

Boone County Northeast Transportation Plan



Prepared for Boone County by:



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Executive Summary

Northeast Boone County has come under increased development pressure, and as a result, Boone County and partnering agencies have created a transportation plan for the northeast subarea. Agencies partnering to create this transportation plan include Boone County, City of Columbia, Columbia Area Transportation Study Organization (CATSO), and the Missouri Department of Transportation (MoDOT). This transportation plan is intended to assist coordination between the partner agencies, who throughout the plan's development have been considering various transportation projects and development proposals affecting the subarea. Thus, this subarea transportation plan is intended to ensure that transportation decisions result in a cohesive and connected transportation network. Known previous studies and programmed improvements are coordinated in this plan.

The overall goal of this Boone County Northeast Transportation Plan is to *'Identify the needed transportation improvements for the area, linking all agency and potential development needs together, and create a plan for everyone to use as a tool.'* The purpose is ultimately to provide agencies and developers a guide for further coordination on transportation improvements in this subarea.

The overarching objectives of this Boone County Northeast Transportation Plan are:

- Forecast the traffic generated from all potential future developments over the next 20 years.
- Identify how much traffic will be distributed on local roadways.
- Identify what roadway improvements are needed to accommodate all forecasted future travel demands.
- Identify the cost needed for these improvements.
- Develop and identify possible funding mechanisms for these improvements.

This subarea contains roughly 3,100 acres (including over 1,800 developable acres) and the potential to support an estimated 2,800 new dwelling units and 1,900 new jobs. If all of this development occurs, the existing roadway infrastructure cannot support the generated traffic. If infrastructure improvements are not made and development occurs, the roadway system would operate at poor levels of service.

Existing roadways in the study area were generally constructed for the rural land uses that historically predominated until more recent suburban development. As such, roads tend to be narrow (and without shoulders), windy, and follow the terrain vertically. Intersections tend to be stop controlled and often include undesirable geometric conditions such as intersection skew. Sight distance is limited at many locations. Updating of the study area roadways to suburban standards is necessary as the land uses continue to evolve from rural uses to suburban uses.

Ensuring appropriate roadway infrastructure for emergency response is a key need for the subarea. Redundant access is required in the event the primary access route is blocked, or to provide the ability to evacuate civilians from an area while simultaneously deploying emergency

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responders. Emergency response to the northeast subarea is currently provided by way of the Boone County Lake of the Woods Fire Station (Station 1) near the intersection of St. Charles Road and Lake of the Woods Road. This fire station serves the entire study area. Fire district officials have expressed concern about access routes to Battle High School and the proposed elementary school using existing roads. Alternate access is provided via I-70 or I-70 Drive Southeast, Route Z, and St. Charles Road from the east. This route is nearly three times longer than the primary route.

The potential for annexation of this area into the City of Columbia heightens the need for coordination/partnerships between the City of Columbia and Boone County. These agencies have different design standards, functional classification thresholds, etc. Moreover, the agencies currently have different philosophies with regards to road building. While Boone County is not generally in a financial position to take the lead on financing the construction of new roads (deferring, rather, to the development community to get roads built) the City of Columbia has adopted a policy to take on the construction of arterial roadways to better serve their citizens and the business community (and thus spur further economic development). Creative partnering agreements will be required for the implementation of this plan. “Rolling Hills” was put forward an example of how an intergovernmental agreement such as this could work. In this case Boone County and the City of Columbia shared the cost to build a roadway outside of the City’s Limits (in Boone County) because the roadway would be important for the City as development and annexation occur.

Segment A of the Battle Avenue extension consistently surfaced as one of the highest priority improvements in the study area. This roadway would connect the recently constructed segment near Battle High School north to Mexico Gravel Road and provide access to Battle High School and the future elementary school from the north. This would allow many school related trips to access the academic campus area without traveling on other congested roadways such as Lake of the Woods Road, Clark Lane, or through the intersection of Route Z with St. Charles Road. A partnership between the City of Columbia and Boone County is critical to getting this portion of segment ‘A’ constructed. This segment is highly likely to be fully publically funded, although developer participation is possible.

Segment B is between St. Charles Road and the future Clark Extension. This segment, in conjunction with the Clark Lane extension, would carry most of the traffic currently on the corresponding section of St. Charles Road. The intersection of Battle Avenue and Clark Lane would be a prominent and highly traveled part of the landscape in the subarea, providing an opportunity for high-quality commercial development. As such, there may be opportunities, such as the formation of a Transportation Development District (TDD), to fund a part of this roadway in partnership with the City and/or County. Special consideration should be paid to the design of this intersection as it may present an opportunity for a “gateway” type treatment into the subarea.

