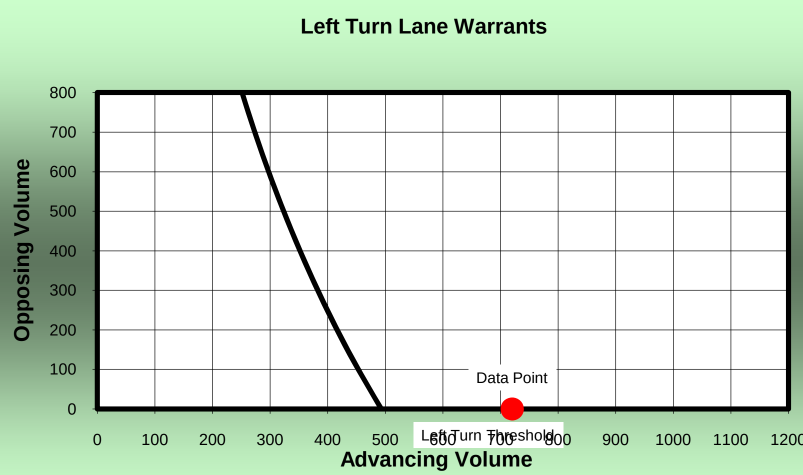
Left Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	100	Speed Limit (mph)	35
Advancing Volume (vph)	720	No. of through lanes	2
Opposing Volume (vph)	0	Percent Heavy Vehicles (decimal percent)	0.02



Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	10	Speed Limit (mph)	35
Advancing Volume (vph)	720		

Right Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

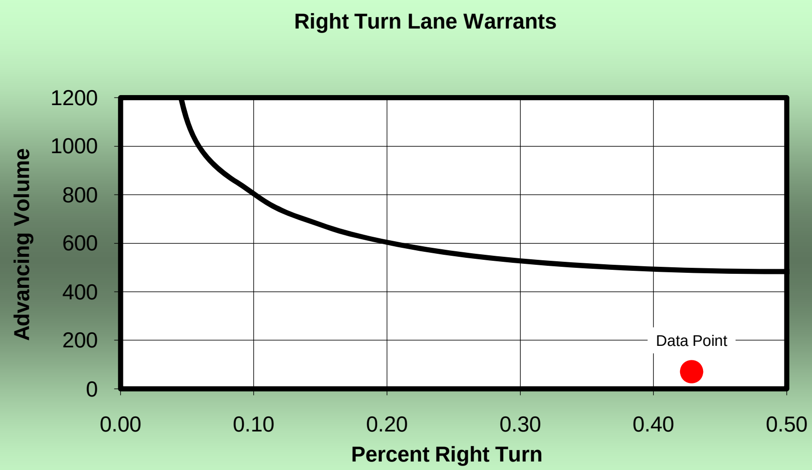
Turn Volume	100	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**125**
Cycle Length	0	Minimum	**125**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)			
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	30	Speed Limit (mph)	35
Advancing Volume (vph)	70		



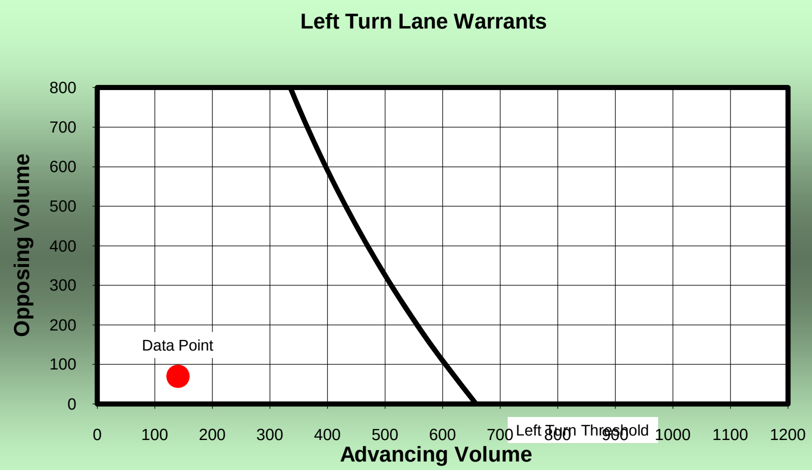
Right Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	130	Speed Limit (mph)	35
Advancing Volume (vph)	140	No. of through lanes	1
Opposing Volume (vph)	70	Percent Heavy Vehicles (decimal percent)	0.02



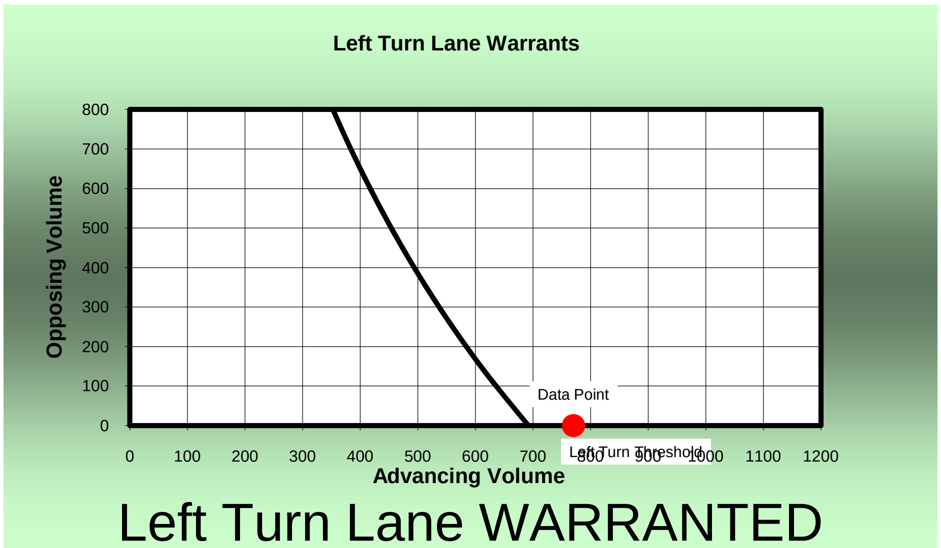
Left Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	50	Speed Limit (mph)	35
Advancing Volume (vph)	770	No. of through lanes	2
Opposing Volume (vph)	0	Percent Heavy Vehicles (decimal percent)	0.02

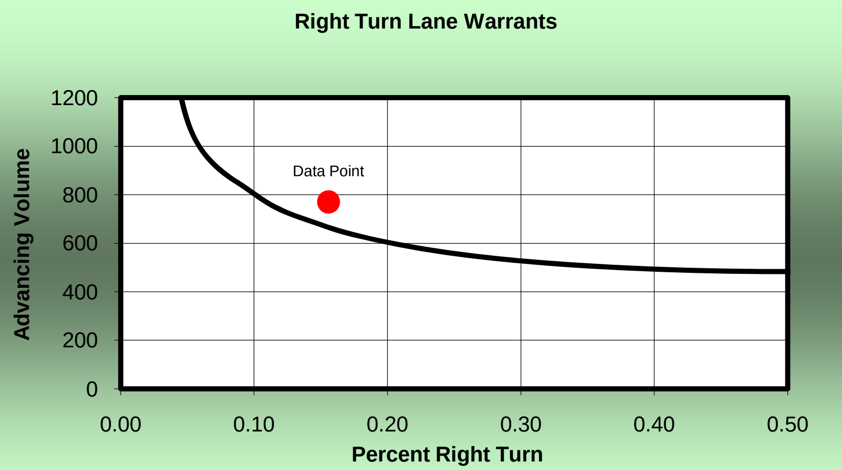


Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	120	Speed Limit (mph)	35
Advancing Volume (vph)	770		



Right Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

Input Fields

Turn Volume	50	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**125**
Cycle Length *(Enter 0 for Uncontrolled, 60 for Stop Controlled)*	60	Minimum	**125**
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

Input Fields

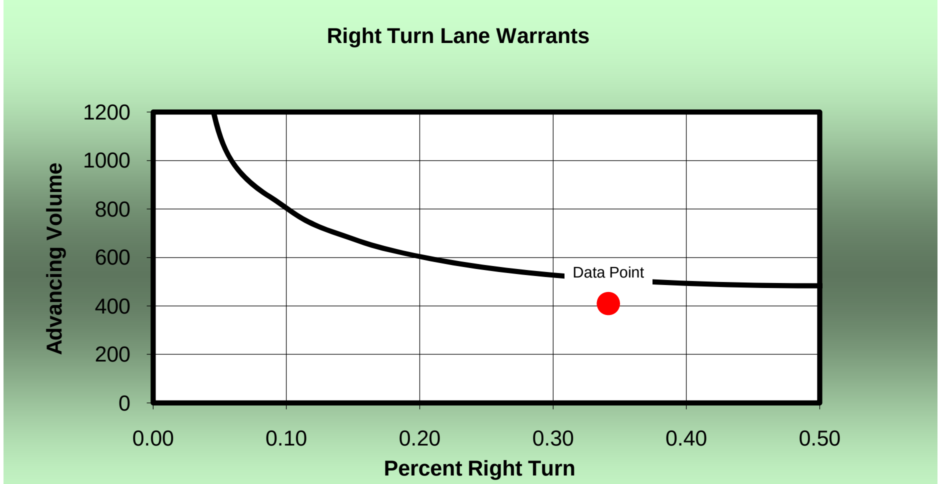
Turn Volume	120	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**150**
Cycle Length *(Enter 0 for Uncontrolled, 60 for Stop Controlled)*	60	Minimum	**125**
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	140	Speed Limit (mph)	35
Advancing Volume (vph)	410		



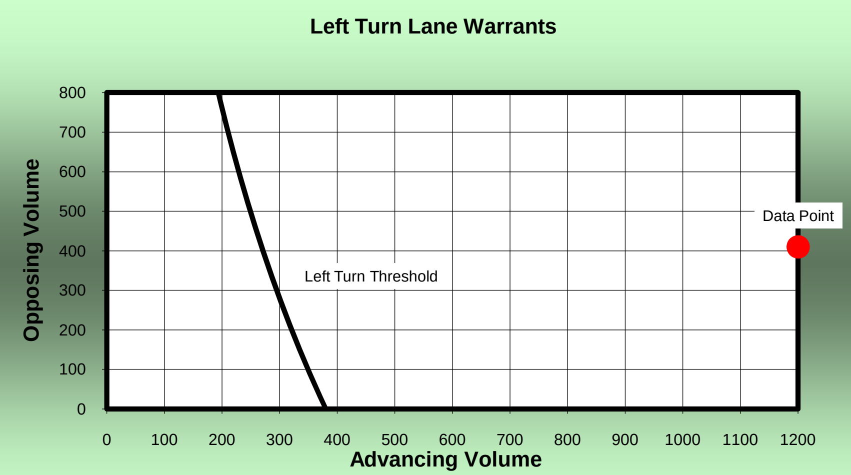
Right Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	390	Speed Limit (mph)	35
Advancing Volume (vph)	1390	No. of through lanes	1
Opposing Volume (vph)	410	Percent Heavy Vehicles (decimal percent)	0.02



Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

Input Fields

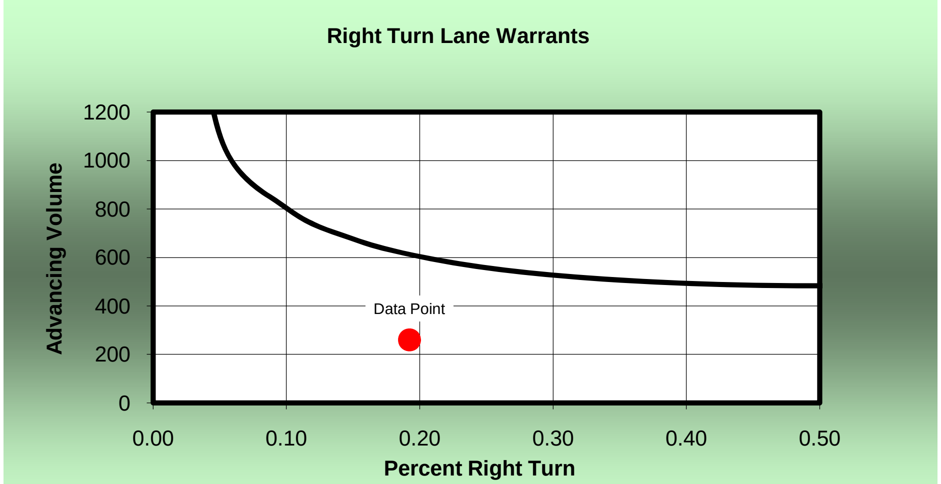
Turn Volume	390	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**375**
Cycle Length	60	Minimum	**300**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)			
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	50	Speed Limit (mph)	35
Advancing Volume (vph)	260		



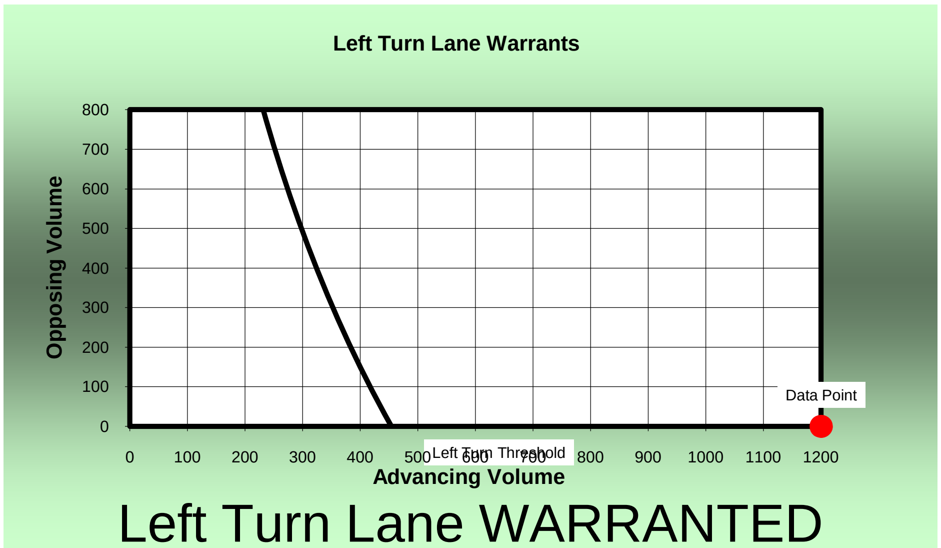
Right Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	260	Speed Limit (mph)	35
Advancing Volume (vph)	1530	No. of through lanes	3
Opposing Volume (vph)	0	Percent Heavy Vehicles (decimal percent)	0.02

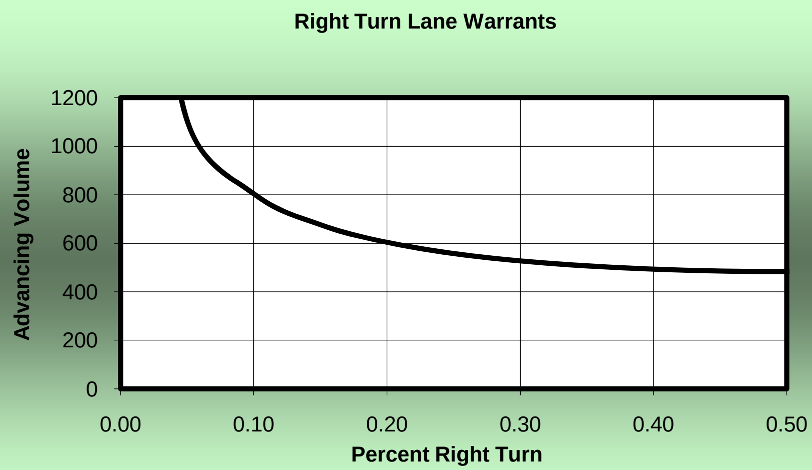


Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	580	Speed Limit (mph)	35
Advancing Volume (vph)	1530		



Right Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

Input	Value
Turn Volume	260
Speed Limit	35
Cycle Length *(Enter 0 for Uncontrolled, 60 for Stop Controlled)*	60
Approach Percent Grade (G)	0
Is this a Rural Arterial (Y or N)	N

Calculated Turn Lane Length (ft)

Desirable	**275**
Minimum	**225**

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

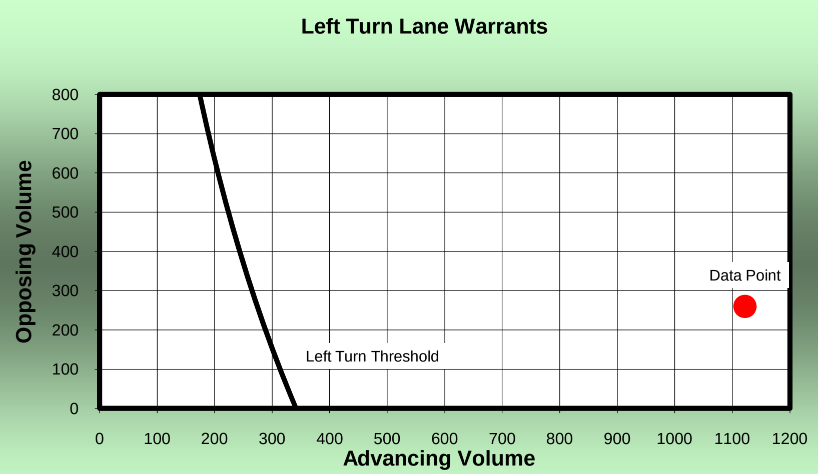
Turn Volume	580	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**525**
Cycle Length	60	Minimum	**425**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)			
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

<u>Input Fields</u>

Left Turn Volume (vph)	530	Speed Limit (mph)	35
Advancing Volume (vph)	1120	No. of through lanes	2
Opposing Volume (vph)	260	Percent Heavy Vehicles (decimal percent)	0.02



Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

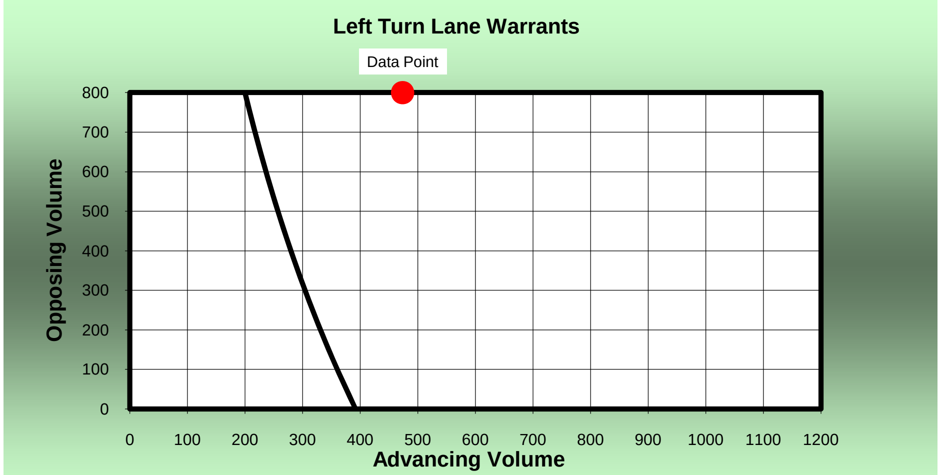
Turn Volume	530	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**500**
Cycle Length	60	Minimum	**375**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)			
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

<u>Input Fields</u>

Left Turn Volume (vph)	120	Speed Limit (mph)	35
Advancing Volume (vph)	470	No. of through lanes	2
Opposing Volume (vph)	1090	Percent Heavy Vehicles (decimal percent)	0.02



Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

Input	Value
Turn Volume	120
Speed Limit	35
Cycle Length *(Enter 0 for Uncontrolled, 60 for Stop Controlled)*	60
Approach Percent Grade (G)	0
Is this a Rural Arterial (Y or N)	N

Calculated Turn Lane Length (ft)

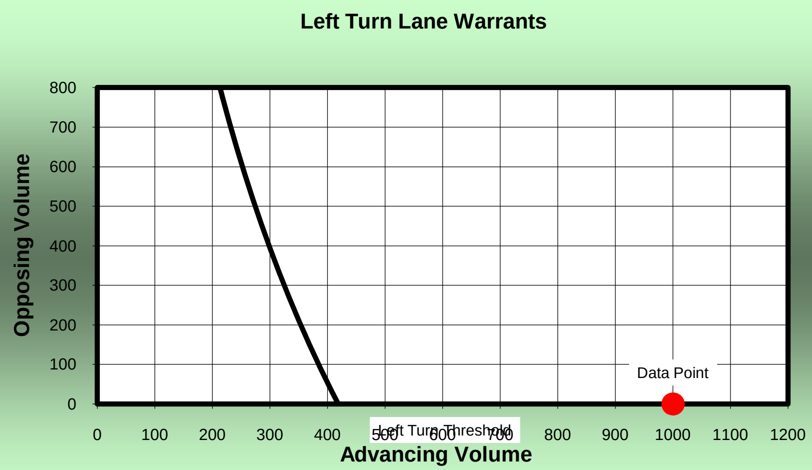
Desirable	**150**
Minimum	**125**

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

<u>Input Fields</u>

Left Turn Volume (vph)	210	Speed Limit (mph)	35
Advancing Volume (vph)	1000	No. of through lanes	3
Opposing Volume (vph)	0	Percent Heavy Vehicles (decimal percent)	0.02



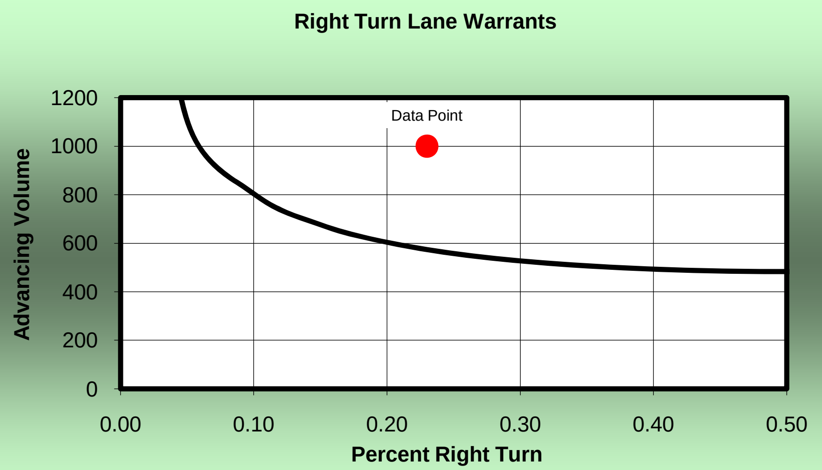
Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	230	Speed Limit (mph)	35
Advancing Volume (vph)	1000		



Right Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

Turn Volume	210	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**225**
Cycle Length *(Enter 0 for Uncontrolled, 60 for Stop Controlled)*	60	Minimum	**175**
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

Input Fields

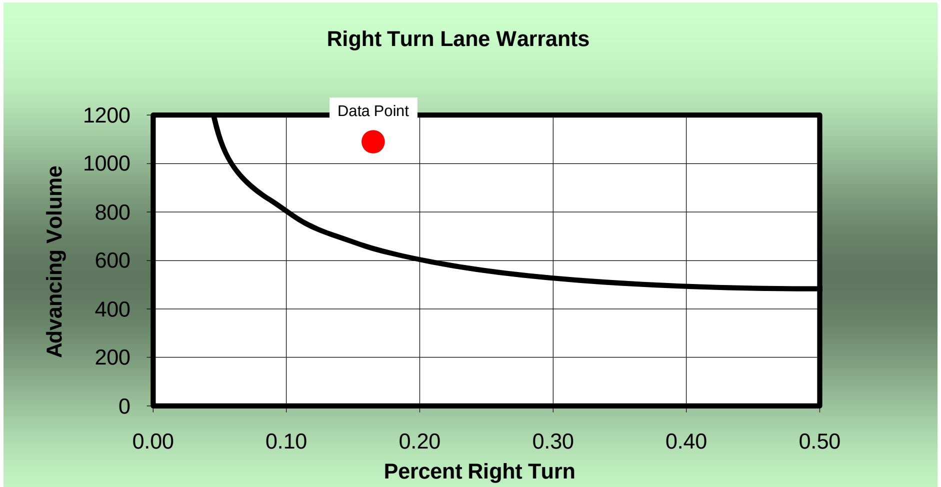
Input	Value		Calculated Turn Lane Length (ft)	
Turn Volume	230			
Speed Limit	35		Desirable	**250**
Cycle Length *(Enter 0 for Uncontrolled, 60 for Stop Controlled)*	60		Minimum	**200**
Approach Percent Grade (G)	0			
Is this a Rural Arterial (Y or N)	N			

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	180	Speed Limit (mph)	35
Advancing Volume (vph)	1090		



Right Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

Input Fields

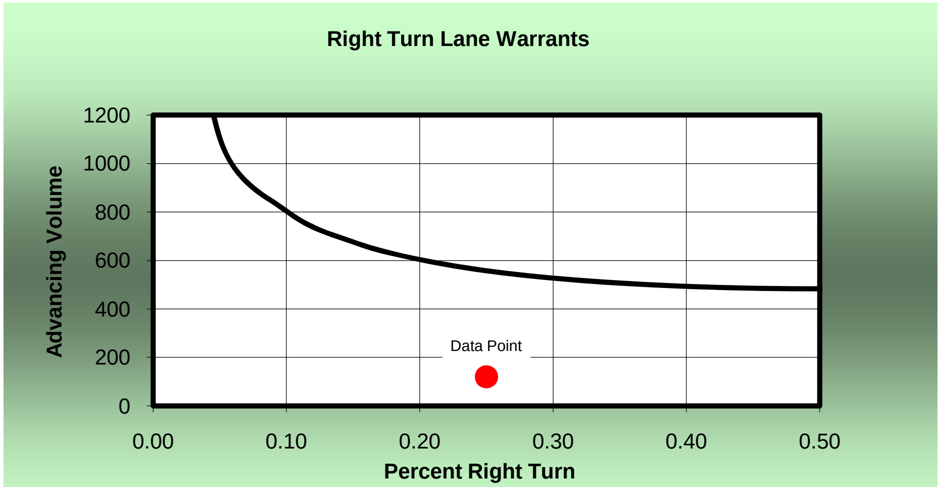
Turn Volume	180	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**200**
Cycle Length	60	Minimum	**175**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)			
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	30	Speed Limit (mph)	35
Advancing Volume (vph)	120		



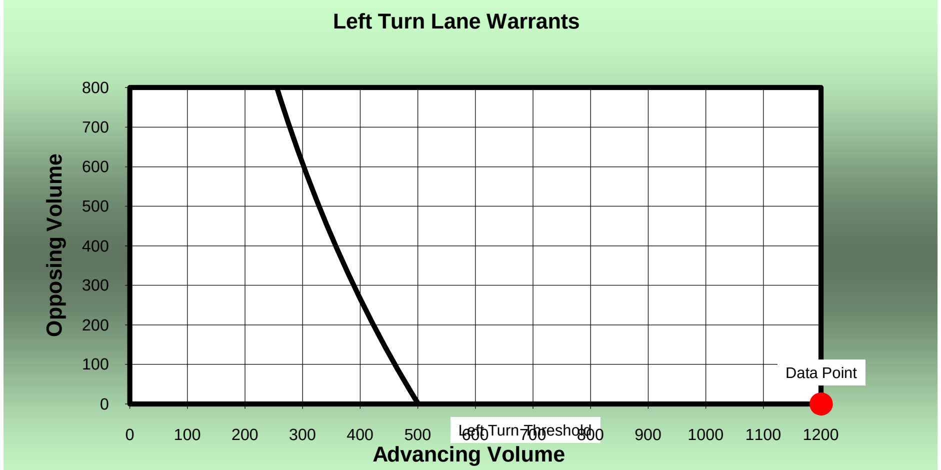
Right Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	170	Speed Limit (mph)	35
Advancing Volume (vph)	1270	No. of through lanes	1
Opposing Volume (vph)	0	Percent Heavy Vehicles (decimal percent)	0.02



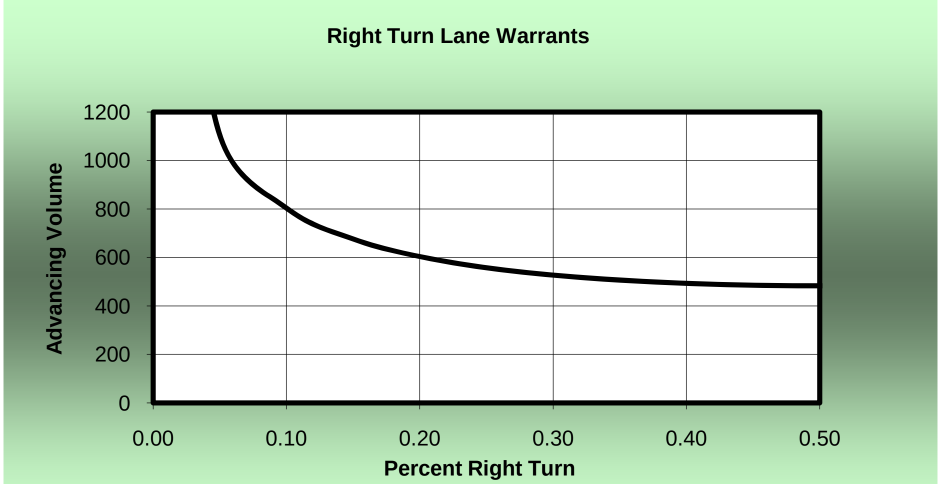
Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	40	Speed Limit (mph)	35
Advancing Volume (vph)	1270		



Right Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

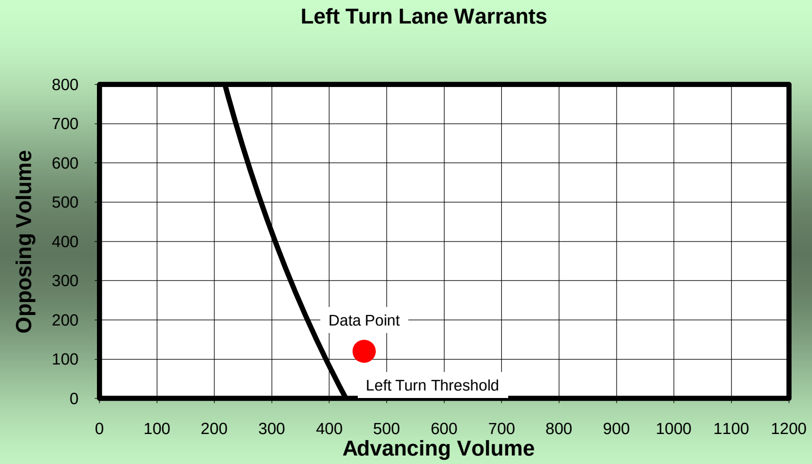
Turn Volume	170	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**200**
Cycle Length *(Enter 0 for Uncontrolled, 60 for Stop Controlled)*	60	Minimum	**150**
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	370	Speed Limit (mph)	35
Advancing Volume (vph)	460	No. of through lanes	1
Opposing Volume (vph)	120	Percent Heavy Vehicles (decimal percent)	0.02



Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

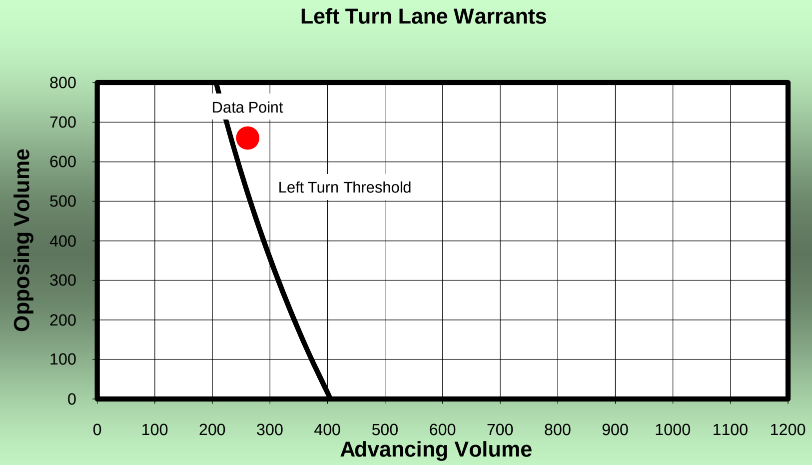
Turn Volume	370	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**350**
Cycle Length	60	Minimum	**275**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)			
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	60	Speed Limit (mph)	35
Advancing Volume (vph)	260	No. of through lanes	2
Opposing Volume (vph)	660	Percent Heavy Vehicles (decimal percent)	0.02



Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

Turn Volume	60	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**125**
Cycle Length *(Enter 0 for Uncontrolled, 60 for Stop Controlled)*	60	Minimum	**125**
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

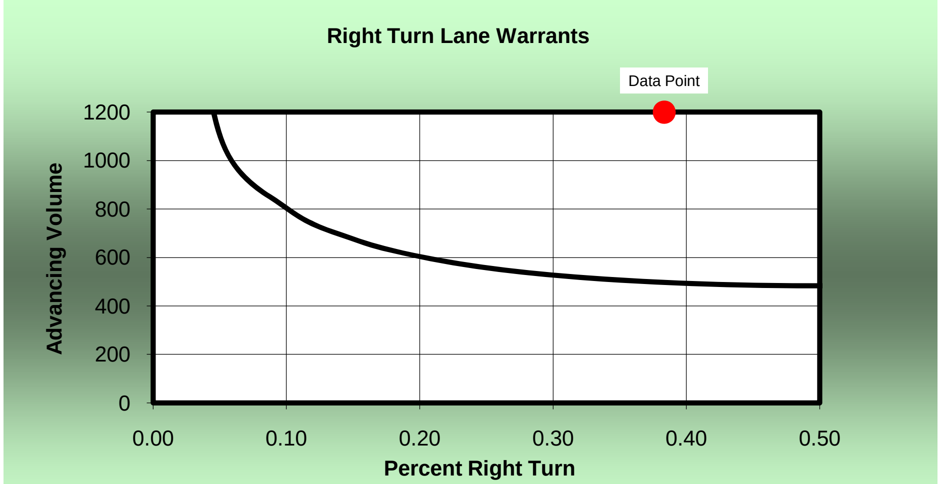
Left Turn Volume (vph)	70	Speed Limit (mph)	35
Advancing Volume (vph)	1200	No. of through lanes	3
Opposing Volume (vph)	0	Percent Heavy Vehicles (decimal percent)	0.02

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	460	Speed Limit (mph)	35
Advancing Volume (vph)	1200		



Right Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

Input Fields

Turn Volume	70	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**125**
Cycle Length	60	Minimum	**125**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)			
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

Input Fields

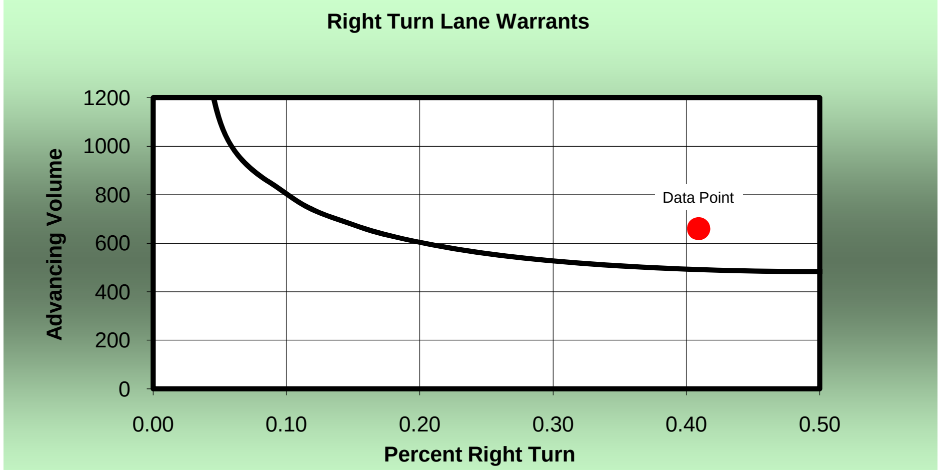
Turn Volume	460		Calculated Turn Lane Length (ft)	
Speed Limit	35		Desirable	**425**
Cycle Length	60		Minimum	**350**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)				
Approach Percent Grade (G)	0			
Is this a Rural Arterial (Y or N)	N			

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

<u>Input Fields</u>

Right Turn Volume (vph)	270	Speed Limit (mph)	35
Advancing Volume (vph)	660		



Right Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

Input Fields

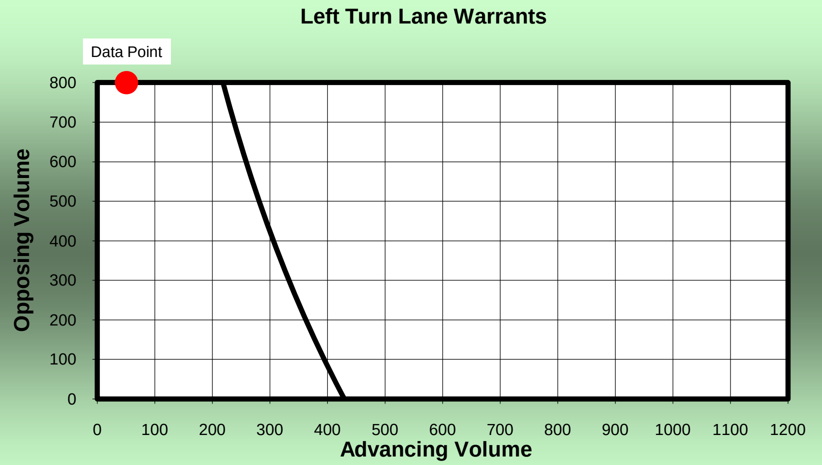
Turn Volume	270	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**275**
Cycle Length *(Enter 0 for Uncontrolled, 60 for Stop Controlled)*	60	Minimum	**225**
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	10	Speed Limit (mph)	35
Advancing Volume (vph)	50	No. of through lanes	1
Opposing Volume (vph)	1240	Percent Heavy Vehicles (decimal percent)	0.02



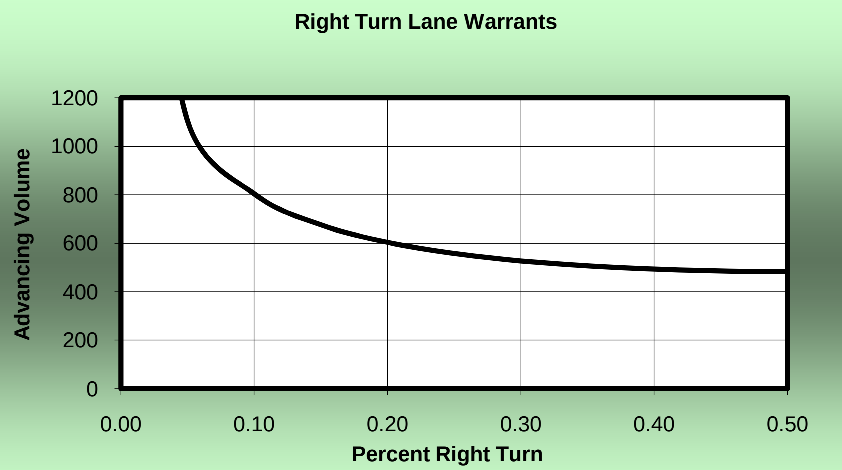
Left Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	30	Speed Limit (mph)	35
Advancing Volume (vph)	50		



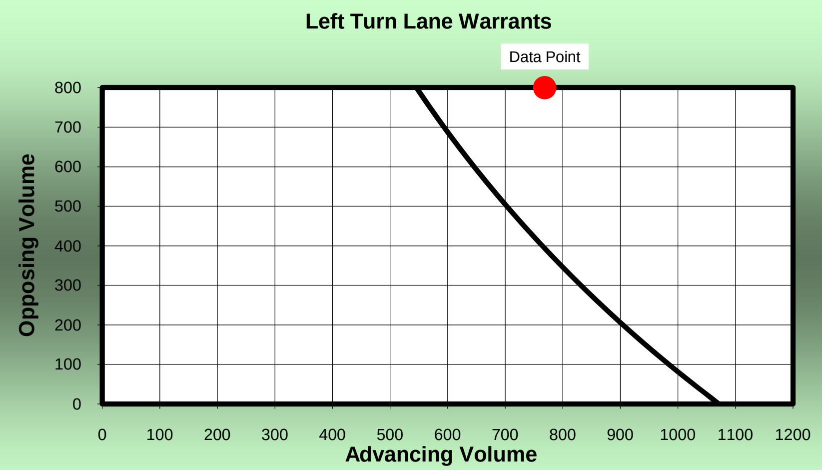
Right Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	20	Speed Limit (mph)	35
Advancing Volume (vph)	760	No. of through lanes	2
Opposing Volume (vph)	1600	Percent Heavy Vehicles (decimal percent)	0.02



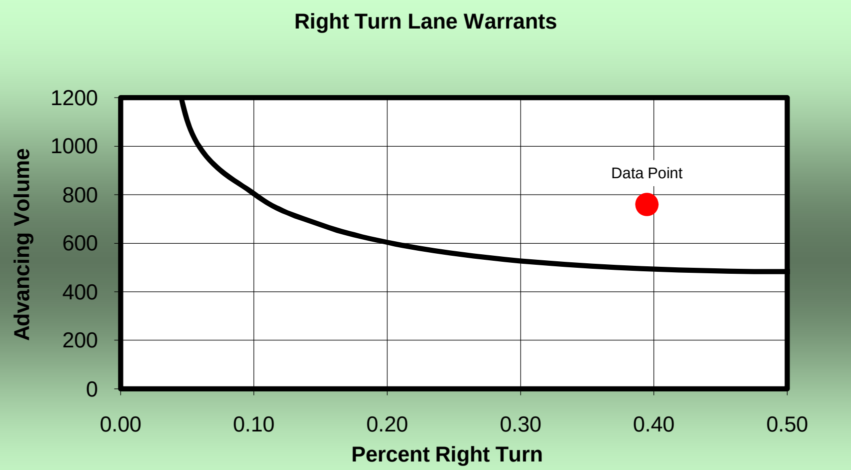
Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	300	Speed Limit (mph)	35
Advancing Volume (vph)	760		



Right Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

Input Fields

Turn Volume	20	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**125**
Cycle Length *(Enter 0 for Uncontrolled, 60 for Stop Controlled)*	100	Minimum	**125**
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

Input Fields

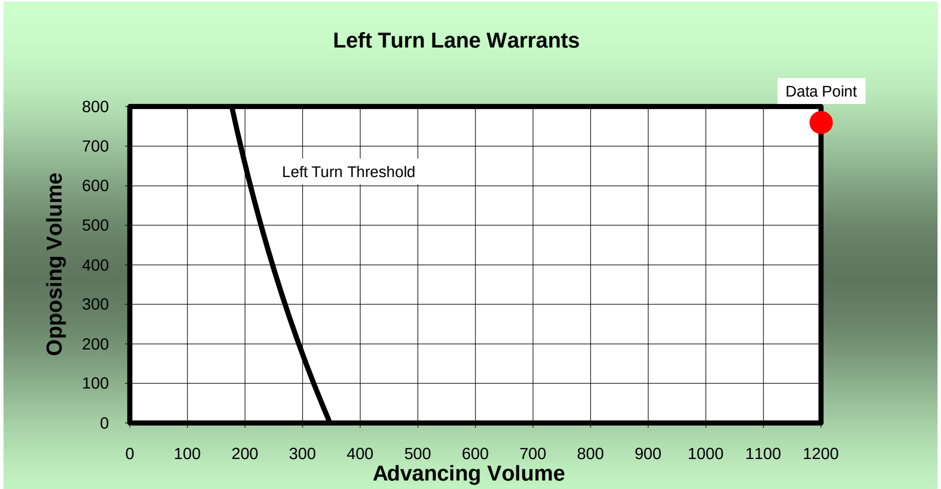
Turn Volume	300	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**475**
Cycle Length *(Enter 0 for Uncontrolled, 60 for Stop Controlled)*	100	Minimum	**375**
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	650	Speed Limit (mph)	35
Advancing Volume (vph)	1600	No. of through lanes	2
Opposing Volume (vph)	760	Percent Heavy Vehicles (decimal percent)	0.02



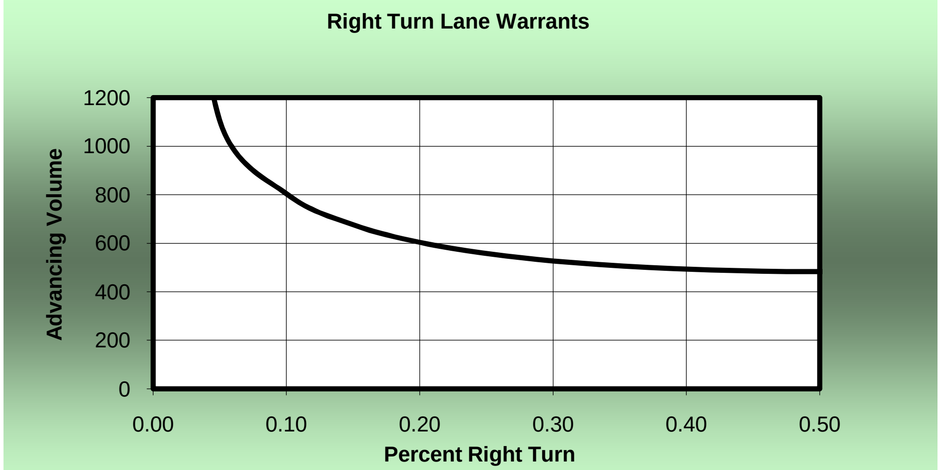
Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	20	Speed Limit (mph)	35
Advancing Volume (vph)	1600		



Right Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

Turn Volume	650	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**950**
Cycle Length	100	Minimum	**725**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)			
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

<u>Input Fields</u>

Left Turn Volume (vph)	380	Speed Limit (mph)	35
Advancing Volume (vph)	1240	No. of through lanes	1
Opposing Volume (vph)	50	Percent Heavy Vehicles (decimal percent)	0.02

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

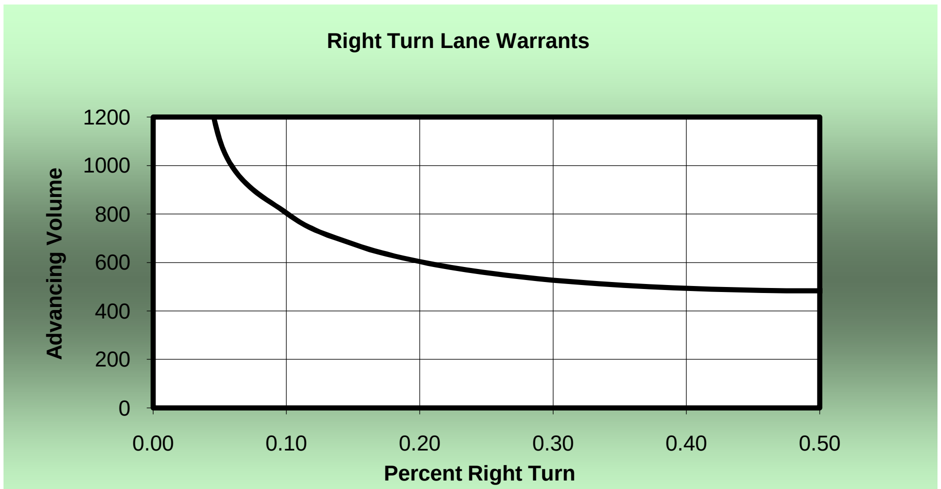
Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph) 830

Speed Limit (mph) 35

Advancing Volume (vph) 1240



Right Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

Input Fields

Turn Volume	380	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**575**
Cycle Length	100	Minimum	**450**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)			
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

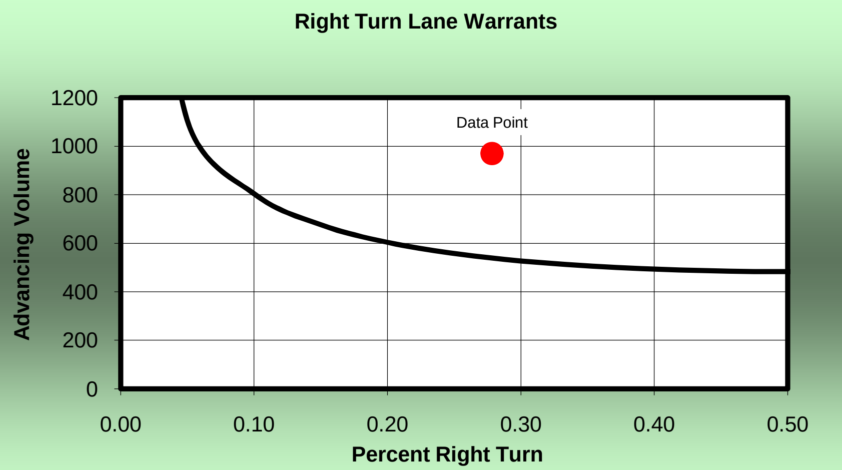
Turn Volume	830	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**1200**
Cycle Length	100	Minimum	**925**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)			
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	270	Speed Limit (mph)	35
Advancing Volume (vph)	970		



Right Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

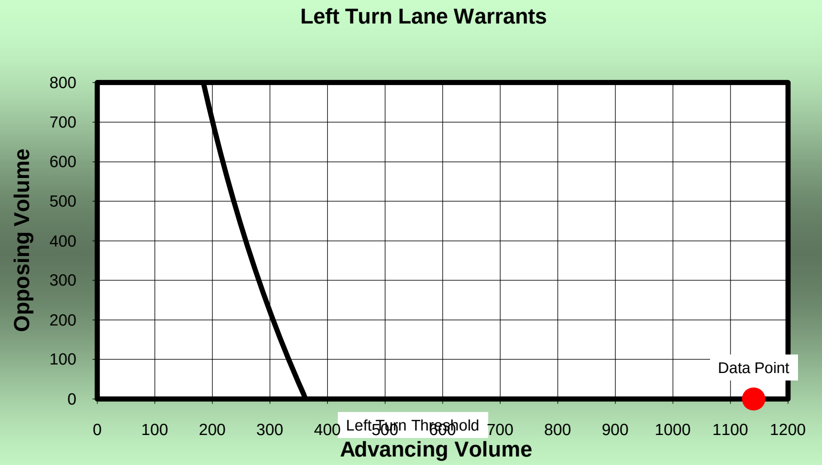
Turn Volume	270	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**425**
Cycle Length *(Enter 0 for Uncontrolled, 60 for Stop Controlled)*	100	Minimum	**325**
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	760	Speed Limit (mph)	35
Advancing Volume (vph)	1140	No. of through lanes	0
Opposing Volume (vph)	0	Percent Heavy Vehicles (decimal percent)	0.02



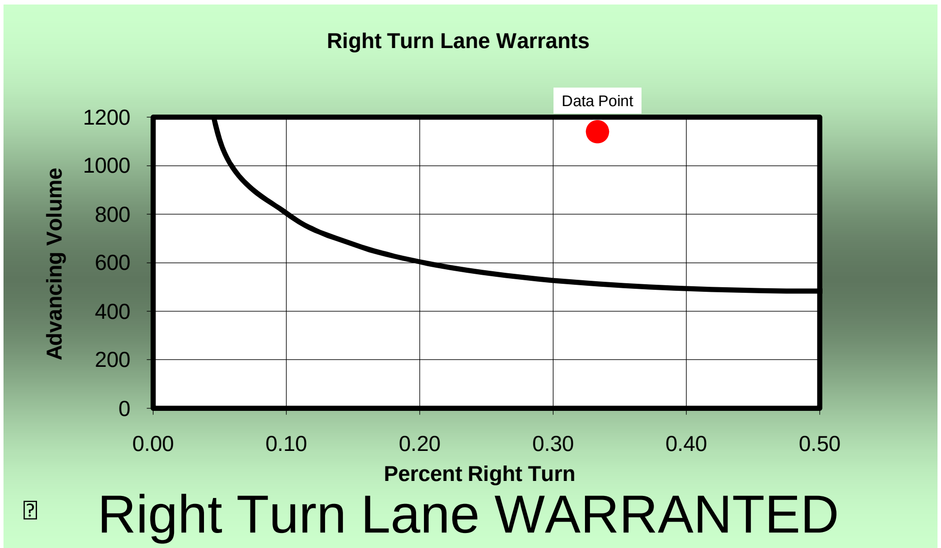
Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	380	Speed Limit (mph)	35
Advancing Volume (vph)	1140		



Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

Turn Volume	760	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**1100**
Cycle Length	100	Minimum	**850**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)			
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

Input Fields

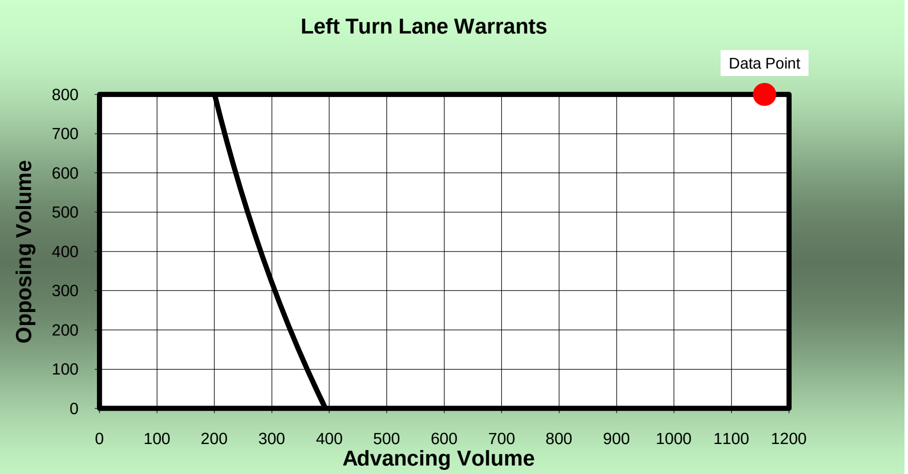
Turn Volume	380	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**575**
Cycle Length *(Enter 0 for Uncontrolled, 60 for Stop Controlled)*	100	Minimum	**450**
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	290	Speed Limit (mph)	35
Advancing Volume (vph)	1150	No. of through lanes	2
Opposing Volume (vph)	970	Percent Heavy Vehicles (decimal percent)	0.02



Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

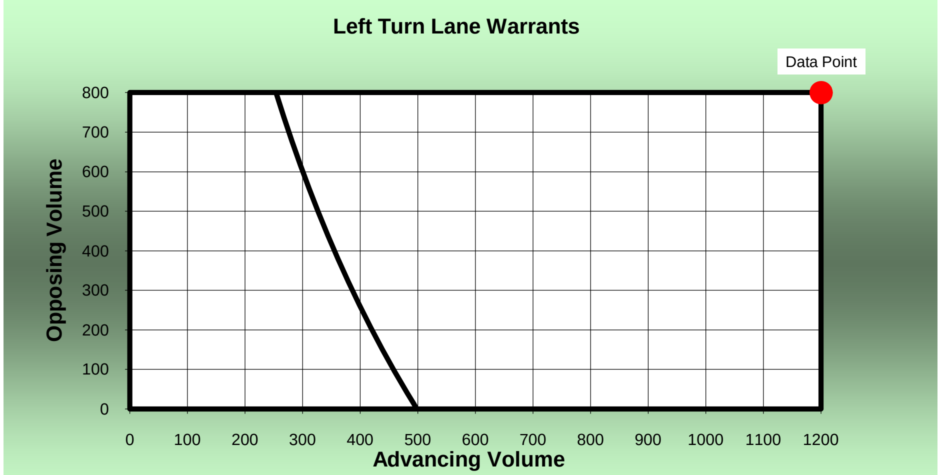
Turn Volume	290	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**450**
Cycle Length *(Enter 0 for Uncontrolled, 60 for Stop Controlled)*	100	Minimum	**350**
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	200	Speed Limit (mph)	35
Advancing Volume (vph)	1460	No. of through lanes	2
Opposing Volume (vph)	1320	Percent Heavy Vehicles (decimal percent)	0.02



Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

Input Fields

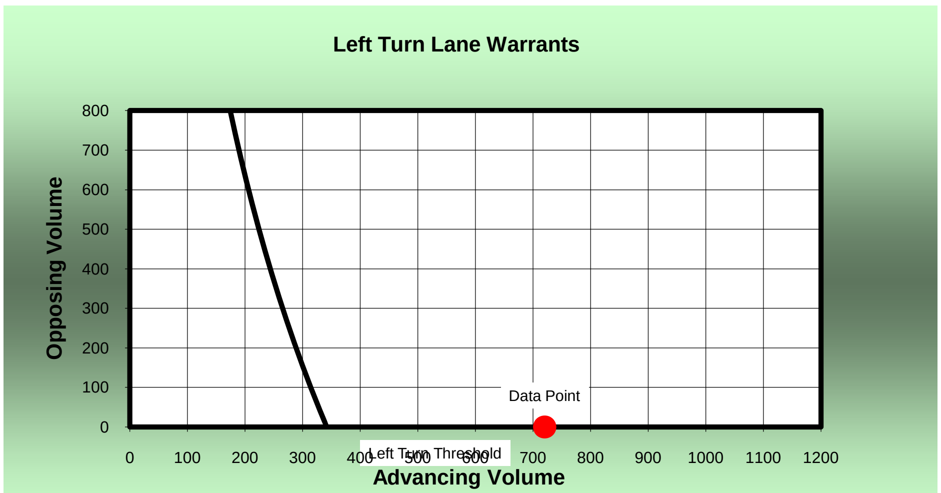
Turn Volume	200	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**325**
Cycle Length	100	Minimum	**250**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)			
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	340	Speed Limit (mph)	35
Advancing Volume (vph)	720	No. of through lanes	0
Opposing Volume (vph)	0	Percent Heavy Vehicles (decimal percent)	0.02



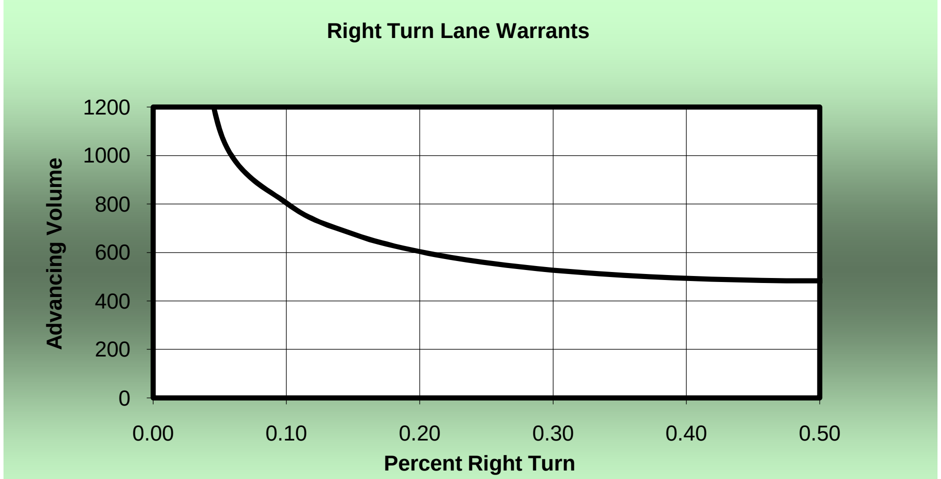
Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

<u>Input Fields</u>

Right Turn Volume (vph)	380	Speed Limit (mph)	35
Advancing Volume (vph)	720		



Right Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

Input Fields

Turn Volume	340	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**525**
Cycle Length *(Enter 0 for Uncontrolled, 60 for Stop Controlled)*	100	Minimum	**400**
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

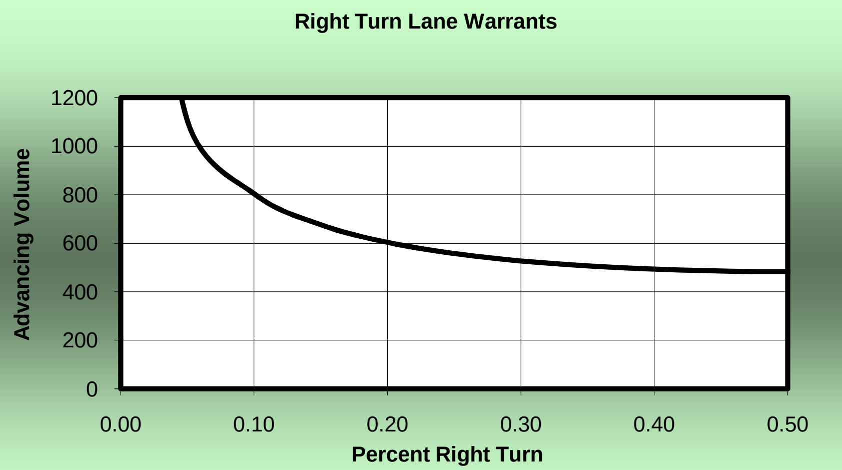
Turn Volume	380	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**575**
Cycle Length	100	Minimum	**450**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)			
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	510	Speed Limit (mph)	35
Advancing Volume (vph)	1320		



Right Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

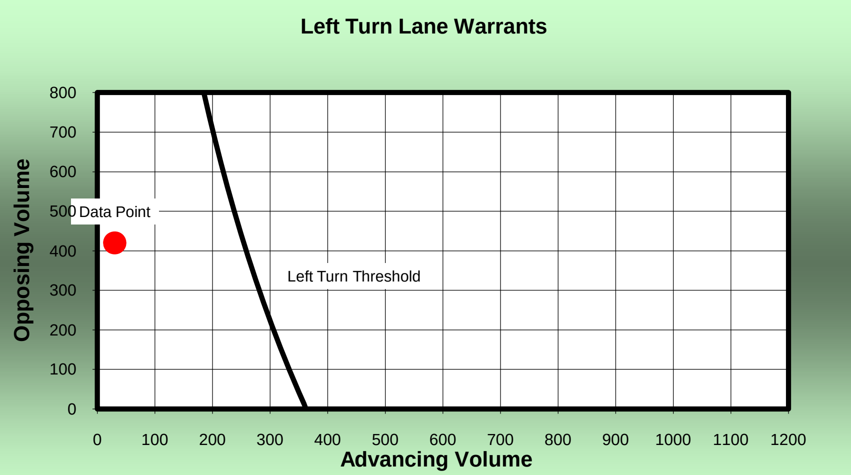
Turn Volume	510	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**750**
Cycle Length *(Enter 0 for Uncontrolled, 60 for Stop Controlled)*	100	Minimum	**575**
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	10	Speed Limit (mph)	35
Advancing Volume (vph)	30	No. of through lanes	1
Opposing Volume (vph)	420	Percent Heavy Vehicles (decimal percent)	0.02



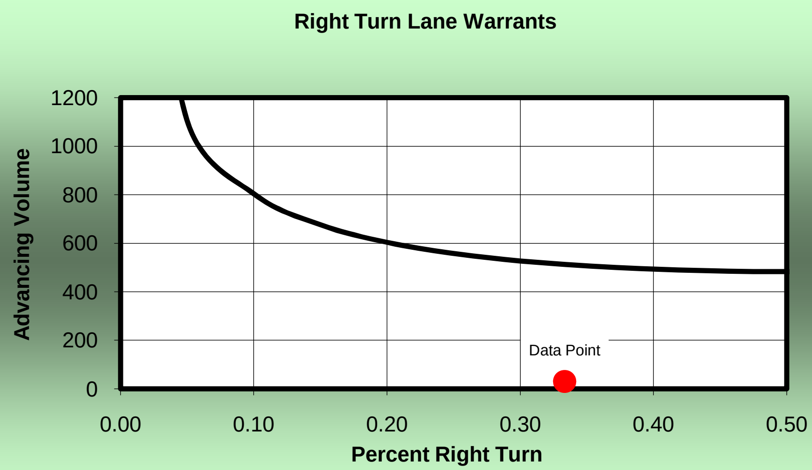
Left Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	10	Speed Limit (mph)	35
Advancing Volume (vph)	30		



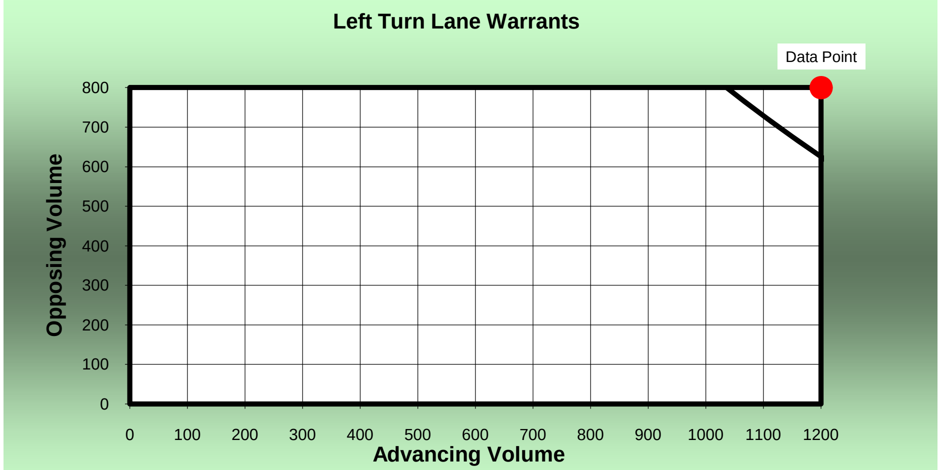
Right Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

<u>Input Fields</u>

Left Turn Volume (vph)	10	Speed Limit (mph)	35
Advancing Volume (vph)	1380	No. of through lanes	1
Opposing Volume (vph)	1640	Percent Heavy Vehicles (decimal percent)	0.02



Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

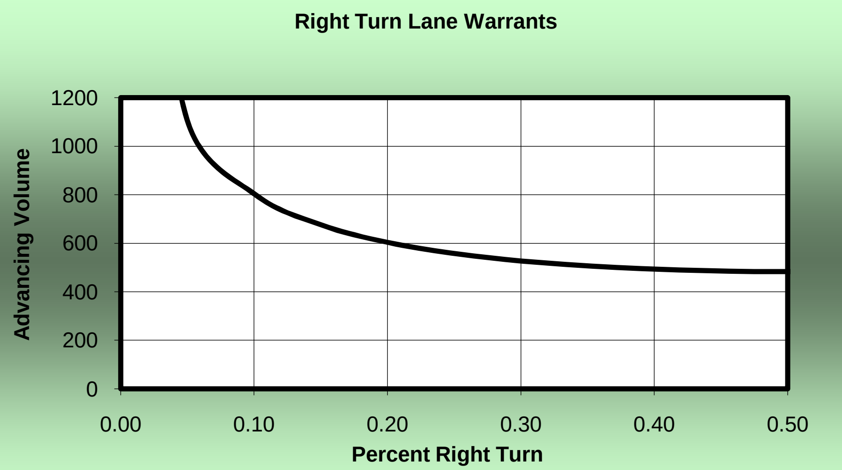
Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph) 230

Advancing Volume (vph) 1380

Speed Limit (mph) 35



Right Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

Input Fields

Turn Volume	10	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**125**
Cycle Length	100	Minimum	**125**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)			
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

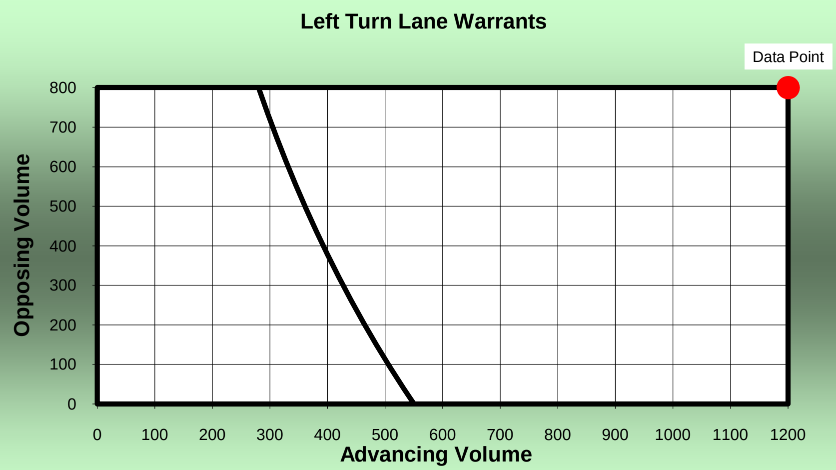
Turn Volume	230	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**375**
Cycle Length	100	Minimum	**300**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)			
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	180	Speed Limit (mph)	35
Advancing Volume (vph)	1640	No. of through lanes	1
Opposing Volume (vph)	1380	Percent Heavy Vehicles (decimal percent)	0.02



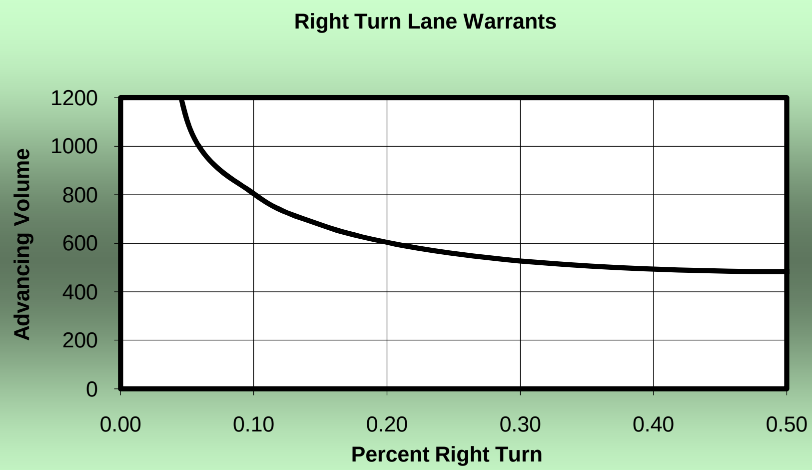
Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	10	Speed Limit (mph)	35
Advancing Volume (vph)	1640		



Right Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

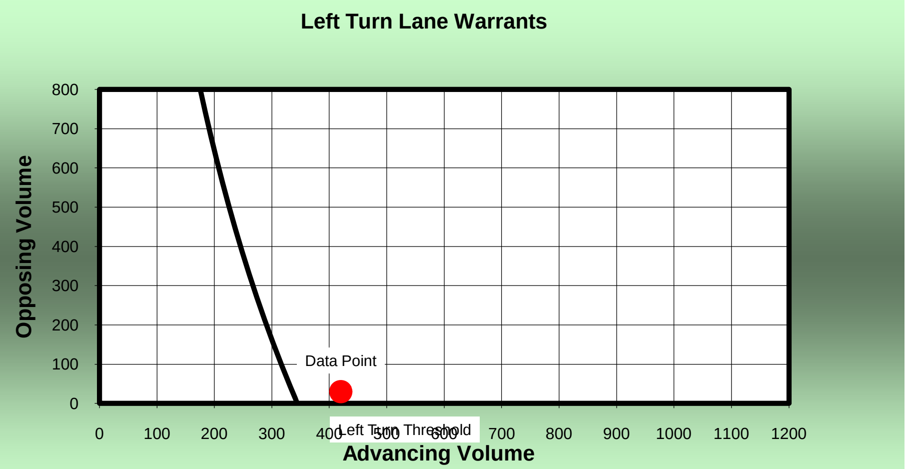
Input	Value		Calculated Turn Lane Length (ft)	
Turn Volume	180			
Speed Limit	35		Desirable	**300**
Cycle Length	100		Minimum	**250**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)				
Approach Percent Grade (G)	0			
Is this a Rural Arterial (Y or N)	N			

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	240	Speed Limit (mph)	35
Advancing Volume (vph)	420	No. of through lanes	1
Opposing Volume (vph)	30	Percent Heavy Vehicles (decimal percent)	0.02



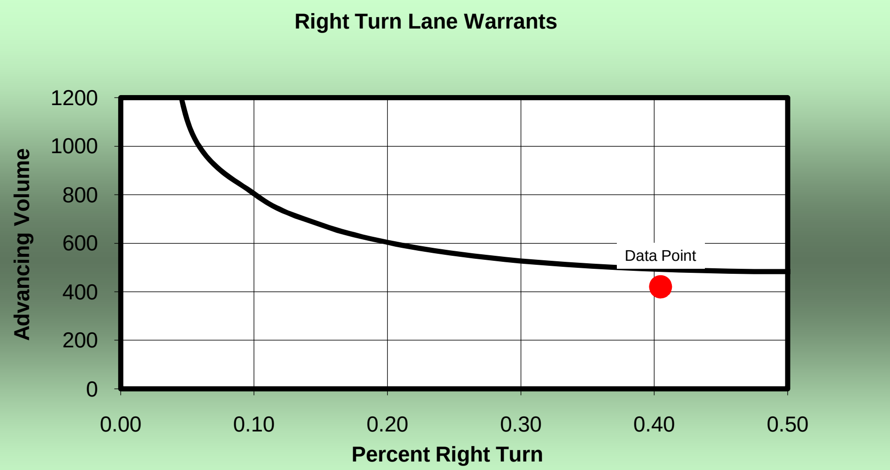
Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	170	Speed Limit (mph)	35
Advancing Volume (vph)	420		



Right Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

Input Fields

Turn Volume	240	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**375**
Cycle Length	100	Minimum	**300**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)			
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

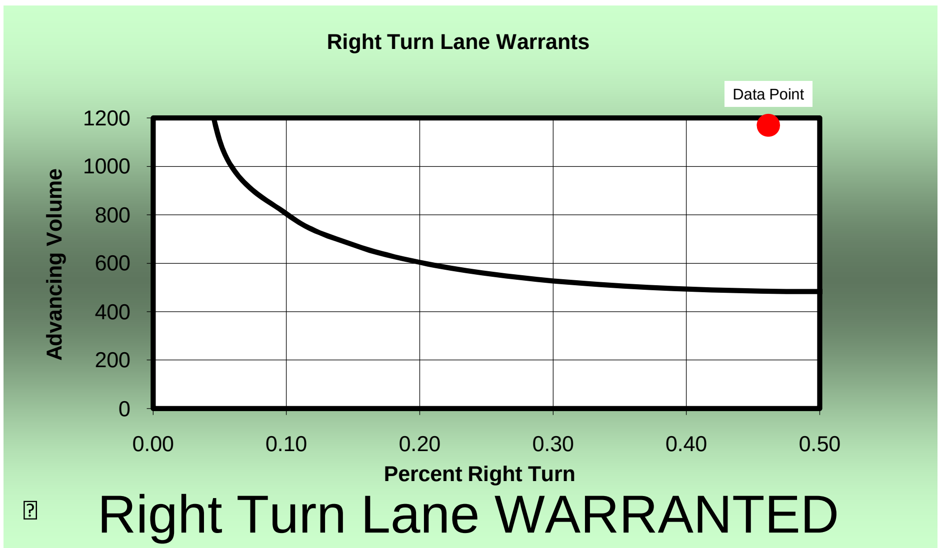
Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

<u>Input Fields</u>

Right Turn Volume (vph) 540 Speed Limit (mph) 35

Advancing Volume (vph) 1170



Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

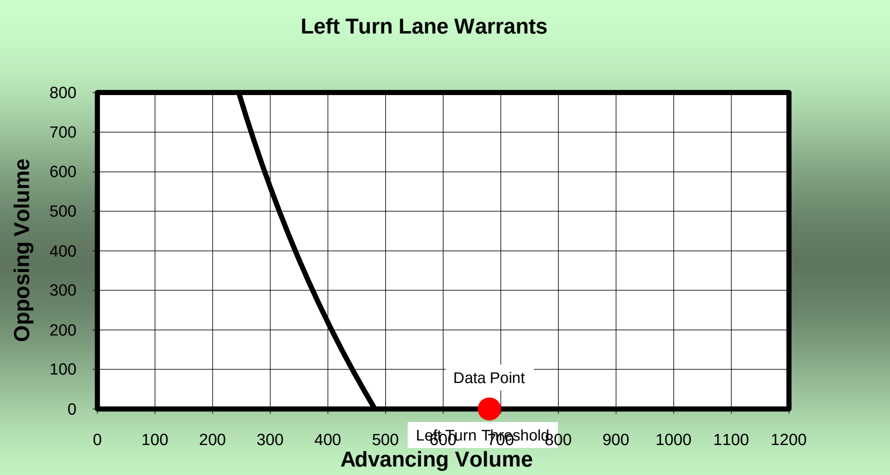
Turn Volume	540	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**575**
Cycle Length *(Enter 0 for Uncontrolled, 60 for Stop Controlled)*	70	Minimum	**450**
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

<u>Input Fields</u>

Left Turn Volume (vph)	580	Speed Limit (mph)	35
Advancing Volume (vph)	680	No. of through lanes	0
Opposing Volume (vph)	0	Percent Heavy Vehicles (decimal percent)	0.02



Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

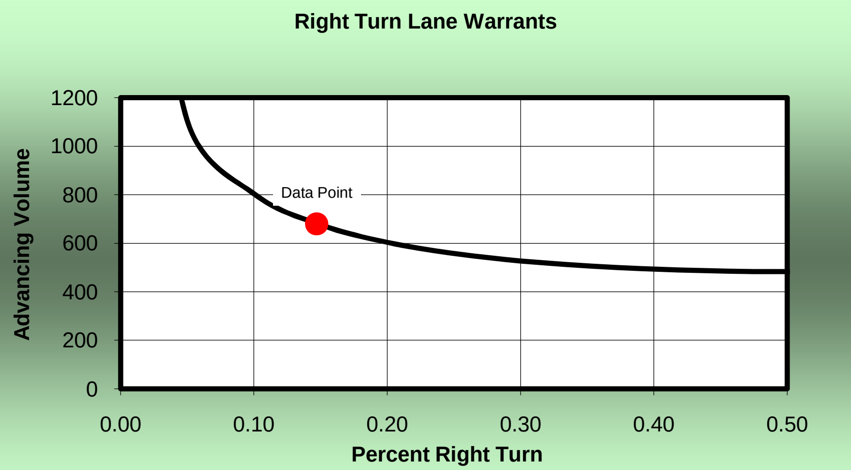
Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph) 100

Advancing Volume (vph) 680

Speed Limit (mph) 35



Right Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

Input Fields

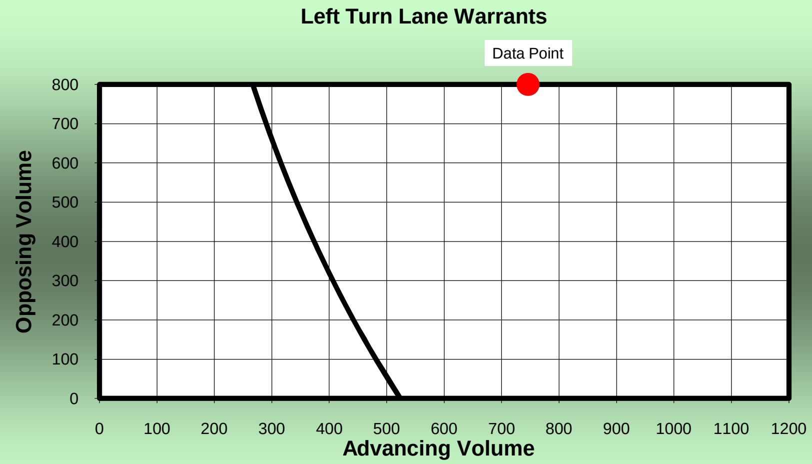
Turn Volume	580	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**625**
Cycle Length *(Enter 0 for Uncontrolled, 60 for Stop Controlled)*	70	Minimum	**475**
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

<u>Input Fields</u>

Left Turn Volume (vph)	90	Speed Limit (mph)	35
Advancing Volume (vph)	740	No. of through lanes	2
Opposing Volume (vph)	1170	Percent Heavy Vehicles (decimal percent)	0.02



Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

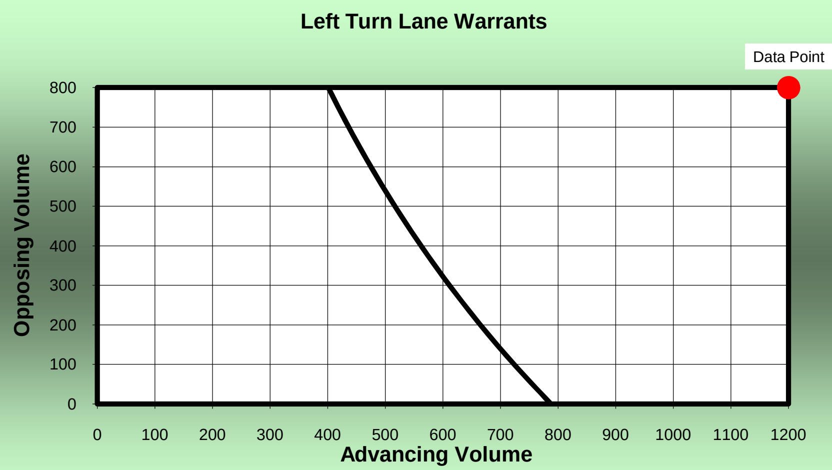
Turn Volume	90	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**150**
Cycle Length	70	Minimum	**125**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)			
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	60	Speed Limit (mph)	35
Advancing Volume (vph)	1210	No. of through lanes	2
Opposing Volume (vph)	810	Percent Heavy Vehicles (decimal percent)	0.02



Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

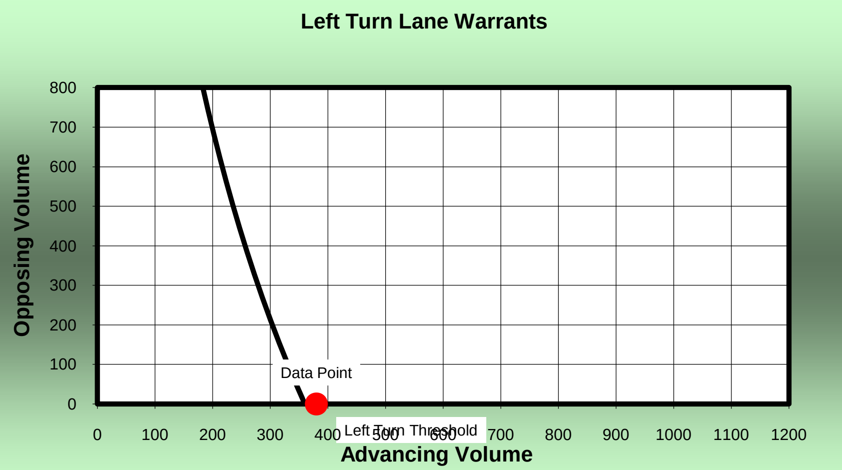
Turn Volume	60	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**125**
Cycle Length	70	Minimum	**125**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)			
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	250	Speed Limit (mph)	35
Advancing Volume (vph)	380	No. of through lanes	0
Opposing Volume (vph)	0	Percent Heavy Vehicles (decimal percent)	0.02



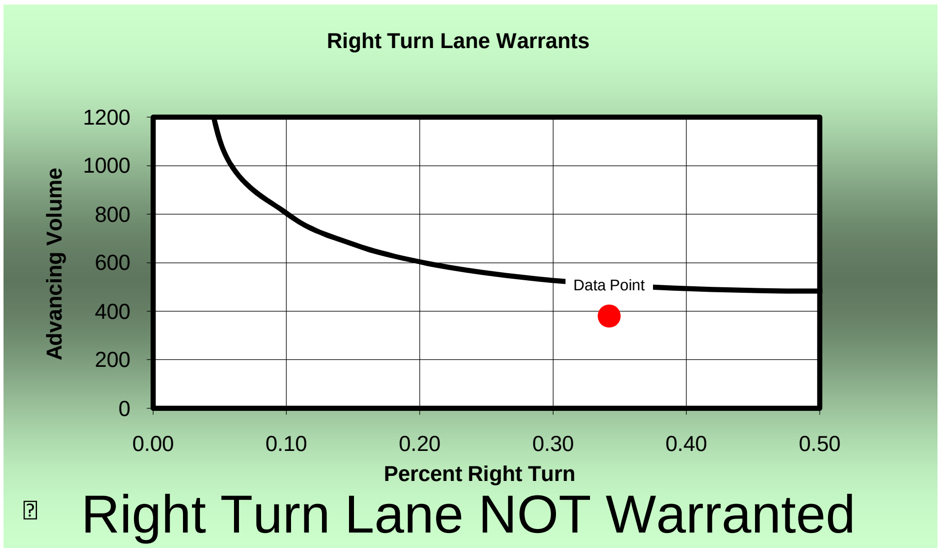
Left Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	130	Speed Limit (mph)	35
Advancing Volume (vph)	380		



Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

<u>Input Fields</u>

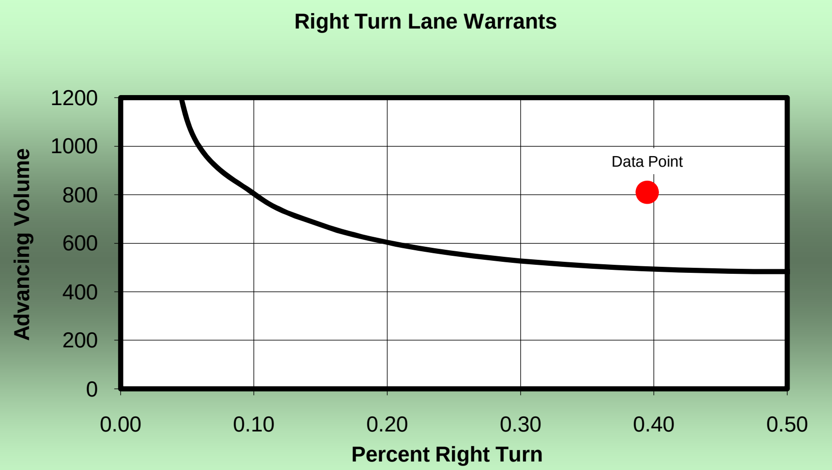
Turn Volume	250		Calculated Turn Lane Length (ft)	
Speed Limit	35		Desirable	**300**
Cycle Length	70		Minimum	**225**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)				
Approach Percent Grade (G)	0			
Is this a Rural Arterial (Y or N)	N			

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	320	Speed Limit (mph)	35
Advancing Volume (vph)	810		



Right Turn Lane WARRANTED

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Turn Lane Length

Input Fields

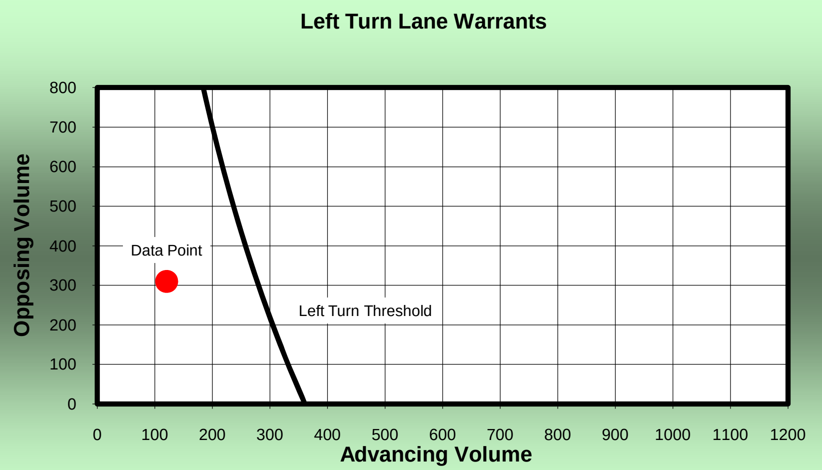
Turn Volume	320	Calculated Turn Lane Length (ft)	
Speed Limit	35	Desirable	**350**
Cycle Length	70	Minimum	**275**
(Enter 0 for Uncontrolled, 60 for Stop Controlled)			
Approach Percent Grade (G)	0		
Is this a Rural Arterial (Y or N)	N		

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	80	Speed Limit (mph)	35
Advancing Volume (vph)	120	No. of through lanes	1
Opposing Volume (vph)	310	Percent Heavy Vehicles (decimal percent)	0.02



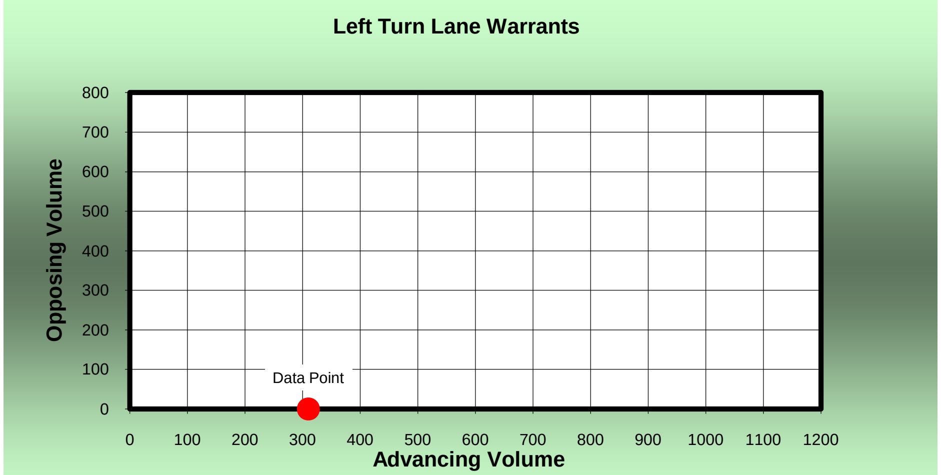
Left Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	1	Speed Limit (mph)	35
Advancing Volume (vph)	310	No. of through lanes	2
Opposing Volume (vph)	0	Percent Heavy Vehicles (decimal percent)	0.02



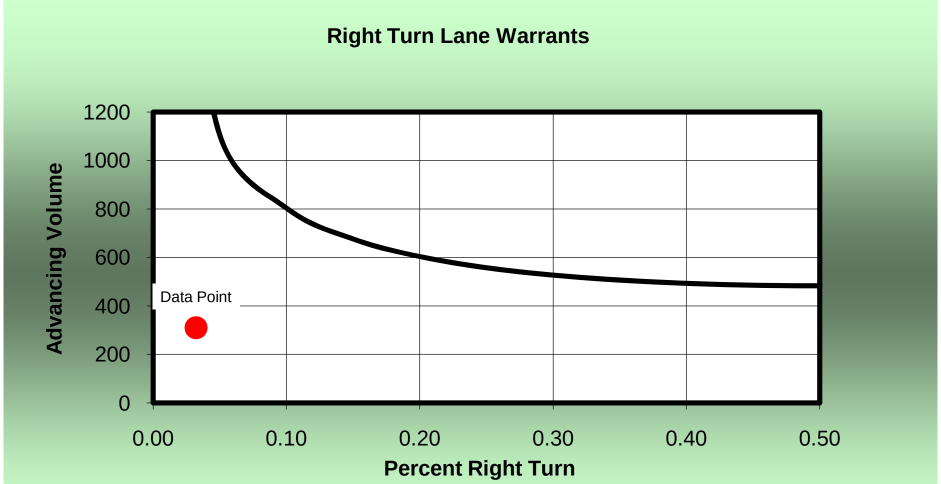
Left Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	10	Speed Limit (mph)	35
Advancing Volume (vph)	310		



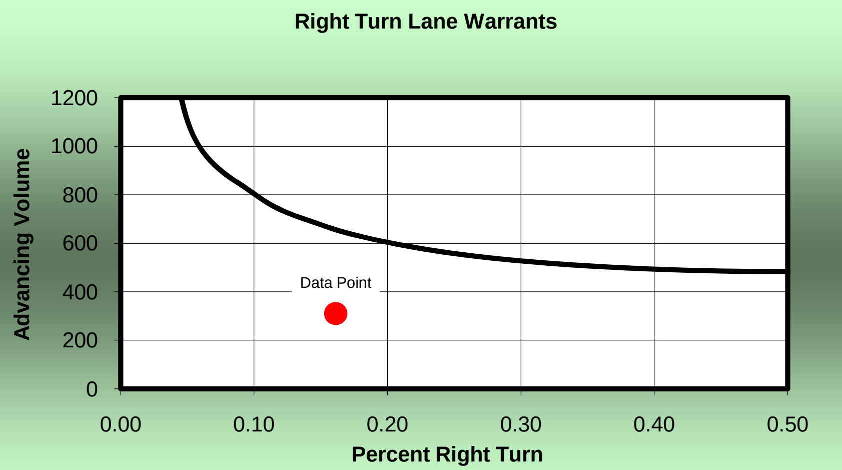
Right Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	50	Speed Limit (mph)	35
Advancing Volume (vph)	310		



Right Turn Lane NOT Warranted

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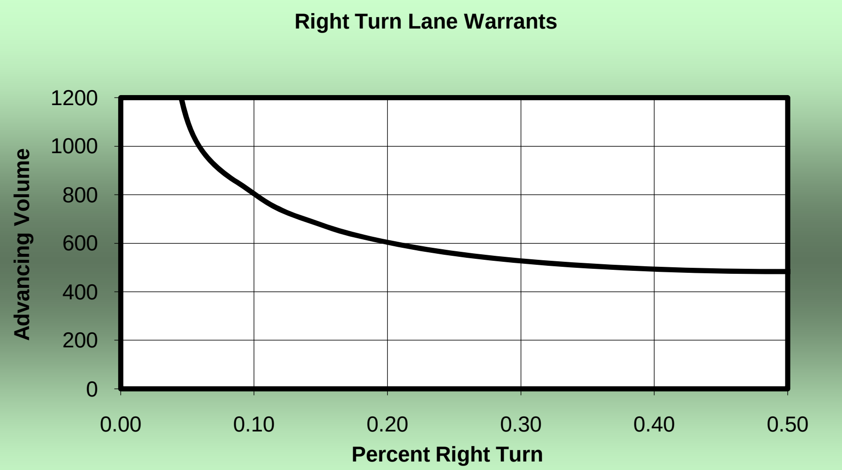
Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph) 140

Advancing Volume (vph) 250

Speed Limit (mph) 35



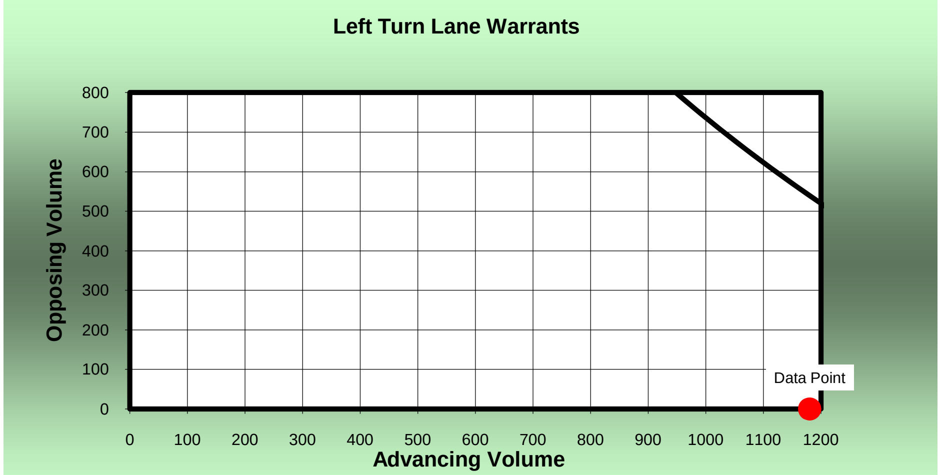
Right Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	10	Speed Limit (mph)	35
Advancing Volume (vph)	1180	No. of through lanes	3
Opposing Volume (vph)	0	Percent Heavy Vehicles (decimal percent)	0.02



Left Turn Lane NOT Warranted

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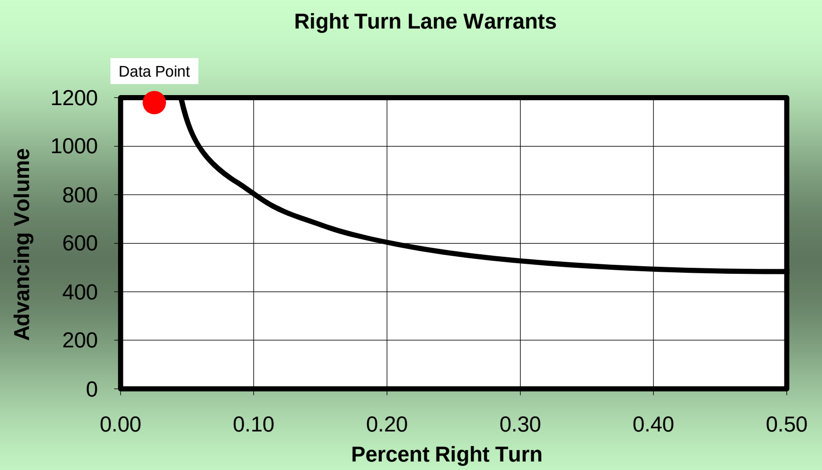
Right Turn Lane Warrants

Input Fields

Right Turn Volume (vph)	30		35
Advancing Volume (vph)	1180		



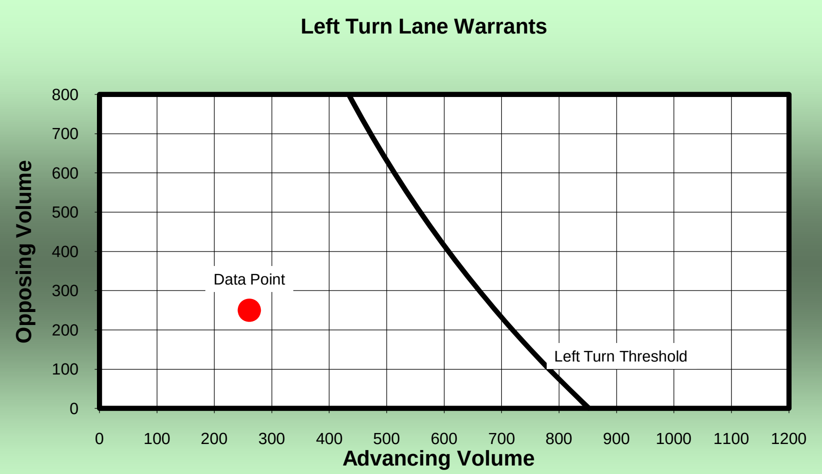
Right Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

Left Turn Lane Warrants

Input Fields

Left Turn Volume (vph)	250	Speed Limit (mph)	35
Advancing Volume (vph)	260	No. of through lanes	1
Opposing Volume (vph)	250	Percent Heavy Vehicles (decimal percent)	0.02



Left Turn Lane NOT Warranted

Note: This spreadsheet is intended to supplement the guidance provided in the Auxiliary Turn Lane policy outlined in the KYTC Highway Design Manual. This policy should be fully reviewed and understood prior to using this application.

BSB_Turn Lane Calcs_Alt-I_I-1.xlsx
I-1_Bank & Dalton WBR AM

North - South Road	Dalton Ave
East - West Road	Bank St
Peak Hour	AM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	240
DHV (Through Lane)	70
Signal cycle length	60
Number of through lanes	2
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	4
Required storage length (401-7, 401-8)	175
Offset taper storage length	50
Final Length of storage	175

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	286 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	1
Backup Length	50 FT
Calculated turn lane length	286 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

286 FT

BSB_Turn Lane Calcs_Alt-I_I-1.xlsx
I-1_Bank & Dalton WBR PM

North - South Road	Dalton Ave
East - West Road	Bank St
Peak Hour	PM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	450
DHV (Through Lane)	50
Signal cycle length	60
Number of through lanes	2
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	YES

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	8
Required storage length (401-7, 401-8)	325
Offset taper storage length	50
Final Length of storage	325

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	436 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	1
Backup Length	50 FT
Calculated turn lane length	436 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

436 FT

BSB_Turn Lane Calcs_Alt-I_I-1.xlsx
I-1_Bank & Dalton NBL AM

North - South Road	Dalton Ave
East - West Road	Bank St
Peak Hour	AM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	20
DHV (Through Lane)	370
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	low
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	161 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	4
Backup Length	175 FT
Calculated turn lane length	175 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

175 FT

BSB_Turn Lane Calcs_Alt-I_I-1.xlsx
I-1_Bank & Dalton NBL PM

North - South Road	Dalton Ave
East - West Road	Bank St
Peak Hour	PM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	30
DHV (Through Lane)	630
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	low
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table	
Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table	
Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	161 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	6
Backup Length	250 FT
Calculated turn lane length	250 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

250 FT

BSB_Turn Lane Calcs_Alt-I_I-1.xlsx
I-1_Bank & Dalton SBL AM

North - South Road	Dalton Ave
East - West Road	Bank St
Peak Hour	AM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	100
DHV (Through Lane)	560
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	211 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	5
Backup Length	200 FT
Calculated turn lane length	211 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

211 FT

BSB_Turn Lane Calcs_Alt-I_I-1.xlsx
I-1_Bank & Dalton SBL PM

North - South Road	Dalton Ave
East - West Road	Bank St
Peak Hour	PM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	190
DHV (Through Lane)	850
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	4
Required storage length (401-7, 401-8)	175
Offset taper storage length	50
Final Length of storage	175

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	286 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	8
Backup Length	325 FT
Calculated turn lane length	325 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

325 FT

BSB_Turn Lane Calcs_Alt-I_I-2.xlsx
I-2_Bank & Winchell WBR AM

North - South Road	Winchell Avenue
East - West Road	Bank St
Peak Hour	AM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	50
DHV (Through Lane)	50
Signal cycle length	60
Number of through lanes	2
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	161 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	1
Backup Length	50 FT
Calculated turn lane length	161 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

161 FT

BSB_Turn Lane Calcs_Alt-I_I-2.xlsx
I-2_Bank & Winchell WBR PM

North - South Road	Winchell Avenue
East - West Road	Bank St
Peak Hour	PM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	70
DHV (Through Lane)	160
Signal cycle length	60
Number of through lanes	2
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	211 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	211 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

211 FT

BSB_Turn Lane Calcs_Alt-I_I-2.xlsx
I-2_Bank & Winchell NBL AM

North - South Road	Winchell Avenue
East - West Road	Bank St
Peak Hour	AM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	260
DHV (Through Lane)	160
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	5
Required storage length (401-7, 401-8)	200
Offset taper storage length	50
Final Length of storage	200

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	311 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	311 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

311 FT

BSB_Turn Lane Calcs_Alt-I_I-2.xlsx
I-2_Bank & Winchell NBL PM

North - South Road	Winchell Avenue
East - West Road	Bank St
Peak Hour	PM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	340
DHV (Through Lane)	350
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	6
Required storage length (401-7, 401-8)	250
Offset taper storage length	50
Final Length of storage	250

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	361 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	3
Backup Length	150 FT
Calculated turn lane length	361 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

361 FT

BSB_Turn Lane Calcs_Alt-I_I-3.xlsx
I-3_Central Pwky & Linn NBL AM

North - South Road	Central Parkway
East - West Road	Linn Street
Peak Hour	AM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	90
DHV (Through Lane)	60
Signal cycle length	60
Number of through lanes	1
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	211 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	1
Backup Length	50 FT
Calculated turn lane length	211 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

211 FT

BSB_Turn Lane Calcs_Alt-I_I-3.xlsx
I-3_Central Pwky & Linn NBL PM

North - South Road	Central Parkway
East - West Road	Linn Street
Peak Hour	PM Peak

Givens

Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	160
DHV (Through Lane)	90
Signal cycle length	60
Number of through lanes	1
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations

Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	3
Required storage length (401-7, 401-8)	150
Offset taper storage length	50
Final Length of storage	150

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	261 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	261 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

261 FT

BSB_Turn Lane Calcs_Alt-I_I-3.xlsx
I-3_Central Pwky & Linn NBR AM

North - South Road	Central Parkway
East - West Road	Linn Street
Peak Hour	AM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	40
DHV (Through Lane)	60
Signal cycle length	60
Number of through lanes	1
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	161 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	1
Backup Length	50 FT
Calculated turn lane length	161 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

161 FT

BSB_Turn Lane Calcs_Alt-I_I-3.xlsx
I-3_Central Pwky & Linn NBR PM

North - South Road	Central Parkway
East - West Road	Linn Street
Peak Hour	PM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	30
DHV (Through Lane)	90
Signal cycle length	60
Number of through lanes	1
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	161 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	161 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

161 FT

BSB_Turn Lane Calcs_Alt-I_I-3.xlsx
I-3_Central Pwky & Linn EBR AM

North - South Road	Central Parkway
East - West Road	Linn Street
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	80
DHV (Through Lane)	1240
Signal cycle length	60
Number of through lanes	2
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	low
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	150 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	11
Backup Length	400 FT
Calculated turn lane length	400 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

400 FT

BSB_Turn Lane Calcs_Alt-I_I-3.xlsx
I-3_Central Pwky & Linn EBR PM

North - South Road	Central Parkway
East - West Road	Linn Street
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	80
DHV (Through Lane)	600
Signal cycle length	60
Number of through lanes	2
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	150 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	5
Backup Length	200 FT
Calculated turn lane length	200 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

200 FT

BSB_Turn Lane Calcs_Alt-I_I-4.xlsx
I-4_Bank St & Linn SBR AM

North - South Road	Bank Street
East - West Road	Linn Street
Peak Hour	AM Peak

Givens	
Design speed	40
Type of traffic control	Unsignalized Through Road
DHV (Turning Lane)	30
DHV (Through Lane)	180
Signal cycle length	60
Number of through lanes	2
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	condition c
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	161 FT
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	-
Backup Length	No backup on unsignalized through road
Calculated turn lane length	161 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

161 FT

BSB_Turn Lane Calcs_Alt-I_I-4.xlsx
I-4_Bank St & Linn SBR PM

North - South Road	Bank Street
East - West Road	Linn Street
Peak Hour	PM Peak

Givens	
Design speed	40
Type of traffic control	Unsignalized Through Road
DHV (Turning Lane)	50
DHV (Through Lane)	270
Signal cycle length	60
Number of through lanes	2
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	condition c
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	161 FT
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	-
Backup Length	No backup on unsignalized through road
Calculated turn lane length	161 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

161 FT

BSB_Turn Lane Calcs_Alt-I_I-4.xlsx
I-4_Bank St & Linn WBL AM

North - South Road	Bank Street
East - West Road	Linn Street
Peak Hour	AM Peak

Givens	
Design speed	35
Type of traffic control	Unsignalized Stopped Crossroad
DHV (Turning Lane)	30
DHV (Through Lane)	40
Signal cycle length	60
Number of through lanes	1
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	1
Backup Length	50 FT
Calculated turn lane length	100 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

100 FT

BSB_Turn Lane Calcs_Alt-I_I-4.xlsx
I-4_Bank St & Linn WBL PM

North - South Road	Central Parkway
East - West Road	Linn Street
Peak Hour	PM Peak

Givens	
Design speed	35
Type of traffic control	Unsignalized Stopped Crossroad
DHV (Turning Lane)	40
DHV (Through Lane)	80
Signal cycle length	60
Number of through lanes	1
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table	
Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table	
Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	100 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

100 FT

BSB_Turn Lane Calcs_Alt-I_I-4.xlsx
I-4_Bank St & Linn WBR AM

North - South Road	Bank Street
East - West Road	Linn Street
Peak Hour	AM Peak

Givens	
Design speed	35
Type of traffic control	Unsignalized Stopped Crossroad
DHV (Turning Lane)	40
DHV (Through Lane)	30
Signal cycle length	60
Number of through lanes	1
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume? -

Does turn volume exceed 100 VPH? -

Right Turns

Does turn volume exceed 300 VPH? NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table	
Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table	
Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E) Condition A

Condition A 100 FT
Length = 50' + storage length

Condition B -
Length Including 50' taper

Condition C -
Length Including 50' taper

Greatest Value from Condition B or C -
Length Including 50' taper

Single offset turn lane -

Dual left turn lane -

Backup Length
# of through vehicles per cycle 1

Backup Length 50 FT

Calculated turn lane length 100 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

100 FT

BSB_Turn Lane Calcs_Alt-I_I-4.xlsx
I-4_Bank St & Linn WBR PM

North - South Road	Bank Street
East - West Road	Linn Street
Peak Hour	PM Peak

Givens	
Design speed	35
Type of traffic control	Unsignalized Stopped Crossroad
DHV (Turning Lane)	80
DHV (Through Lane)	40
Signal cycle length	60
Number of through lanes	1
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	150 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	1
Backup Length	50 FT
Calculated turn lane length	150 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

150 FT

BSB_Turn Lane Calcs_Alt-I_I-5.xlsx
I-5_Dalton & Findlay EBL AM

North - South Road	Dalton Avenue
East - West Road	Findlay Street
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	10
DHV (Through Lane)	20
Signal cycle length	60
Number of through lanes	1
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table	
Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table	
Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	1
Backup Length	50 FT
Calculated turn lane length	100 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

100 FT

BSB_Turn Lane Calcs_Alt-I_I-5.xlsx
I-5_Dalton & Findlay EBL PM

North - South Road	Dalton Avenue
East - West Road	Findlay Street
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	40
DHV (Through Lane)	60
Signal cycle length	60
Number of through lanes	1
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	1
Backup Length	50 FT
Calculated turn lane length	100 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

100 FT

BSB_Turn Lane Calcs_Alt-I_I-5.xlsx
I-5_Dalton & Findlay WBL AM

North - South Road	Dalton Avenue
East - West Road	Findlay Street
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	100
DHV (Through Lane)	50
Signal cycle length	60
Number of through lanes	1
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	150 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	1
Backup Length	50 FT
Calculated turn lane length	150 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

150 FT

BSB_Turn Lane Calcs_Alt-I_I-5.xlsx
I-5_Dalton & Findlay WBL PM

North - South Road	Dalton Avenue
East - West Road	Findlay Street
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	130
DHV (Through Lane)	10
Signal cycle length	60
Number of through lanes	1
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	3
Required storage length (401-7, 401-8)	150
Offset taper storage length	50
Final Length of storage	150

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	200 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	1
Backup Length	50 FT
Calculated turn lane length	200 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

200 FT

BSB_Turn Lane Calcs_Alt-I_I-5.xlsx
I-5_Dalton & Findlay WBR AM

North - South Road	Dalton Avenue
East - West Road	Findlay Street
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	80
DHV (Through Lane)	50
Signal cycle length	60
Number of through lanes	1
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	150 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	1
Backup Length	50 FT
Calculated turn lane length	150 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

150 FT

BSB_Turn Lane Calcs_Alt-I_I-5.xlsx
I-5_Dalton & Findlay WBR PM

North - South Road	Dalton Avenue
East - West Road	Findlay Street
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	100
DHV (Through Lane)	10
Signal cycle length	60
Number of through lanes	1
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table	
Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table	
Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	150 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	1
Backup Length	50 FT
Calculated turn lane length	150 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

150 FT

BSB_Turn Lane Calcs_Alt-I_I-5.xlsx
I-5_Dalton & Findlay NBL AM

North - South Road	Dalton Avenue
East - West Road	Findlay Street
Peak Hour	AM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	10
DHV (Through Lane)	410
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	low
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	161 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	4
Backup Length	175 FT
Calculated turn lane length	175 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

175 FT

BSB_Turn Lane Calcs_Alt-I_I-5.xlsx
I-5_Dalton & Findlay NBL PM

North - South Road	Dalton Avenue
East - West Road	Findlay Street
Peak Hour	PM Peak

Givens

Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	10
DHV (Through Lane)	700
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations

Demand	low
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	161 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	6
Backup Length	250 FT
Calculated turn lane length	250 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

250 FT

BSB_Turn Lane Calcs_Alt-I_I-5.xlsx
I-5_Dalton & Findlay SBL AM

North - South Road	Dalton Avenue
East - West Road	Findlay Street
Peak Hour	AM Peak

Givens

Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	150
DHV (Through Lane)	490
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations

Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	3
Required storage length (401-7, 401-8)	150
Offset taper storage length	50
Final Length of storage	150

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	261 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	5
Backup Length	200 FT
Calculated turn lane length	261 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

261 FT

BSB_Turn Lane Calcs_Alt-I_I-5.xlsx
I-5_Dalton & Findlay SBL PM

North - South Road	Dalton Avenue
East - West Road	Findlay Street
Peak Hour	PM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	170
DHV (Through Lane)	580
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	3
Required storage length (401-7, 401-8)	150
Offset taper storage length	50
Final Length of storage	150

Condition B Table	
Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table	
Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	261 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	5
Backup Length	200 FT
Calculated turn lane length	261 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

261 FT

BSB_Turn Lane Calcs_Alt-I_I-6.xlsx
I-6_Findlay & Western EBR AM

North - South Road	Western Avenue
East - West Road	Findlay Street
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	120
DHV (Through Lane)	240
Signal cycle length	60
Number of through lanes	2
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	150 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	150 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

150 FT

BSB_Turn Lane Calcs_Alt-I_I-6.xlsx
I-6_Findlay & Western EBR PM

North - South Road	Western Avenue
East - West Road	Findlay Street
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	90
DHV (Through Lane)	180
Signal cycle length	60
Number of through lanes	2
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	150 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	150 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

150 FT

BSB_Turn Lane Calcs_Alt-I_I-6.xlsx
I-6_Findlay & Western SBL AM

North - South Road	Western Avenue
East - West Road	Findlay Street
Peak Hour	AM Peak

Givens	
Design speed	35
Type of traffic control	Signalized
DHV (Turning Lane)	20
DHV (Through Lane)	180
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	low
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	100 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

100 FT

BSB_Turn Lane Calcs_Alt-I_I-6.xlsx
I-6_Findlay & Western SBL PM

North - South Road	Western Avenue
East - West Road	Findlay Street
Peak Hour	PM Peak

Givens	
Design speed	35
Type of traffic control	Signalized
DHV (Turning Lane)	80
DHV (Through Lane)	220
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	150 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	150 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

150 FT

BSB_Turn Lane Calcs_Alt-I_I-8.xlsx
I-8_Dalton & Liberty WBL AM

North - South Road	Dalton Avenue
East - West Road	Liberty Street
Peak Hour	AM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	120
DHV (Through Lane)	160
Signal cycle length	60
Number of through lanes	1
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	211 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	3
Backup Length	150 FT
Calculated turn lane length	211 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

211 FT

BSB_Turn Lane Calcs_Alt-I_I-8.xlsx
I-8_Dalton & Liberty WBL PM

North - South Road	Dalton Avenue
East - West Road	Liberty Street
Peak Hour	PM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	130
DHV (Through Lane)	260
Signal cycle length	60
Number of through lanes	1
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	3
Required storage length (401-7, 401-8)	150
Offset taper storage length	50
Final Length of storage	150

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	261 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	5
Backup Length	200 FT
Calculated turn lane length	261 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

261 FT

BSB_Turn Lane Calcs_Alt-I_I-8.xlsx
I-8_Dalton & Liberty WBR AM

North - South Road	Dalton Avenue
East - West Road	Liberty Street
Peak Hour	AM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	160
DHV (Through Lane)	120
Signal cycle length	60
Number of through lanes	1
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	3
Required storage length (401-7, 401-8)	150
Offset taper storage length	50
Final Length of storage	150

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	261 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	261 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

261 FT

BSB_Turn Lane Calcs_Alt-I_I-8.xlsx
I-8_Dalton & Liberty WBR PM

North - South Road	Dalton Avenue
East - West Road	Liberty Street
Peak Hour	PM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	260
DHV (Through Lane)	130
Signal cycle length	60
Number of through lanes	1
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	5
Required storage length (401-7, 401-8)	200
Offset taper storage length	50
Final Length of storage	200

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	311 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	3
Backup Length	150 FT
Calculated turn lane length	311 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

311 FT

BSB_Turn Lane Calcs_Alt-I_I-8.xlsx
I-8_Dalton & Liberty SBL AM

North - South Road	Dalton Avenue
East - West Road	Liberty Street
Peak Hour	AM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	190
DHV (Through Lane)	470
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	4
Required storage length (401-7, 401-8)	175
Offset taper storage length	50
Final Length of storage	175

Condition B Table	
Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table	
Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	286 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	4
Backup Length	175 FT
Calculated turn lane length	286 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

286 FT

BSB_Turn Lane Calcs_Alt-I_I-8.xlsx
I-8_Dalton & Liberty SBL PM

North - South Road	Dalton Avenue
East - West Road	Liberty Street
Peak Hour	PM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	170
DHV (Through Lane)	810
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	3
Required storage length (401-7, 401-8)	150
Offset taper storage length	50
Final Length of storage	150

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	261 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	7
Backup Length	275 FT
Calculated turn lane length	275 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

275 FT

BSB_Turn Lane Calcs_Alt-I_I-9.xlsx
I-9_Western & Liberty WBL AM

North - South Road	Western Avenue
East - West Road	Liberty Street
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	50
DHV (Through Lane)	230
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	100 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

100 FT

BSB_Turn Lane Calcs_Alt-I_I-9.xlsx
I-9_Western & Liberty WBL PM

North - South Road	Western Avenue
East - West Road	Liberty Street
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	70
DHV (Through Lane)	260
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	150 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	3
Backup Length	150 FT
Calculated turn lane length	150 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

150 FT

BSB_Turn Lane Calcs_Alt-I_I-9.xlsx
I-9_Western & Liberty SBL AM

North - South Road	Western Avenue
East - West Road	Liberty Street
Peak Hour	AM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	98
DHV (Through Lane)	292
Signal cycle length	60
Number of through lanes	3
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	211 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	211 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

211 FT

BSB_Turn Lane Calcs_Alt-I_I-9.xlsx
I-9_Western & Liberty SBL PM

North - South Road	Western Avenue
East - West Road	Liberty Street
Peak Hour	PM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	70
DHV (Through Lane)	210
Signal cycle length	60
Number of through lanes	3
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	211 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	211 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

211 FT

BSB_Turn Lane Calcs_Alt-I_I-11.xlsx
I-11_Linn St & Liberty EBL AM

North - South Road	Linn Street
East - West Road	Liberty Street
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	10
DHV (Through Lane)	270
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	low
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	3
Backup Length	150 FT
Calculated turn lane length	150 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

150 FT

BSB_Turn Lane Calcs_Alt-I_I-11.xlsx
I-11 Linn St & Liberty EBL PM

North - South Road	Linn Street
East - West Road	Liberty Street
Peak Hour	PM Peak

Givens

Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	10
DHV (Through Lane)	170
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations

Demand	low
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	100 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

100 FT

BSB_Turn Lane Calcs_Alt-I_I-11.xlsx
I-11_Linn St & Liberty WBL AM

North - South Road	Linn Street
East - West Road	Liberty Street
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	120
DHV (Through Lane)	150
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	150 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	150 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

150 FT

BSB_Turn Lane Calcs_Alt-I_I-11.xlsx
I-11 Linn St & Liberty WBL PM

North - South Road	Linn Street
East - West Road	Liberty Street
Peak Hour	PM Peak

Givens

Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	190
DHV (Through Lane)	300
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations

Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	4
Required storage length (401-7, 401-8)	175
Offset taper storage length	50
Final Length of storage	175

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	225 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	3
Backup Length	150 FT
Calculated turn lane length	225 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

225 FT

BSB_Turn Lane Calcs_Alt-I_I-11.xlsx
I-11_Linn St & Liberty NBL AM

North - South Road	Linn Street
East - West Road	Liberty Street
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	20
DHV (Through Lane)	230
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	low
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	100 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

100 FT

BSB_Turn Lane Calcs_Alt-I_I-11.xlsx
I-11 Linn St & Liberty NBL PM

North - South Road	Linn Street
East - West Road	Liberty Street
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	60
DHV (Through Lane)	380
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	4
Backup Length	175 FT
Calculated turn lane length	175 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

175 FT

BSB_Turn Lane Calcs_Alt-I_I-11.xlsx
I-11_Linn St & Liberty NBR AM

North - South Road	Linn Street
East - West Road	Liberty Street
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	120
DHV (Through Lane)	230
Signal cycle length	60
Number of through lanes	2
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	150 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	150 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

150 FT

BSB_Turn Lane Calcs_Alt-I_I-11.xlsx
I-11 Linn St & Liberty NBR PM

North - South Road	Linn Street
East - West Road	Liberty Street
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	160
DHV (Through Lane)	380
Signal cycle length	60
Number of through lanes	2
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	3
Required storage length (401-7, 401-8)	150
Offset taper storage length	50
Final Length of storage	150

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	200 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	4
Backup Length	175 FT
Calculated turn lane length	200 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

200 FT

BSB_Turn Lane Calcs_Alt-I_I-11.xlsx
I-11_Linn St & Liberty SBL AM

North - South Road	Linn Street
East - West Road	Liberty Street
Peak Hour	AM Peak

Givens	
Design speed	35
Type of traffic control	Signalized
DHV (Turning Lane)	40
DHV (Through Lane)	250
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	3
Backup Length	150 FT
Calculated turn lane length	150 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

150 FT

BSB_Turn Lane Calcs_Alt-I_I-11.xlsx
I-11 Linn St & Liberty SBL PM

North - South Road	Linn Street
East - West Road	Liberty Street
Peak Hour	PM Peak

Givens	
Design speed	35
Type of traffic control	Signalized
DHV (Turning Lane)	50
DHV (Through Lane)	320
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	3
Backup Length	150 FT
Calculated turn lane length	150 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

150 FT

BSB_Turn Lane Calcs_Alt-I_I-11.xlsx
I-11_Linn St & Liberty SBR AM

North - South Road	Linn Street
East - West Road	Liberty Street
Peak Hour	AM Peak

Givens	
Design speed	35
Type of traffic control	Signalized
DHV (Turning Lane)	20
DHV (Through Lane)	250
Signal cycle length	60
Number of through lanes	2
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	low
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	3
Backup Length	150 FT
Calculated turn lane length	150 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

150 FT

BSB_Turn Lane Calcs_Alt-I_I-11.xlsx
I-11 Linn St & Liberty SBR PM

North - South Road	Linn Street
East - West Road	Liberty Street
Peak Hour	PM Peak

Givens	
Design speed	35
Type of traffic control	Signalized
DHV (Turning Lane)	30
DHV (Through Lane)	320
Signal cycle length	60
Number of through lanes	2
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	low
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	3
Backup Length	150 FT
Calculated turn lane length	150 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

150 FT

BSB_Turn Lane Calcs_Alt-I_I-12.xlsx
I-12_Ezz Char & Western WBL AM

North - South Road	Western Avenue
East - West Road	Ezzard Charles Drive
Peak Hour	AM Peak

Givens	
Design speed	35
Type of traffic control	Signalized
DHV (Turning Lane)	20
DHV (Through Lane)	30
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	1
Backup Length	50 FT
Calculated turn lane length	100 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

100 FT

BSB_Turn Lane Calcs_Alt-I_I-12.xlsx
I-12_Ezz Char & Western WBL PM

North - South Road	Western Avenue
East - West Road	Ezzard Charles Drive
Peak Hour	PM Peak

Givens	
Design speed	35
Type of traffic control	Signalized
DHV (Turning Lane)	30
DHV (Through Lane)	30
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	1
Backup Length	50 FT
Calculated turn lane length	100 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

100 FT

BSB_Turn Lane Calcs_Alt-I_I-13.xlsx
I-13_Ezz Char & Winchell WBR AM

North - South Road	Winchell Avenue
East - West Road	Ezzard Charles Drive
Peak Hour	AM Peak

Givens	
Design speed	35
Type of traffic control	Signalized
DHV (Turning Lane)	60
DHV (Through Lane)	80
Signal cycle length	60
Number of through lanes	2
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	1
Backup Length	50 FT
Calculated turn lane length	100 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

100 FT

BSB_Turn Lane Calcs_Alt-I_I-13.xlsx
I-13_Ezz Char & Winchell WBR PM

North - South Road	Winchell Avenue
East - West Road	Ezzard Charles Drive
Peak Hour	PM Peak

Givens	
Design speed	35
Type of traffic control	Signalized
DHV (Turning Lane)	205
DHV (Through Lane)	245
Signal cycle length	60
Number of through lanes	2
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	4
Required storage length (401-7, 401-8)	175
Offset taper storage length	50
Final Length of storage	175

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	225 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	3
Backup Length	150 FT
Calculated turn lane length	225 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

225 FT

BSB_Turn Lane Calcs_Alt-I_I-13.xlsx
I-13_Ezz Char & Winchell NBL AM

North - South Road	Winchell Avenue
East - West Road	Ezzard Charles Drive
Peak Hour	AM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	30
DHV (Through Lane)	500
Signal cycle length	60
Number of through lanes	3
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	low
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	161 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	3
Backup Length	150 FT
Calculated turn lane length	161 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

161 FT

BSB_Turn Lane Calcs_Alt-I_I-13.xlsx
I-13_Ezz Char & Winchell NBL PM

North - South Road	Winchell Avenue
East - West Road	Ezzard Charles Drive
Peak Hour	PM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	20
DHV (Through Lane)	880
Signal cycle length	60
Number of through lanes	3
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	low
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	161 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	5
Backup Length	200 FT
Calculated turn lane length	200 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

200 FT

BSB_Turn Lane Calcs_Alt-I_I-14.xlsx
I-14_Ezz Char & Western SBL AM

North - South Road	Western Avenue
East - West Road	Ezzard Charles Drive
Peak Hour	AM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	160
DHV (Through Lane)	250
Signal cycle length	60
Number of through lanes	3
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	3
Required storage length (401-7, 401-8)	150
Offset taper storage length	50
Final Length of storage	150

Condition B Table	
Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table	
Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	261 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	261 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

261 FT

BSB_Turn Lane Calcs_Alt-I_I-14.xlsx
I-14_Ezz Char & Western SBL PM

North - South Road	Western Avenue
East - West Road	Ezzard Charles Drive
Peak Hour	PM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	85
DHV (Through Lane)	255
Signal cycle length	60
Number of through lanes	3
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	211 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	211 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

211 FT

BSB_Turn Lane Calcs_Alt-I_I-15.xlsx
I-15_Ezz Char & Winchell EBL AM

North - South Road	Winchell Avenue
East - West Road	Ezzard Charles Drive
Peak Hour	AM Peak

Givens	
Design speed	35
Type of traffic control	Signalized
DHV (Turning Lane)	10
DHV (Through Lane)	320
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	low
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	3
Backup Length	150 FT
Calculated turn lane length	150 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

150 FT

BSB_Turn Lane Calcs_Alt-I_I-15.xlsx
I-15_Ezz Char & Winchell EBL PM

North - South Road	Winchell Avenue
East - West Road	Ezzard Charles Drive
Peak Hour	PM Peak

Givens	
Design speed	35
Type of traffic control	Signalized
DHV (Turning Lane)	50
DHV (Through Lane)	130
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	100 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

100 FT

BSB_Turn Lane Calcs_Alt-I_I-16.xlsx
I-16_Ezz Char & Linn St EBL AM

North - South Road	Linn Street
East - West Road	Ezzard Charles Drive
Peak Hour	AM Peak

Givens	
Design speed	35
Type of traffic control	Signalized
DHV (Turning Lane)	50
DHV (Through Lane)	470
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	low
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	4
Backup Length	175 FT
Calculated turn lane length	175 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

175 FT

BSB_Turn Lane Calcs_Alt-I_I-16.xlsx
I-16_Ezz Char & Linn St EBL PM

North - South Road	Linn Street
East - West Road	Ezzard Charles Drive
Peak Hour	PM Peak

Givens	
Design speed	35
Type of traffic control	Signalized
DHV (Turning Lane)	40
DHV (Through Lane)	190
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	100 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

100 FT

BSB_Turn Lane Calcs_Alt-I_I-16.xlsx
I-16_Ezz Char & Linn St WBL AM

North - South Road	Linn Street
East - West Road	Ezzard Charles Drive
Peak Hour	AM Peak

Givens	
Design speed	35
Type of traffic control	Signalized
DHV (Turning Lane)	20
DHV (Through Lane)	120
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	1
Backup Length	50 FT
Calculated turn lane length	100 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

100 FT

BSB_Turn Lane Calcs_Alt-I_I-16.xlsx
I-16_Ezz Char & Linn St WBL PM

North - South Road	Linn Street
East - West Road	Ezzard Charles Drive
Peak Hour	PM Peak

Givens	
Design speed	35
Type of traffic control	Signalized
DHV (Turning Lane)	30
DHV (Through Lane)	400
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	low
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	4
Backup Length	175 FT
Calculated turn lane length	175 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

175 FT

BSB_Turn Lane Calcs_Alt-I_I-16.xlsx
I-16_Ezz Char & Linn St NBL AM

North - South Road	Linn Street
East - West Road	Ezzard Charles Drive
Peak Hour	AM Peak

Givens	
Design speed	35
Type of traffic control	Signalized
DHV (Turning Lane)	40
DHV (Through Lane)	250
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	3
Backup Length	150 FT
Calculated turn lane length	150 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

150 FT

BSB_Turn Lane Calcs_Alt-I_I-16.xlsx
I-16_Ezz Char & Linn St NBL PM

North - South Road	Linn Street
East - West Road	Ezzard Charles Drive
Peak Hour	PM Peak

Givens	
Design speed	35
Type of traffic control	Signalized
DHV (Turning Lane)	40
DHV (Through Lane)	410
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	low
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	4
Backup Length	175 FT
Calculated turn lane length	175 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

175 FT

BSB_Turn Lane Calcs_Alt-I_I-16.xlsx
I-16_Ezz Char & Linn St NBR AM

North - South Road	Linn Street
East - West Road	Ezzard Charles Drive
Peak Hour	AM Peak

Givens	
Design speed	35
Type of traffic control	Signalized
DHV (Turning Lane)	60
DHV (Through Lane)	250
Signal cycle length	60
Number of through lanes	2
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	3
Backup Length	150 FT
Calculated turn lane length	150 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

150 FT

BSB_Turn Lane Calcs_Alt-I_I-16.xlsx
I-16_Ezz Char & Linn St NBR PM

North - South Road	Linn Street
East - West Road	Ezzard Charles Drive
Peak Hour	PM Peak

Givens	
Design speed	35
Type of traffic control	Signalized
DHV (Turning Lane)	30
DHV (Through Lane)	410
Signal cycle length	60
Number of through lanes	2
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	low
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	4
Backup Length	175 FT
Calculated turn lane length	175 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

175 FT

BSB_Turn Lane Calcs_Alt-I_I-16.xlsx
I-16_Ezz Char & Linn St SBL AM

North - South Road	Linn Street
East - West Road	Ezzard Charles Drive
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	80
DHV (Through Lane)	210
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	150 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	150 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

150 FT

BSB_Turn Lane Calcs_Alt-I_I-16.xlsx
I-16_Ezz Char & Linn St SBL PM

North - South Road	Linn Street
East - West Road	Ezzard Charles Drive
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	80
DHV (Through Lane)	380
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	150 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	4
Backup Length	175 FT
Calculated turn lane length	175 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

175 FT

BSB_Turn Lane Calcs_Alt-I_I-16.xlsx
I-16_Ezz Char & Linn St SBR AM

North - South Road	Linn Street
East - West Road	Ezzard Charles Drive
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	40
DHV (Through Lane)	210
Signal cycle length	60
Number of through lanes	2
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	100 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

100 FT

BSB_Turn Lane Calcs_Alt-I_I-16.xlsx
I-16_Ezz Char & Linn St SBR PM

North - South Road	Linn Street
East - West Road	Ezzard Charles Drive
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	110
DHV (Through Lane)	380
Signal cycle length	60
Number of through lanes	2
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	150 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	4
Backup Length	175 FT
Calculated turn lane length	175 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

175 FT

BSB_Turn Lane Calcs_Alt-I_I-17.xlsx
I-17_Gest St & Dalton EBL AM

North - South Road	Dalton Avenue
East - West Road	Gest Street
Peak Hour	AM Peak

Givens	
Design speed	35
Type of traffic control	Signalized
DHV (Turning Lane)	90
DHV (Through Lane)	180
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table	
Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table	
Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	150 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	150 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

150 FT

BSB_Turn Lane Calcs_Alt-I_I-17.xlsx
I-17_Gest St & Dalton EBL PM

North - South Road	Dalton Avenue
East - West Road	Gest Street
Peak Hour	PM Peak

Givens	
Design speed	35
Type of traffic control	Signalized
DHV (Turning Lane)	60
DHV (Through Lane)	230
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table	
Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table	
Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	100 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

100 FT

BSB_Turn Lane Calcs_Alt-I_I-17.xlsx
I-17_Gest St & Dalton WBL AM

North - South Road	Dalton Avenue
East - West Road	Gest Street
Peak Hour	AM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	80
DHV (Through Lane)	280
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	211 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	3
Backup Length	150 FT
Calculated turn lane length	211 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

211 FT

BSB_Turn Lane Calcs_Alt-I_I-17.xlsx
I-17_Gest St & Dalton WBL PM

North - South Road	Dalton Avenue
East - West Road	Gest Street
Peak Hour	PM Peak

Givens

Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	70
DHV (Through Lane)	180
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations

Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	211 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	211 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

211 FT

BSB_Turn Lane Calcs_Alt-I_I-17.xlsx
I-17_Gest St & Dalton NBL AM

North - South Road	Dalton Avenue
East - West Road	Gest Street
Peak Hour	AM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	70
DHV (Through Lane)	330
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table	
Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table	
Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	211 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	3
Backup Length	150 FT
Calculated turn lane length	211 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

211 FT

BSB_Turn Lane Calcs_Alt-I_I-17.xlsx
I-17_Gest St & Dalton NBL PM

North - South Road	Dalton Avenue
East - West Road	Gest Street
Peak Hour	PM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	40
DHV (Through Lane)	330
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	161 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	3
Backup Length	150 FT
Calculated turn lane length	161 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

161 FT

BSB_Turn Lane Calcs_Alt-I_I-17.xlsx
I-17_Gest St & Dalton SBL AM

North - South Road	Dalton Avenue
East - West Road	Gest Street
Peak Hour	AM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	60
DHV (Through Lane)	330
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	161 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	3
Backup Length	150 FT
Calculated turn lane length	161 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

161 FT

BSB_Turn Lane Calcs_Alt-I_I-17.xlsx
I-17_Gest St & Dalton SBL PM

North - South Road	Dalton Avenue
East - West Road	Gest Street
Peak Hour	PM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	70
DHV (Through Lane)	820
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	low
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	211 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	7
Backup Length	275 FT
Calculated turn lane length	275 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

275 FT

BSB_Turn Lane Calcs_Alt-I_I-18.xlsx
I-18_Gest St & Western SBL AM

North - South Road	Western Avenue
East - West Road	Gest Street
Peak Hour	AM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	50
DHV (Through Lane)	10
Signal cycle length	120
Number of through lanes	1
Turning direction	Left
Number of turning lanes	2
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	30 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table	
Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table	
Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	175
Backup Length # of through vehicles per cycle	1
Backup Length	50 FT
Calculated turn lane length	175 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

175 FT

BSB_Turn Lane Calcs_Alt-I_I-18.xlsx
I-18_Gest St & Western SBL PM

North - South Road	Western Avenue
East - West Road	Gest Street
Peak Hour	PM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	130
DHV (Through Lane)	100
Signal cycle length	110
Number of through lanes	1
Turning direction	Left
Number of turning lanes	2
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	33 Cycles/Hour
Avg. # of vehicles/cycle*	4
Required storage length (401-7, 401-8)	88
Offset taper storage length	50
Final Length of storage	88

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	213
Backup Length # of through vehicles per cycle	4
Backup Length	175 FT
Calculated turn lane length	213 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

213 FT

BSB_Turn Lane Calcs_Alt-I_I-18.xlsx
I-18_Gest St & Western SBR AM

North - South Road	Western Avenue
East - West Road	Gest Street
Peak Hour	AM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	10
DHV (Through Lane)	50
Signal cycle length	120
Number of through lanes	2
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	30 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	161 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	1
Backup Length	50 FT
Calculated turn lane length	161 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

161 FT

BSB_Turn Lane Calcs_Alt-I_I-18.xlsx
I-18_Gest St & Western SBR PM

North - South Road	Western Avenue
East - West Road	Gest Street
Peak Hour	PM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	100
DHV (Through Lane)	130
Signal cycle length	110
Number of through lanes	2
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	33 Cycles/Hour
Avg. # of vehicles/cycle*	4
Required storage length (401-7, 401-8)	175
Offset taper storage length	50
Final Length of storage	175

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	286 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	286 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

286 FT

BSB_Turn Lane Calcs_Alt-I_I-19.xlsx
I-19_Gest St & Freeman EBL AM

North - South Road	Freeman Avenue
East - West Road	Gest Street
Peak Hour	AM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	75
DHV (Through Lane)	145
Signal cycle length	110
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	33 Cycles/Hour
Avg. # of vehicles/cycle*	3
Required storage length (401-7, 401-8)	150
Offset taper storage length	50
Final Length of storage	150

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	261 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	3
Backup Length	150 FT
Calculated turn lane length	261 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

261 FT

BSB_Turn Lane Calcs_Alt-I_I-19.xlsx
I-19_Gest St & Freeman EBL PM

North - South Road	Freeman Avenue
East - West Road	Gest Street
Peak Hour	PM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	110
DHV (Through Lane)	210
Signal cycle length	90
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	40 Cycles/Hour
Avg. # of vehicles/cycle*	3
Required storage length (401-7, 401-8)	150
Offset taper storage length	50
Final Length of storage	150

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	261 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	3
Backup Length	150 FT
Calculated turn lane length	261 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

261 FT

BSB_Turn Lane Calcs_Alt-I_I-19.xlsx
I-19_Gest St & Freeman WBL AM

North - South Road	Freeman Avenue
East - West Road	Gest Street
Peak Hour	AM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	10
DHV (Through Lane)	170
Signal cycle length	110
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	low
# of cycles/hour	33 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	161 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	3
Backup Length	150 FT
Calculated turn lane length	161 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

161 FT

BSB_Turn Lane Calcs_Alt-I_I-19.xlsx
I-19_Gest St & Freeman WBL PM

North - South Road	Freeman Avenue
East - West Road	Gest Street
Peak Hour	PM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	10
DHV (Through Lane)	90
Signal cycle length	90
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	low
# of cycles/hour	40 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	161 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	161 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

161 FT

BSB_Turn Lane Calcs_Alt-I_I-19.xlsx
I-19_Gest St & Freeman WBR AM

North - South Road	Freeman Avenue
East - West Road	Gest Street
Peak Hour	AM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	127
DHV (Through Lane)	253
Signal cycle length	110
Number of through lanes	2
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	33 Cycles/Hour
Avg. # of vehicles/cycle*	4
Required storage length (401-7, 401-8)	175
Offset taper storage length	50
Final Length of storage	175

Condition B Table	
Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table	
Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	286 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	4
Backup Length	175 FT
Calculated turn lane length	286 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

286 FT

BSB_Turn Lane Calcs_Alt-I_I-19.xlsx
I-19_Gest St & Freeman WBR PM

North - South Road	Freeman Avenue
East - West Road	Gest Street
Peak Hour	PM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	145
DHV (Through Lane)	235
Signal cycle length	90
Number of through lanes	2
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	40 Cycles/Hour
Avg. # of vehicles/cycle*	4
Required storage length (401-7, 401-8)	175
Offset taper storage length	50
Final Length of storage	175

Condition B Table	
Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table	
Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	286 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	3
Backup Length	150 FT
Calculated turn lane length	286 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

286 FT

BSB_Turn Lane Calcs_Alt-I_I-19.xlsx
I-19_Gest St & Freeman NBL AM

North - South Road	Freeman Avenue
East - West Road	Gest Street
Peak Hour	AM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	10
DHV (Through Lane)	520
Signal cycle length	110
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	low
# of cycles/hour	33 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	161 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	8
Backup Length	325 FT
Calculated turn lane length	325 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

325 FT

BSB_Turn Lane Calcs_Alt-I_I-19.xlsx
I-19_Gest St & Freeman NBL PM

North - South Road	Freeman Avenue
East - West Road	Gest Street
Peak Hour	PM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	20
DHV (Through Lane)	430
Signal cycle length	90
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	low
# of cycles/hour	40 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	161 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	6
Backup Length	250 FT
Calculated turn lane length	250 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

250 FT

BSB_Turn Lane Calcs_Alt-I_I-19.xlsx
I-19_Gest St & Freeman NBR AM

North - South Road	Freeman Avenue
East - West Road	Gest Street
Peak Hour	AM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	10
DHV (Through Lane)	520
Signal cycle length	110
Number of through lanes	2
Turning direction	Right
Number of turning lanes	2
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	low
# of cycles/hour	33 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	25
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	175
Backup Length # of through vehicles per cycle	8
Backup Length	325 FT
Calculated turn lane length	325 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

325 FT

BSB_Turn Lane Calcs_Alt-I_I-19.xlsx
I-19_Gest St & Freeman NBR PM

North - South Road	Freeman Avenue
East - West Road	Gest Street
Peak Hour	PM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	10
DHV (Through Lane)	430
Signal cycle length	90
Number of through lanes	2
Turning direction	Right
Number of turning lanes	2
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	low
# of cycles/hour	40 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	25
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	175
Backup Length # of through vehicles per cycle	6
Backup Length	250 FT
Calculated turn lane length	250 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

250 FT

BSB_Turn Lane Calcs_Alt-I_I-19.xlsx
I-19_Gest St & Freeman SBL AM

North - South Road	Freeman Avenue
East - West Road	Gest Street
Peak Hour	AM Peak

Givens	
Design speed	35
Type of traffic control	Signalized
DHV (Turning Lane)	300
DHV (Through Lane)	510
Signal cycle length	110
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	33 Cycles/Hour
Avg. # of vehicles/cycle*	10
Required storage length (401-7, 401-8)	375
Offset taper storage length	50
Final Length of storage	375

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	425 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	8
Backup Length	325 FT
Calculated turn lane length	425 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

425 FT

BSB_Turn Lane Calcs_Alt-I_I-19.xlsx
I-19_Gest St & Freeman SBL PM

North - South Road	Freeman Avenue
East - West Road	Gest Street
Peak Hour	PM Peak

Givens	
Design speed	35
Type of traffic control	Signalized
DHV (Turning Lane)	130
DHV (Through Lane)	480
Signal cycle length	90
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	40 Cycles/Hour
Avg. # of vehicles/cycle*	4
Required storage length (401-7, 401-8)	175
Offset taper storage length	50
Final Length of storage	175

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	225 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	6
Backup Length	250 FT
Calculated turn lane length	250 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

250 FT

BSB_Turn Lane Calcs_Alt-I_I-20.xlsx
I-20_Gest St & Linn St WBR AM

North - South Road	Gest Street
East - West Road	Linn Street
Peak Hour	AM Peak

Givens

Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	195
DHV (Through Lane)	195
Signal cycle length	60
Number of through lanes	1
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations

Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	4
Required storage length (401-7, 401-8)	175
Offset taper storage length	50
Final Length of storage	175

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	286 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	4
Backup Length	175 FT
Calculated turn lane length	286 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

286 FT

BSB_Turn Lane Calcs_Alt-I_I-20.xlsx
I-20_Gest St & Linn St WBR PM

North - South Road	Gest Street
East - West Road	Linn Street
Peak Hour	PM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	200
DHV (Through Lane)	240
Signal cycle length	60
Number of through lanes	1
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	4
Required storage length (401-7, 401-8)	175
Offset taper storage length	50
Final Length of storage	175

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	286 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	4
Backup Length	175 FT
Calculated turn lane length	286 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

286 FT

BSB_Turn Lane Calcs_Alt-I_I-20.xlsx
I-20_Gest St & Linn St SBL AM

North - South Road	Gest Street
East - West Road	Linn Street
Peak Hour	AM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	70
DHV (Through Lane)	90
Signal cycle length	60
Number of through lanes	1
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	211 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	211 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

211 FT

BSB_Turn Lane Calcs_Alt-I_I-20.xlsx
I-20_Gest St & Linn St SBL PM

North - South Road	Gest Street
East - West Road	Linn Street
Peak Hour	PM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	95
DHV (Through Lane)	95
Signal cycle length	60
Number of through lanes	1
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	211 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	211 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

211 FT

BSB_Turn Lane Calcs_Alt-I_I-21.xlsx
I-21_Court St & Linn St WBR AM

North - South Road	Linn Street
East - West Road	Court Street
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Unsignalized Stopped Crossroad
DHV (Turning Lane)	10
DHV (Through Lane)	30
Signal cycle length	60
Number of through lanes	1
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	1
Backup Length	50 FT
Calculated turn lane length	100 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

100 FT

BSB_Turn Lane Calcs_Alt-I_I-21.xlsx
I-21_Court St & Linn St WBR PM

North - South Road	Linn Street
East - West Road	Court Street
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Unsignalized Stopped Crossroad
DHV (Turning Lane)	10
DHV (Through Lane)	60
Signal cycle length	60
Number of through lanes	1
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	1
Backup Length	50 FT
Calculated turn lane length	100 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

100 FT

BSB_Turn Lane Calcs_Alt-I_I-21.xlsx
I-21_Court St & Linn St SBL AM

North - South Road	Linn Street
East - West Road	Court Street
Peak Hour	AM Peak

Givens	
Design speed	35
Type of traffic control	Unsignalized Through Road
DHV (Turning Lane)	10
DHV (Through Lane)	160
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	low
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	-
Backup Length	No backup on unsignalized through road
Calculated turn lane length	100 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

100 FT

BSB_Turn Lane Calcs_Alt-I_I-21.xlsx
I-21_Court St & Linn St SBL PM

North - South Road	Linn Street
East - West Road	Court Street
Peak Hour	PM Peak

Givens	
Design speed	35
Type of traffic control	Unsignalized Through Road
DHV (Turning Lane)	10
DHV (Through Lane)	290
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	low
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table	
Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table	
Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	-
Backup Length	No backup on unsignalized through road
Calculated turn lane length	100 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

100 FT

BSB_Turn Lane Calcs_Alt-I_I-21.xlsx
I-21_Court St & Linn St NBL AM

North - South Road	Linn Street
East - West Road	Court Street
Peak Hour	AM Peak

Givens	
Design speed	40
Type of traffic control	Unsignalized Through Road
DHV (Turning Lane)	20
DHV (Through Lane)	180
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	low
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table	
Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table	
Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	125 FT
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	-
Backup Length	No backup on unsignalized through road
Calculated turn lane length	125 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

125 FT

BSB_Turn Lane Calcs_Alt-I_I-21.xlsx
I-21_Court St & Linn St NBL PM

North - South Road	Linn Street
East - West Road	Court Street
Peak Hour	PM Peak

Givens	
Design speed	40
Type of traffic control	Unsignalized Through Road
DHV (Turning Lane)	20
DHV (Through Lane)	260
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	low
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	125 FT
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	-
Backup Length	No backup on unsignalized through road
Calculated turn lane length	125 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

125 FT

BSB_Turn Lane Calcs_Alt-I_I-21.xlsx
I-21_Court St & Linn St NBR AM

North - South Road	Linn Street
East - West Road	Court Street
Peak Hour	AM Peak

Givens	
Design speed	40
Type of traffic control	Unsignalized Through Road
DHV (Turning Lane)	80
DHV (Through Lane)	180
Signal cycle length	60
Number of through lanes	2
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	condition c
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	211 FT
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	-
Backup Length	No backup on unsignalized through road
Calculated turn lane length	211 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

211 FT

BSB_Turn Lane Calcs_Alt-I_I-21.xlsx
I-21_Court St & Linn St NBR PM

North - South Road	Linn Street
East - West Road	Court Street
Peak Hour	PM Peak

Givens	
Design speed	40
Type of traffic control	Unsignalized Through Road
DHV (Turning Lane)	40
DHV (Through Lane)	260
Signal cycle length	60
Number of through lanes	2
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	condition c
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	161 FT
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	-
Backup Length	No backup on unsignalized through road
Calculated turn lane length	161 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

161 FT

BSB_Turn Lane Calcs_Alt-I_I-23.xlsx
I-23_ 8th St W & Dalton EBL AM

North - South Road	Dalton Avenue
East - West Road	8th St W
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	120
DHV (Through Lane)	620
Signal cycle length	60
Number of through lanes	3
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	150 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	4
Backup Length	175 FT
Calculated turn lane length	175 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

175 FT

BSB_Turn Lane Calcs_Alt-I_I-23.xlsx
I-23_ 8th St W & Dalton EBL PM

North - South Road	Dalton Avenue
East - West Road	8th St W
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	50
DHV (Through Lane)	270
Signal cycle length	60
Number of through lanes	3
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	100 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

100 FT

BSB_Turn Lane Calcs_Alt-I_I-23.xlsx
I-23_ 8th St W & Dalton EBR AM

North - South Road	Dalton Avenue
East - West Road	8th St W
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	40
DHV (Through Lane)	620
Signal cycle length	60
Number of through lanes	3
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	low
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	4
Backup Length	175 FT
Calculated turn lane length	175 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

175 FT

BSB_Turn Lane Calcs_Alt-I_I-23.xlsx
I-23_ 8th St W & Dalton EBR PM

North - South Road	Dalton Avenue
East - West Road	8th St W
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	40
DHV (Through Lane)	270
Signal cycle length	60
Number of through lanes	3
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	100 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

100 FT

BSB_Turn Lane Calcs_Alt-I_I-23.xlsx
I-23_ 8th St W & Dalton WBL AM

North - South Road	Dalton Avenue
East - West Road	8th St W
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	30
DHV (Through Lane)	240
Signal cycle length	60
Number of through lanes	3
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table	
Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table	
Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	100 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

100 FT

BSB_Turn Lane Calcs_Alt-I_I-23.xlsx
I-23_ 8th St W & Dalton WBL PM

North - South Road	Dalton Avenue
East - West Road	8th St W
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	20
DHV (Through Lane)	620
Signal cycle length	60
Number of through lanes	3
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	low
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	4
Backup Length	175 FT
Calculated turn lane length	175 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

175 FT

BSB_Turn Lane Calcs_Alt-I_I-23.xlsx
I-23_ 8th St W & Dalton WBR AM

North - South Road	Dalton Avenue
East - West Road	8th St W
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	130
DHV (Through Lane)	240
Signal cycle length	60
Number of through lanes	3
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	3
Required storage length (401-7, 401-8)	150
Offset taper storage length	50
Final Length of storage	150

Condition B Table	
Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table	
Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	200 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	200 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

200 FT

BSB_Turn Lane Calcs_Alt-I_I-23.xlsx
I-23_ 8th St W & Dalton WBR PM

North - South Road	Dalton Avenue
East - West Road	8th St W
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	90
DHV (Through Lane)	620
Signal cycle length	60
Number of through lanes	3
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	150 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	4
Backup Length	175 FT
Calculated turn lane length	175 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

175 FT

BSB_Turn Lane Calcs_Alt-I_I-23.xlsx
I-23_8th St W & Dalton SBL AM

North - South Road	Dalton Avenue
East - West Road	8th St W
Peak Hour	AM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	170
DHV (Through Lane)	200
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	3
Required storage length (401-7, 401-8)	150
Offset taper storage length	50
Final Length of storage	150

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	261 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	261 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

261 FT

BSB_Turn Lane Calcs_Alt-I_I-23.xlsx
I-23_8th St W & Dalton SBL PM

North - South Road	Dalton Avenue
East - West Road	8th St W
Peak Hour	PM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	230
DHV (Through Lane)	520
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	4
Required storage length (401-7, 401-8)	175
Offset taper storage length	50
Final Length of storage	175

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	286 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	5
Backup Length	200 FT
Calculated turn lane length	286 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

286 FT

BSB_Turn Lane Calcs_Alt-I_I-23.xlsx
I-23_8th St W & Dalton NBL AM

North - South Road	Dalton Avenue
East - West Road	8th St W
Peak Hour	AM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	70
DHV (Through Lane)	240
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	211 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	211 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

211 FT

BSB_Turn Lane Calcs_Alt-I_I-23.xlsx
I-23_8th St W & Dalton NBL PM

North - South Road	Dalton Avenue
East - West Road	8th St W
Peak Hour	PM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	70
DHV (Through Lane)	200
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	211 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	211 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

211 FT

BSB_Turn Lane Calcs_Alt-I_I-24.xlsx
I-24_ 8th St W & Freeman EBL AM

North - South Road	Freeman Avenue
East - West Road	8th St W
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	50
DHV (Through Lane)	670
Signal cycle length	60
Number of through lanes	3
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	low
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	4
Backup Length	175 FT
Calculated turn lane length	175 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

175 FT

BSB_Turn Lane Calcs_Alt-I_I-24.xlsx
I-24_ 8th St W & Freeman EBL PM

North - South Road	Freeman Avenue
East - West Road	8th St W
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	70
DHV (Through Lane)	350
Signal cycle length	60
Number of through lanes	3
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	150 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	150 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

150 FT

BSB_Turn Lane Calcs_Alt-I_I-24.xlsx
I-24_ 8th St W & Freeman EBR AM

North - South Road	Freeman Avenue
East - West Road	8th St W
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	100
DHV (Through Lane)	670
Signal cycle length	60
Number of through lanes	3
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	150 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	4
Backup Length	175 FT
Calculated turn lane length	175 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

175 FT

BSB_Turn Lane Calcs_Alt-I_I-24.xlsx
I-24_ 8th St W & Freeman EBR PM

North - South Road	Freeman Avenue
East - West Road	8th St W
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	270
DHV (Through Lane)	350
Signal cycle length	60
Number of through lanes	3
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	5
Required storage length (401-7, 401-8)	200
Offset taper storage length	50
Final Length of storage	200

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	250 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	250 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

250 FT

BSB_Turn Lane Calcs_Alt-I_I-24.xlsx
I-24_ 8th St W & Freeman WBL AM

North - South Road	Freeman Avenue
East - West Road	8th St W
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	60
DHV (Through Lane)	250
Signal cycle length	60
Number of through lanes	3
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	100 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

100 FT

BSB_Turn Lane Calcs_Alt-I_I-24.xlsx
I-24_ 8th St W & Freeman WBL PM

North - South Road	Freeman Avenue
East - West Road	8th St W
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	220
DHV (Through Lane)	610
Signal cycle length	60
Number of through lanes	3
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	4
Required storage length (401-7, 401-8)	175
Offset taper storage length	50
Final Length of storage	175

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	225 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	4
Backup Length	175 FT
Calculated turn lane length	225 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

225 FT

BSB_Turn Lane Calcs_Alt-I_I-24.xlsx
I-24_ 8th St W & Freeman WBR AM

North - South Road	Freeman Avenue
East - West Road	8th St W
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	50
DHV (Through Lane)	250
Signal cycle length	60
Number of through lanes	3
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table	
Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table	
Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	100 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

100 FT

BSB_Turn Lane Calcs_Alt-I_I-24.xlsx
I-24_ 8th St W & Freeman WBR PM

North - South Road	Freeman Avenue
East - West Road	8th St W
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	110
DHV (Through Lane)	610
Signal cycle length	60
Number of through lanes	3
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	150 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	4
Backup Length	175 FT
Calculated turn lane length	175 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

175 FT

BSB_Turn Lane Calcs_Alt-I_I-24.xlsx
I-24_8th St W & Freeman NBL AM

North - South Road	Freeman Avenue
East - West Road	8th St W
Peak Hour	AM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	70
DHV (Through Lane)	660
Signal cycle length	60
Number of through lanes	3
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	low
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	211 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	4
Backup Length	175 FT
Calculated turn lane length	211 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

211 FT

BSB_Turn Lane Calcs_Alt-I_I-24.xlsx
I-24_8th St W & Freeman NBL PM

North - South Road	Freeman Avenue
East - West Road	8th St W
Peak Hour	PM Peak

Givens

Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	60
DHV (Through Lane)	250
Signal cycle length	60
Number of through lanes	3
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations

Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	161 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	161 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

161 FT

BSB_Turn Lane Calcs_Alt-I_I-24.xlsx
I-24_8th St W & Freeman SBL AM

North - South Road	Freeman Avenue
East - West Road	8th St W
Peak Hour	AM Peak

Givens

Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	120
DHV (Through Lane)	280
Signal cycle length	60
Number of through lanes	3
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations

Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	211 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	211 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

211 FT

BSB_Turn Lane Calcs_Alt-I_I-24.xlsx
I-24_8th St W & Freeman SBL PM

North - South Road	Freeman Avenue
East - West Road	8th St W
Peak Hour	PM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	90
DHV (Through Lane)	460
Signal cycle length	60
Number of through lanes	3
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	211 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	3
Backup Length	150 FT
Calculated turn lane length	211 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

211 FT

BSB_Turn Lane Calcs_Alt-I_I-24.xlsx
I-24_8th St W & Freeman SBR AM

North - South Road	Freeman Avenue
East - West Road	8th St W
Peak Hour	AM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	90
DHV (Through Lane)	280
Signal cycle length	60
Number of through lanes	3
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	211 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	211 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

211 FT

BSB_Turn Lane Calcs_Alt-I_I-24.xlsx
I-24_8th St W & Freeman SBR PM

North - South Road	Freeman Avenue
East - West Road	8th St W
Peak Hour	PM Peak

Givens

Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	50
DHV (Through Lane)	460
Signal cycle length	60
Number of through lanes	3
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations

Demand	low
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	161 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	3
Backup Length	150 FT
Calculated turn lane length	161 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

161 FT

BSB_Turn Lane Calcs_Alt-I_I-25.xlsx
I-25_ 8th St W & Linn St EBL AM

North - South Road	Linn Street
East - West Road	8th St W
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	230
DHV (Through Lane)	570
Signal cycle length	60
Number of through lanes	3
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	4
Required storage length (401-7, 401-8)	175
Offset taper storage length	50
Final Length of storage	175

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	225 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	4
Backup Length	175 FT
Calculated turn lane length	225 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

225 FT

BSB_Turn Lane Calcs_Alt-I_I-25.xlsx
I-25_ 8th St W & Linn St EBL PM

North - South Road	Linn Street
East - West Road	8th St W
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	120
DHV (Through Lane)	230
Signal cycle length	65
Number of through lanes	3
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	55 Cycles/Hour
Avg. # of vehicles/cycle*	3
Required storage length (401-7, 401-8)	150
Offset taper storage length	50
Final Length of storage	150

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	200 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	200 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

200 FT

BSB_Turn Lane Calcs_Alt-I_I-25.xlsx
I-25_ 8th St W & Linn St EBR AM

North - South Road	Linn Street
East - West Road	8th St W
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	170
DHV (Through Lane)	570
Signal cycle length	60
Number of through lanes	3
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	3
Required storage length (401-7, 401-8)	150
Offset taper storage length	50
Final Length of storage	150

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	200 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	4
Backup Length	175 FT
Calculated turn lane length	200 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

200 FT

BSB_Turn Lane Calcs_Alt-I_I-25.xlsx
I-25_ 8th St W & Linn St EBR PM

North - South Road	Linn Street
East - West Road	8th St W
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	160
DHV (Through Lane)	230
Signal cycle length	65
Number of through lanes	3
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	55 Cycles/Hour
Avg. # of vehicles/cycle*	3
Required storage length (401-7, 401-8)	150
Offset taper storage length	50
Final Length of storage	150

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	200 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	200 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

200 FT

BSB_Turn Lane Calcs_Alt-I_I-25.xlsx
I-25_ 8th St W & Linn St WBL AM

North - South Road	Linn Street
East - West Road	8th St W
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	50
DHV (Through Lane)	190
Signal cycle length	60
Number of through lanes	3
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	100 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

100 FT

BSB_Turn Lane Calcs_Alt-I_I-25.xlsx
I-25_ 8th St W & Linn St WBL PM

North - South Road	Linn Street
East - West Road	8th St W
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	150
DHV (Through Lane)	540
Signal cycle length	65
Number of through lanes	3
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	55 Cycles/Hour
Avg. # of vehicles/cycle*	3
Required storage length (401-7, 401-8)	150
Offset taper storage length	50
Final Length of storage	150

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	200 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	4
Backup Length	175 FT
Calculated turn lane length	200 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

200 FT

BSB_Turn Lane Calcs_Alt-I_I-25.xlsx
I-25_8th St W & Linn St NBL AM

North - South Road	Linn St
East - West Road	8th St W
Peak Hour	AM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	150
DHV (Through Lane)	170
Signal cycle length	60
Number of through lanes	3
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	3
Required storage length (401-7, 401-8)	150
Offset taper storage length	50
Final Length of storage	150

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	261 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	1
Backup Length	50 FT
Calculated turn lane length	261 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

261 FT

BSB_Turn Lane Calcs_Alt-I_I-25.xlsx
I-25_8th St W & Linn St NBL PM

North - South Road	Linn St
East - West Road	8th St W
Peak Hour	PM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	300
DHV (Through Lane)	270
Signal cycle length	65
Number of through lanes	3
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	55 Cycles/Hour
Avg. # of vehicles/cycle*	6
Required storage length (401-7, 401-8)	250
Offset taper storage length	50
Final Length of storage	250

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	361 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	361 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

361 FT

BSB_Turn Lane Calcs_Alt-I_I-25.xlsx
I-25_8th St W & Linn St SBL AM

North - South Road	Linn Street
East - West Road	8th St W
Peak Hour	AM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	100
DHV (Through Lane)	240
Signal cycle length	60
Number of through lanes	3
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table	
Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table	
Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	211 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	211 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

211 FT

BSB_Turn Lane Calcs_Alt-I_I-25.xlsx
I-25_8th St W & Linn St SBL PM

North - South Road	Linn Street
East - West Road	8th St W
Peak Hour	PM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	140
DHV (Through Lane)	510
Signal cycle length	65
Number of through lanes	3
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	55 Cycles/Hour
Avg. # of vehicles/cycle*	3
Required storage length (401-7, 401-8)	150
Offset taper storage length	50
Final Length of storage	150

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	261 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	4
Backup Length	175 FT
Calculated turn lane length	261 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

261 FT

BSB_Turn Lane Calcs_Alt-I_I-25.xlsx
I-25_8th St W & Linn St NBR AM

North - South Road	Linn Street
East - West Road	8th St W
Peak Hour	AM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	60
DHV (Through Lane)	170
Signal cycle length	60
Number of through lanes	3
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	161 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	1
Backup Length	50 FT
Calculated turn lane length	161 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

161 FT

BSB_Turn Lane Calcs_Alt-I_I-25.xlsx
I-25_8th St W & Linn St NBR PM

North - South Road	Linn Street
East - West Road	8th St W
Peak Hour	PM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	50
DHV (Through Lane)	270
Signal cycle length	65
Number of through lanes	3
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	55 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	161 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	161 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

161 FT

BSB_Turn Lane Calcs_Alt-I_I-27.xlsx
I-27_ Dalton & Linn St EBL AM

North - South Road	Linn Street
East - West Road	Dalton Avenue
Peak Hour	AM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	10
DHV (Through Lane)	170
Signal cycle length	60
Number of through lanes	1
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	low
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	161 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	3
Backup Length	150 FT
Calculated turn lane length	161 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

161 FT

BSB_Turn Lane Calcs_Alt-I_I-27.xlsx
I-27_ Dalton & Linn St EBL PM

North - South Road	Linn Street
East - West Road	Dalton Avenue
Peak Hour	PM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	10
DHV (Through Lane)	500
Signal cycle length	60
Number of through lanes	1
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	low
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	161 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	9
Backup Length	350 FT
Calculated turn lane length	350 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

350 FT

BSB_Turn Lane Calcs_Alt-I_I-27.xlsx
I-27_ Dalton & Linn St EBR AM

North - South Road	Linn Street
East - West Road	Dalton Avenue
Peak Hour	AM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	170
DHV (Through Lane)	10
Signal cycle length	60
Number of through lanes	1
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	3
Required storage length (401-7, 401-8)	150
Offset taper storage length	50
Final Length of storage	150

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	261 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	1
Backup Length	50 FT
Calculated turn lane length	261 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

261 FT

BSB_Turn Lane Calcs_Alt-I_I-27.xlsx
I-27_ Dalton & Linn St EBR PM

North - South Road	Linn Street
East - West Road	Dalton Avenue
Peak Hour	PM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	500
DHV (Through Lane)	10
Signal cycle length	60
Number of through lanes	1
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	YES

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	9
Required storage length (401-7, 401-8)	350
Offset taper storage length	50
Final Length of storage	350

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	461 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	1
Backup Length	50 FT
Calculated turn lane length	461 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

461 FT

BSB_Turn Lane Calcs_Alt-I_I-27.xlsx
I-27_ Dalton & Linn St WBL AM

North - South Road	Linn Street
East - West Road	Dalton Avenue
Peak Hour	AM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	10
DHV (Through Lane)	540
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	low
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	161 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	5
Backup Length	200 FT
Calculated turn lane length	200 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

200 FT

BSB_Turn Lane Calcs_Alt-I_I-27.xlsx
I-27_ Dalton & Linn St WBL PM

North - South Road	Linn Street
East - West Road	Dalton Avenue
Peak Hour	PM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	50
DHV (Through Lane)	230
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	161 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	161 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

161 FT

BSB_Turn Lane Calcs_Alt-I_I-27.xlsx
I-27_Dalton & Linn St NBL AM

North - South Road	Linn St
East - West Road	Dalton Avenue
Peak Hour	AM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	110
DHV (Through Lane)	110
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	211 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	1
Backup Length	50 FT
Calculated turn lane length	211 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

211 FT

BSB_Turn Lane Calcs_Alt-I_I-27.xlsx
I-27_Dalton & Linn St NBL PM

North - South Road	Linn St
East - West Road	Dalton Avenue
Peak Hour	PM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	100
DHV (Through Lane)	160
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	211 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	211 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

211 FT

BSB_Turn Lane Calcs_Alt-I_I-27.xlsx
I-27_Dalton & Linn St SBR AM

North - South Road	Linn Street
East - West Road	Dalton Avenue
Peak Hour	AM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	20
DHV (Through Lane)	210
Signal cycle length	60
Number of through lanes	3
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	low
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	161 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	161 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

161 FT

BSB_Turn Lane Calcs_Alt-I_I-27.xlsx
I-27_Dalton & Linn St SBR PM

North - South Road	Linn Street
East - West Road	Dalton Avenue
Peak Hour	PM Peak

Givens	
Design speed	40
Type of traffic control	Signalized
DHV (Turning Lane)	30
DHV (Through Lane)	630
Signal cycle length	60
Number of through lanes	3
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	low
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition B or C
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	161 FT
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	4
Backup Length	175 FT
Calculated turn lane length	175 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

175 FT

BSB_Turn Lane Calcs_Alt-I_I-28.xlsx
I-28_ 6th St & Linn St SBL AM

North - South Road	Linn Street
East - West Road	W 6th Street
Peak Hour	AM Peak

Givens	
Design speed	40
Type of traffic control	Unsignalized Through Road
DHV (Turning Lane)	190
DHV (Through Lane)	200
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	4
Required storage length (401-7, 401-8)	175
Offset taper storage length	50
Final Length of storage	175

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	condition c
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	286 FT
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	-
Backup Length	No backup on unsignalized through road
Calculated turn lane length	286 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

286 FT

BSB_Turn Lane Calcs_Alt-I_I-28.xlsx
I-28_ 6th St & Linn St SBL PM

North - South Road	Linn Street
East - West Road	W 6th Street
Peak Hour	PM Peak

Givens	
Design speed	40
Type of traffic control	Unsignalized Through Road
DHV (Turning Lane)	680
DHV (Through Lane)	500
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	12
Required storage length (401-7, 401-8)	450
Offset taper storage length	50
Final Length of storage	450

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	condition c
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	561 FT
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	-
Backup Length	No backup on unsignalized through road
Calculated turn lane length	561 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

561 FT

BSB_Turn Lane Calcs_Alt-I_I-29.xlsx
I-29_ Court St & Central EBL AM

North - South Road	Central Avenue
East - West Road	W. Court Street
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	40
DHV (Through Lane)	340
Signal cycle length	60
Number of through lanes	1
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	6
Backup Length	250 FT
Calculated turn lane length	250 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

250 FT

BSB_Turn Lane Calcs_Alt-I_I-29.xlsx
I-29_ Court St & Central EBL PM

North - South Road	Central Avenue
East - West Road	W. Court Street
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	20
DHV (Through Lane)	150
Signal cycle length	60
Number of through lanes	1
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	3
Backup Length	150 FT
Calculated turn lane length	150 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

150 FT

BSB_Turn Lane Calcs_Alt-I_I-29.xlsx
I-29_ Court St & Central WBL AM

North - South Road	Central Avenue
East - West Road	W. Court Street
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	20
DHV (Through Lane)	70
Signal cycle length	60
Number of through lanes	1
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	100 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

100 FT

BSB_Turn Lane Calcs_Alt-I_I-29.xlsx
I-29_ Court St & Central WBL PM

North - South Road	Central Avenue
East - West Road	W. Court Street
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	130
DHV (Through Lane)	160
Signal cycle length	60
Number of through lanes	1
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	3
Required storage length (401-7, 401-8)	150
Offset taper storage length	50
Final Length of storage	150

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	200 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	3
Backup Length	150 FT
Calculated turn lane length	200 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

200 FT

BSB_Turn Lane Calcs_Alt-I_I-29.xlsx
I-29_ Court St & Central WBR AM

North - South Road	Central Avenue
East - West Road	W. Court Street
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	70
DHV (Through Lane)	70
Signal cycle length	60
Number of through lanes	1
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	150 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	150 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

150 FT

BSB_Turn Lane Calcs_Alt-I_I-29.xlsx
I-29_ Court St & Central WBR PM

North - South Road	Central Avenue
East - West Road	W. Court Street
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	30
DHV (Through Lane)	160
Signal cycle length	60
Number of through lanes	1
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	3
Backup Length	150 FT
Calculated turn lane length	150 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

150 FT

BSB_Turn Lane Calcs_Alt-I_I-29.xlsx
I-29_Court St & Central NBL AM

North - South Road	Central Avenue
East - West Road	W. Court Street
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	10
DHV (Through Lane)	160
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	low
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table	
Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table	
Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	100 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

100 FT

BSB_Turn Lane Calcs_Alt-I_I-29.xlsx
I-29_Court St & Central NBL PM

North - South Road	Central Avenue
East - West Road	W. Court Street
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	30
DHV (Through Lane)	170
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	100 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

100 FT

BSB_Turn Lane Calcs_Alt-I_I-29.xlsx
I-29_Court St & Central NBR AM

North - South Road	Central Avenue
East - West Road	W. Court Street
Peak Hour	AM Peak

Givens

Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	190
DHV (Through Lane)	160
Signal cycle length	60
Number of through lanes	2
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations

Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	4
Required storage length (401-7, 401-8)	175
Offset taper storage length	50
Final Length of storage	175

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	225 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	225 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

225 FT

BSB_Turn Lane Calcs_Alt-I_I-29.xlsx
I-29_Court St & Central NBR PM

North - South Road	Central Avenue
East - West Road	W. Court Street
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	130
DHV (Through Lane)	170
Signal cycle length	60
Number of through lanes	2
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	3
Required storage length (401-7, 401-8)	150
Offset taper storage length	50
Final Length of storage	150

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	200 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	200 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

200 FT

BSB_Turn Lane Calcs_Alt-I_I-30.xlsx
I-30_ W 9th St & Central NBL AM

North - South Road	Central Avenue
East - West Road	W 9th Street
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	80
DHV (Through Lane)	340
Signal cycle length	60
Number of through lanes	4
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	150 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	150 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

150 FT

BSB_Turn Lane Calcs_Alt-I_I-30.xlsx
I-30_ W 9th St & Central NBL PM

North - South Road	Central Avenue
East - West Road	W 9th Street
Peak Hour	PM Peak

Givens

Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	115
DHV (Through Lane)	385
Signal cycle length	60
Number of through lanes	4
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations

Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	150 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	150 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

150 FT

BSB_Turn Lane Calcs_Alt-I_I-31.xlsx
I-31_ 7th St W & Central NBR AM

North - South Road	Central Avenue
East - West Road	7th Street W
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	200
DHV (Through Lane)	190
Signal cycle length	60
Number of through lanes	2
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	4
Required storage length (401-7, 401-8)	175
Offset taper storage length	50
Final Length of storage	175

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	225 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	225 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

225 FT

BSB_Turn Lane Calcs_Alt-I_I-31.xlsx
I-31_7th St W & Central NBR PM

North - South Road	Central Avenue
East - West Road	7th Street W
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	90
DHV (Through Lane)	230
Signal cycle length	60
Number of through lanes	2
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	150 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	150 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

150 FT

BSB_Turn Lane Calcs_Alt-I_I-32.xlsx
I-32_6th St W & Central NBL AM

North - South Road	Central Avenue
East - West Road	6th Street W
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	20
DHV (Through Lane)	270
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	2
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	low
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	25
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	150
Backup Length # of through vehicles per cycle	3
Backup Length	150 FT
Calculated turn lane length	150 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

150 FT

BSB_Turn Lane Calcs_Alt-I_I-32.xlsx
I-32_6th St W & Central NBL PM

North - South Road	Central Avenue
East - West Road	6th Street W
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	90
DHV (Through Lane)	200
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	2
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A	-
Length = 50' + storage length	
Condition B	-
Length Including 50' taper	
Condition C	-
Length Including 50' taper	
Greatest Value from Condition B or C	-
Length Including 50' taper	
Single offset turn lane	-
Dual left turn lane	150
Backup Length	
# of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	150 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

150 FT

BSB_Turn Lane Calcs_Alt-I_I-33.xlsx
I-33_W 5th St & Central EBL AM

North - South Road	Central Avenue
East - West Road	W 5th Street
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	110
DHV (Through Lane)	1330
Signal cycle length	60
Number of through lanes	3
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	low
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	150 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	8
Backup Length	325 FT
Calculated turn lane length	325 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

325 FT

BSB_Turn Lane Calcs_Alt-I_I-33.xlsx
I-33_W 5th St & Central EBL PM

North - South Road	Central Avenue
East - West Road	W 5th Street
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	20
DHV (Through Lane)	490
Signal cycle length	60
Number of through lanes	3
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	low
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table	
Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table	
Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	3
Backup Length	150 FT
Calculated turn lane length	150 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

150 FT

BSB_Turn Lane Calcs_Alt-I_I-33.xlsx
I-33_W 5th St & Central EBR AM

North - South Road	Central Avenue
East - West Road	W 5th Street
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	80
DHV (Through Lane)	1330
Signal cycle length	60
Number of through lanes	3
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	low
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	150 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	8
Backup Length	325 FT
Calculated turn lane length	325 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

325 FT

BSB_Turn Lane Calcs_Alt-I_I-33.xlsx
I-33_W 5th St & Central EBR PM

North - South Road	Central Avenue
East - West Road	W 5th Street
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	30
DHV (Through Lane)	490
Signal cycle length	60
Number of through lanes	3
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	low
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	3
Backup Length	150 FT
Calculated turn lane length	150 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

150 FT

BSB_Turn Lane Calcs_Alt-I_I-33.xlsx
I-33_W 5th St & Central SBL AM

North - South Road	Central Avenue
East - West Road	W 5th Street
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	20
DHV (Through Lane)	60
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	2
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	25
Offset taper storage length	50
Final Length of storage	50

Condition B Table	
Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table	
Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	150
Backup Length # of through vehicles per cycle	1
Backup Length	50 FT
Calculated turn lane length	150 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

150 FT

BSB_Turn Lane Calcs_Alt-I_I-33.xlsx
I-33_W 5th St & Central SBL PM

North - South Road	Central Avenue
East - West Road	W 5th Street
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	30
DHV (Through Lane)	160
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	2
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	25
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	150
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	150 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

150 FT

BSB_Turn Lane Calcs_Alt-I_I-34.xlsx
I-34_4th St & Central WBR AM

North - South Road	Central Avenue
East - West Road	4th Street
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	180
DHV (Through Lane)	250
Signal cycle length	60
Number of through lanes	2
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	3
Required storage length (401-7, 401-8)	150
Offset taper storage length	50
Final Length of storage	150

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	200 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	3
Backup Length	150 FT
Calculated turn lane length	200 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

200 FT

BSB_Turn Lane Calcs_Alt-I_I-34.xlsx
I-34_4th St & Central WBR PM

North - South Road	Central Avenue
East - West Road	4th Street
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	140
DHV (Through Lane)	1180
Signal cycle length	100
Number of through lanes	2
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	36 Cycles/Hour
Avg. # of vehicles/cycle*	4
Required storage length (401-7, 401-8)	175
Offset taper storage length	50
Final Length of storage	175

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	225 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	17
Backup Length	600 FT
Calculated turn lane length	600 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

600 FT

BSB_Turn Lane Calcs_Alt-I_I-34.xlsx
I-34_4th St & Central NBL AM

North - South Road	Central Avenue
East - West Road	4th Street
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	40
DHV (Through Lane)	150
Signal cycle length	60
Number of through lanes	2
Turning direction	Left
Number of turning lanes	2
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	25
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	150
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	150 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

150 FT

BSB_Turn Lane Calcs_Alt-I_I-34.xlsx
I-34_4th St & Central NBL PM

North - South Road	Central Avenue
East - West Road	4th Street
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	330
DHV (Through Lane)	480
Signal cycle length	100
Number of through lanes	2
Turning direction	Left
Number of turning lanes	2
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	36 Cycles/Hour
Avg. # of vehicles/cycle*	10
Required storage length (401-7, 401-8)	188
Offset taper storage length	50
Final Length of storage	188

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	288
Backup Length # of through vehicles per cycle	7
Backup Length	275 FT
Calculated turn lane length	288 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

288 FT

BSB_Turn Lane Calcs_Alt-I_I-35.xlsx
I-35_3rd St & Central EBL AM

North - South Road	Central Avenue
East - West Road	3rd Street
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	170
DHV (Through Lane)	300
Signal cycle length	100
Number of through lanes	1
Turning direction	Left
Number of turning lanes	2
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	36 Cycles/Hour
Avg. # of vehicles/cycle*	5
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table	
Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table	
Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	200
Backup Length # of through vehicles per cycle	9
Backup Length	350 FT
Calculated turn lane length	350 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

350 FT

BSB_Turn Lane Calcs_Alt-I_I-35.xlsx
I-35_3rd St & Central EBL PM

North - South Road	Central Avenue
East - West Road	3rd Street
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	210
DHV (Through Lane)	100
Signal cycle length	110
Number of through lanes	1
Turning direction	Left
Number of turning lanes	2
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	33 Cycles/Hour
Avg. # of vehicles/cycle*	7
Required storage length (401-7, 401-8)	138
Offset taper storage length	50
Final Length of storage	138

Condition B Table	
Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table	
Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	238
Backup Length # of through vehicles per cycle	4
Backup Length	175 FT
Calculated turn lane length	238 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

238 FT

BSB_Turn Lane Calcs_Alt-I_I-35.xlsx
I-35_3rd St & Central EBR AM

North - South Road	Central Avenue
East - West Road	3rd Street
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	300
DHV (Through Lane)	170
Signal cycle length	100
Number of through lanes	2
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	36 Cycles/Hour
Avg. # of vehicles/cycle*	9
Required storage length (401-7, 401-8)	350
Offset taper storage length	50
Final Length of storage	350

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	400 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	3
Backup Length	150 FT
Calculated turn lane length	400 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

400 FT

BSB_Turn Lane Calcs_Alt-I_I-35.xlsx
I-35_3rd St & Central EBR PM

North - South Road	Central Avenue
East - West Road	3rd Street
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	100
DHV (Through Lane)	210
Signal cycle length	110
Number of through lanes	2
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	33 Cycles/Hour
Avg. # of vehicles/cycle*	4
Required storage length (401-7, 401-8)	175
Offset taper storage length	50
Final Length of storage	175

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	225 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	4
Backup Length	175 FT
Calculated turn lane length	225 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

225 FT

BSB_Turn Lane Calcs_Alt-I_I-35.xlsx
I-35_3rd St & Central WBL AM

North - South Road	Central Avenue
East - West Road	3rd Street
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	420
DHV (Through Lane)	480
Signal cycle length	100
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	36 Cycles/Hour
Avg. # of vehicles/cycle*	12
Required storage length (401-7, 401-8)	450
Offset taper storage length	50
Final Length of storage	450

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	500 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	7
Backup Length	275 FT
Calculated turn lane length	500 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

500 FT

BSB_Turn Lane Calcs_Alt-I_I-35.xlsx
I-35_3rd St & Central WBL PM

North - South Road	Central Avenue
East - West Road	3rd Street
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	90
DHV (Through Lane)	850
Signal cycle length	110
Number of through lanes	2
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	low
# of cycles/hour	33 Cycles/Hour
Avg. # of vehicles/cycle*	3
Required storage length (401-7, 401-8)	150
Offset taper storage length	50
Final Length of storage	150

Condition B Table	
Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table	
Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	200 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	13
Backup Length	475 FT
Calculated turn lane length	475 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

475 FT

BSB_Turn Lane Calcs_Alt-I_I-35.xlsx
I-35_3rd St & Central NBL AM

North - South Road	Central Avenue
East - West Road	3rd Street
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	50
DHV (Through Lane)	30
Signal cycle length	100
Number of through lanes	2
Turning direction	Left
Number of turning lanes	2
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	36 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table	
Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table	
Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	150
Backup Length # of through vehicles per cycle	1
Backup Length	50 FT
Calculated turn lane length	150 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

150 FT

BSB_Turn Lane Calcs_Alt-I_I-35.xlsx
I-35_3rd St & Central NBL PM

North - South Road	Central Avenue
East - West Road	3rd Street
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	350
DHV (Through Lane)	360
Signal cycle length	110
Number of through lanes	2
Turning direction	Left
Number of turning lanes	2
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	33 Cycles/Hour
Avg. # of vehicles/cycle*	11
Required storage length (401-7, 401-8)	200
Offset taper storage length	50
Final Length of storage	200

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	300
Backup Length # of through vehicles per cycle	6
Backup Length	250 FT
Calculated turn lane length	300 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

300 FT

BSB_Turn Lane Calcs_Alt-I_I-36.xlsx
I-36_4th St & Plum St WBL AM

North - South Road	Plum Street
East - West Road	4th Street
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	60
DHV (Through Lane)	410
Signal cycle length	60
Number of through lanes	3
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	3
Backup Length	150 FT
Calculated turn lane length	150 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

150 FT

BSB_Turn Lane Calcs_Alt-I_I-36.xlsx
I-36_4th St & Plum St WBL PM

North - South Road	Plum Street
East - West Road	4th Street
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	70
DHV (Through Lane)	1270
Signal cycle length	60
Number of through lanes	3
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	low
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table	
Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table	
Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	150 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	8
Backup Length	325 FT
Calculated turn lane length	325 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

325 FT

BSB_Turn Lane Calcs_Alt-I_I-36.xlsx
I-36_4th St & Plum St SBR AM

North - South Road	Plum Street
East - West Road	4th Street
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	50
DHV (Through Lane)	70
Signal cycle length	60
Number of through lanes	2
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	1
Backup Length	50 FT
Calculated turn lane length	100 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

100 FT

BSB_Turn Lane Calcs_Alt-I_I-36.xlsx
I-36_4th St & Plum St SBR PM

North - South Road	Plum Street
East - West Road	4th Street
Peak Hour	PM Peak

Givens

Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	60
DHV (Through Lane)	30
Signal cycle length	60
Number of through lanes	2
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations

Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	1
Backup Length	50 FT
Calculated turn lane length	100 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

100 FT

BSB_Turn Lane Calcs_Alt-I_I-38.xlsx
I-38_4th St & Elm St NBL AM

North - South Road	Elm
East - West Road	4th Street
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	150
DHV (Through Lane)	450
Signal cycle length	60
Number of through lanes	3
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	3
Required storage length (401-7, 401-8)	150
Offset taper storage length	50
Final Length of storage	150

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	200 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	3
Backup Length	150 FT
Calculated turn lane length	200 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

200 FT

BSB_Turn Lane Calcs_Alt-I_I-38.xlsx
I-38_4th St & Elm St NBL PM

North - South Road	Elm Street
East - West Road	4th Street
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	148
DHV (Through Lane)	442
Signal cycle length	60
Number of through lanes	3
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	3
Required storage length (401-7, 401-8)	150
Offset taper storage length	50
Final Length of storage	150

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	200 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	3
Backup Length	150 FT
Calculated turn lane length	200 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

200 FT

BSB_Turn Lane Calcs_Alt-I_I-38.xlsx
I-38_4th St & Elm St WBR AM

North - South Road	Elm Street
East - West Road	4th Street
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	170
DHV (Through Lane)	550
Signal cycle length	60
Number of through lanes	3
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	3
Required storage length (401-7, 401-8)	150
Offset taper storage length	50
Final Length of storage	150

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	200 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	4
Backup Length	175 FT
Calculated turn lane length	200 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

200 FT

BSB_Turn Lane Calcs_Alt-I_I-38.xlsx
I-38_4th St & Elm St WBR PM

North - South Road	Elm Street
East - West Road	4th Street
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	388
DHV (Through Lane)	1162
Signal cycle length	60
Number of through lanes	3
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	YES

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	7
Required storage length (401-7, 401-8)	275
Offset taper storage length	50
Final Length of storage	275

Condition B Table	
Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table	
Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E) Condition A

Condition A 325 FT
Length = 50' + storage length

Condition B -
Length Including 50' taper

Condition C -
Length Including 50' taper

Greatest Value from Condition B or C -
Length Including 50' taper

Single offset turn lane -

Dual left turn lane -

Backup Length
# of through vehicles per cycle 7

Backup Length 275 FT

Calculated turn lane length 325 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

325 FT

BSB_Turn Lane Calcs_Alt-I_I-39.xlsx
I-39_3rd St & Elm St NBL AM

North - South Road	Elm
East - West Road	3rd Street
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	150
DHV (Through Lane)	450
Signal cycle length	60
Number of through lanes	3
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	3
Required storage length (401-7, 401-8)	150
Offset taper storage length	50
Final Length of storage	150

Condition B Table	
Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table	
Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	200 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	3
Backup Length	150 FT
Calculated turn lane length	200 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

200 FT

BSB_Turn Lane Calcs_Alt-I_I-39.xlsx
I-39_3rd St & Elm St NBL PM

North - South Road	Elm
East - West Road	3rd Street
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	130
DHV (Through Lane)	220
Signal cycle length	60
Number of through lanes	3
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	3
Required storage length (401-7, 401-8)	150
Offset taper storage length	50
Final Length of storage	150

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	200 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	200 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

200 FT

BSB_Turn Lane Calcs_Alt-I_I-39.xlsx
I-39_3rd St & Elm St WBR AM

North - South Road	Elm
East - West Road	3rd Street
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	250
DHV (Through Lane)	1040
Signal cycle length	60
Number of through lanes	4
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	5
Required storage length (401-7, 401-8)	200
Offset taper storage length	50
Final Length of storage	200

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	250 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	5
Backup Length	200 FT
Calculated turn lane length	250 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

250 FT

BSB_Turn Lane Calcs_Alt-I_I-39.xlsx
I-39_3rd St & Elm St WBR PM

North - South Road	Elm
East - West Road	3rd Street
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	290
DHV (Through Lane)	1970
Signal cycle length	60
Number of through lanes	4
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	5
Required storage length (401-7, 401-8)	200
Offset taper storage length	50
Final Length of storage	200

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	250 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	9
Backup Length	350 FT
Calculated turn lane length	350 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

350 FT

BSB_Turn Lane Calcs_Alt-I_I-40.xlsx
I-40_2nd St & Elm St EBL AM

North - South Road	Elm
East - West Road	2nd Street
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	510
DHV (Through Lane)	2660
Signal cycle length	60
Number of through lanes	5
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	9
Required storage length (401-7, 401-8)	350
Offset taper storage length	50
Final Length of storage	350

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	400 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	9
Backup Length	350 FT
Calculated turn lane length	400 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

400 FT

BSB_Turn Lane Calcs_Alt-I_I-40.xlsx
I-40_2nd St & Elm St EBL PM

North - South Road	Elm
East - West Road	2nd Street
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	220
DHV (Through Lane)	1760
Signal cycle length	60
Number of through lanes	5
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	NO
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	60 Cycles/Hour
Avg. # of vehicles/cycle*	4
Required storage length (401-7, 401-8)	175
Offset taper storage length	50
Final Length of storage	175

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	225 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	6
Backup Length	250 FT
Calculated turn lane length	250 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

250 FT

BSB_Turn Lane Calcs_Alt-I_I-41.xlsx
I-41_3rd St & CW Bailey EBR AM

North - South Road	CW Bailey Bridge
East - West Road	3rd Street
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	210
DHV (Through Lane)	50
Signal cycle length	70
Number of through lanes	1
Turning direction	Right
Number of turning lanes	2
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume? -

Does turn volume exceed 100 VPH? -

Right Turns

Does turn volume exceed 300 VPH? NO

Storage Length Calculations	
Demand	high
# of cycles/hour	51 Cycles/Hour
Avg. # of vehicles/cycle*	5
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	200
Backup Length # of through vehicles per cycle	1
Backup Length	50 FT
Calculated turn lane length	200 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

200 FT

BSB_Turn Lane Calcs_Alt-I_I-41.xlsx
I-41_3rd St & CW Bailey EBR PM

North - South Road	CW Bailey Bridge
East - West Road	3rd Street
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	450
DHV (Through Lane)	100
Signal cycle length	75
Number of through lanes	1
Turning direction	Right
Number of turning lanes	2
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	YES

Storage Length Calculations	
Demand	high
# of cycles/hour	48 Cycles/Hour
Avg. # of vehicles/cycle*	10
Required storage length (401-7, 401-8)	188
Offset taper storage length	50
Final Length of storage	188

Condition B Table	
Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table	
Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	288
Backup Length # of through vehicles per cycle	3
Backup Length	150 FT
Calculated turn lane length	288 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

288 FT

BSB_Turn Lane Calcs_Alt-I_I-41.xlsx
I-41_3rd St & CW Bailey WBL AM

North - South Road	CW Bailey Bridge
East - West Road	3rd Street
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	50
DHV (Through Lane)	130
Signal cycle length	70
Number of through lanes	1
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	NO

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	51 Cycles/Hour
Avg. # of vehicles/cycle*	1
Required storage length (401-7, 401-8)	50
Offset taper storage length	50
Final Length of storage	50

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	100 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	3
Backup Length	150 FT
Calculated turn lane length	150 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

150 FT

BSB_Turn Lane Calcs_Alt-I_I-41.xlsx
I-41_3rd St & CW Bailey WBL PM

North - South Road	CW Bailey Bridge
East - West Road	3rd Street
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	245
DHV (Through Lane)	245
Signal cycle length	75
Number of through lanes	1
Turning direction	Left
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	48 Cycles/Hour
Avg. # of vehicles/cycle*	6
Required storage length (401-7, 401-8)	250
Offset taper storage length	50
Final Length of storage	250

Condition B Table	
Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table	
Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	300 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	6
Backup Length	250 FT
Calculated turn lane length	300 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

300 FT

BSB_Turn Lane Calcs_Alt-I_I-41.xlsx
I-41_3rd St & CW Bailey WBR AM

North - South Road	CW Bailey Bridge
East - West Road	3rd Street
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	140
DHV (Through Lane)	130
Signal cycle length	70
Number of through lanes	1
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	51 Cycles/Hour
Avg. # of vehicles/cycle*	3
Required storage length (401-7, 401-8)	150
Offset taper storage length	50
Final Length of storage	150

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	200 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	3
Backup Length	150 FT
Calculated turn lane length	200 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

200 FT

BSB_Turn Lane Calcs_Alt-I_I-41.xlsx
I-41_3rd St & CW Bailey WBR PM

North - South Road	CW Bailey Bridge
East - West Road	3rd Street
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	410
DHV (Through Lane)	20
Signal cycle length	75
Number of through lanes	1
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	YES

Storage Length Calculations	
Demand	high
# of cycles/hour	48 Cycles/Hour
Avg. # of vehicles/cycle*	9
Required storage length (401-7, 401-8)	350
Offset taper storage length	50
Final Length of storage	350

Condition B Table	
Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table	
Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	400 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	1
Backup Length	50 FT
Calculated turn lane length	400 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

400 FT

BSB_Turn Lane Calcs_Alt-I_I-41.xlsx
I-41_3rd St & CW Bailey NBL AM

North - South Road	CW Bailey Bridge
East - West Road	3rd Street
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	310
DHV (Through Lane)	160
Signal cycle length	70
Number of through lanes	1
Turning direction	Left
Number of turning lanes	2
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	51 Cycles/Hour
Avg. # of vehicles/cycle*	7
Required storage length (401-7, 401-8)	138
Offset taper storage length	50
Final Length of storage	138

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	238
Backup Length # of through vehicles per cycle	4
Backup Length	175 FT
Calculated turn lane length	238 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

238 FT

BSB_Turn Lane Calcs_Alt-I_I-41.xlsx
I-41_3rd St & CW Bailey NBL PM

North - South Road	CW Bailey Bridge
East - West Road	3rd Street
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	260
DHV (Through Lane)	60
Signal cycle length	75
Number of through lanes	1
Turning direction	Left
Number of turning lanes	2
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	YES
Does turn volume exceed 100 VPH?	YES

Right Turns

Does turn volume exceed 300 VPH?	-

Storage Length Calculations	
Demand	high
# of cycles/hour	48 Cycles/Hour
Avg. # of vehicles/cycle*	6
Required storage length (401-7, 401-8)	125
Offset taper storage length	50
Final Length of storage	125

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	-
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	225
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	225 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

225 FT

BSB_Turn Lane Calcs_Alt-I_I-41.xlsx
I-41_3rd St & CW Bailey NBR AM

North - South Road	CW Bailey Bridge
East - West Road	3rd Street
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	210
DHV (Through Lane)	160
Signal cycle length	70
Number of through lanes	1
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	51 Cycles/Hour
Avg. # of vehicles/cycle*	5
Required storage length (401-7, 401-8)	200
Offset taper storage length	50
Final Length of storage	200

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	250 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	4
Backup Length	175 FT
Calculated turn lane length	250 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

250 FT

BSB_Turn Lane Calcs_Alt-I_I-41.xlsx
I-41_3rd St & CW Bailey NBR PM

North - South Road	CW Bailey Bridge
East - West Road	3rd Street
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	80
DHV (Through Lane)	60
Signal cycle length	75
Number of through lanes	1
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	48 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	150 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	2
Backup Length	100 FT
Calculated turn lane length	150 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

150 FT

BSB_Turn Lane Calcs_Alt-I_I-41.xlsx
I-41_3rd St & CW Bailey SBR AM

North - South Road	CW Bailey Bridge
East - West Road	3rd Street
Peak Hour	AM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	70
DHV (Through Lane)	130
Signal cycle length	70
Number of through lanes	1
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume? -

Does turn volume exceed 100 VPH? -

Right Turns

Does turn volume exceed 300 VPH? NO

Storage Length Calculations	
Demand	high
# of cycles/hour	51 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	150 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	3
Backup Length	150 FT
Calculated turn lane length	150 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

150 FT

BSB_Turn Lane Calcs_Alt-I_I-41.xlsx
I-41_3rd St & CW Bailey SBR PM

North - South Road	CW Bailey Bridge
East - West Road	3rd Street
Peak Hour	PM Peak

Givens	
Design speed	30
Type of traffic control	Signalized
DHV (Turning Lane)	60
DHV (Through Lane)	200
Signal cycle length	75
Number of through lanes	1
Turning direction	Right
Number of turning lanes	1
Offset Distance	0

Left Turns

Does turn volume exceed 20% of total direction approach volume?	-
Does turn volume exceed 100 VPH?	-

Right Turns

Does turn volume exceed 300 VPH?	NO

Storage Length Calculations	
Demand	high
# of cycles/hour	48 Cycles/Hour
Avg. # of vehicles/cycle*	2
Required storage length (401-7, 401-8)	100
Offset taper storage length	50
Final Length of storage	100

Condition B Table

Design Speed	Length (including 50' taper)
40	125
45	175
50	225
55	285
60	345

Condition C Table

Design Speed	Length (including 50' taper)
40	111+ Storage Length
45	125+ Storage Length
50	143+ Storage Length
55	164+ Storage Length
60	181+ Storage Length

Type of Condition (Fig 401-9E)	Condition A
Condition A Length = 50' + storage length	150 FT
Condition B Length Including 50' taper	-
Condition C Length Including 50' taper	-
Greatest Value from Condition B or C Length Including 50' taper	-
Single offset turn lane	-
Dual left turn lane	-
Backup Length # of through vehicles per cycle	5
Backup Length	200 FT
Calculated turn lane length	200 FT

Notes:

Left turn lanes should be at least 100' long, and no more than 600' long. (L&D Vol. 1 Sec. 401.6.1)

Right turn lanes should be at least 100' long and no more than 800' long. (L&D Vol. 1 Sec. 401.6.3)

FINAL TURN LANE LENGTH

200 FT