Segment D, also known as the Olivet overpass, runs between Clark Avenue and Richland Road. When fully built out, Battle Avenue will be a north-south arterial roadway serving the high school, future elementary school, and will connect neighborhoods north and south of I-70. Coupled with Segment B, this roadway would provide access to Battle High School and the

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future elementary school from the south. This would allow school related trips approaching from south of I-70 to access the academic campus without traveling through the Lake of the Woods/St. Charles Road and Route Z interchanges. Due to its strategic location Segment D could reduce trips at the Lake of the Woods/St. Charles Road and Route Z interchanges by about 10-15%. This volume reduction would reduce the pressure to enhance those interchanges. Because of these reasons, Segment D also consistently surfaced as a high priority during discussions with partner agencies.

This project may require intergovernmental agreements between Boone County, the City of Columbia, and/or MoDOT. The bridge across I-70 may provide opportunities for participation in state/federal funding programs. Separate studies will be required to obtain MoDOT and Federal Highway Administration (FHWA) permits for the overpass. A critical design element of Segment D is the connections to ABC Lane (North I-70 Frontage Road) and I-70 Drive Southeast. These frontage roads are currently located within 50 feet of I-70, so special design provisions will be required to bring the roadway elevations together in order to create intersection connections. A design study should be undertaken to determine the preferred alignment of these connections so that Boone County or the City of Columbia can reserve the right-of-way needed to create these connections in the future.

An extension of Clark Lane to Route Z is needed for two primary reasons: 1) to facilitate commercial development and 2) to provide an east-west minor arterial relieving traffic volumes on St. Charles Road. The area that will be served by the extension of Clark Lane is ideal for commercial development. However, a new roadway is necessary to provide access in order for this development to occur. Moreover, this roadway extension is needed to alleviate future traffic volumes on St. Charles Road. St. Charles Road is narrow and has poor geometrics to serve as an arterial roadway. It would be difficult to straighten or widen St. Charles Road without major right-of-way and utility impacts. The Clark Lane extension corridor provides a good corridor for an east-west arterial roadway in this part of the study area.

Clark Lane, particularly at the intersection of Battle Avenue, would be a prominent and highly traveled part of the subarea's landscape, providing an opportunity for high-quality commercial development. Land uses abutting the extension would be mostly commercial. As such, there may be opportunities such as the formation of a Transportation Development District (TDD) to fund a part of this roadway. In this light, the Clark Lane extension is most likely initially to be constructed as a collector roadway in order to providing access to new businesses developing along the route. Developers would be required to plat and dedicate right-of-way for an ultimate arterial roadway cross-section, but initially construct a collector roadway. A future project could then be put into place to upgrade to an arterial roadway when conditions warrant.

Segment I would provide for a relocation of the North Outer Road, which is important for Route Z/I-70 interchange operations. The relocation of the North Outer Road would provide better spacing between the I-70 interchange westbound ramp terminal intersection and the north outer road intersection. This connection should be placed to provide for an enhanced connection to the Columbia Area Jobs Foundation (CAJF) site and private developable land to the east of Route Z.

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Planning for Segment F was expanded from its original limits (between Battle Avenue and North Battleground Subdivision) to new limits (between Lake of the Woods Road and Route Z). This was partly due to concerns about allowing subdivision cross-access between the Merideth/West Creek Tracts and Breezewood/Molly Lane. It was believed that if this cross-access were allowed to occur without a designated collector roadway in place it could result in these local roadways becoming “default” collector roadways. People are likely to use the local connections if they are in place and there is not a better alternative route. Breezewood and Molly Lane were not designed to collector roadway specifications and increased traffic volumes would be a problem for the residents along these routes. Therefore, extending Segment F as a collector roadway to Lake of the Woods Road would provide a connection between Battle Avenue and Lake of the Woods Road.

During discussions with partner agencies, it was determined to show Segment F relocated on the north side of the elementary school and reconfigure the Somerset Village collector so that it ties in across from Spartan Drive (Battle High School). This would result in better intersection spacing along Battle Avenue between St. Charles Road and Segment F and would provide an opportunity for a continuous roadway.

The western end of Segment F is critical to avoid overloading Battle Avenue north of St. Charles Road and connecting to Lake of the Woods Road. The western part of Segment F would provide a connection between Lake of the Woods and Battle High School/the future elementary school. However, the western end of Segment F is anticipated to have high construction costs due to terrain, making it less attractive for developers. Segment F could be a shared project with partial public funding and developer responsibility. For instance, a developer could be asked to build the roadway with a public agency taking responsibility for major culverts and/or any required bridges. A location study needs to be conducted to set the alignment for the western portion of Route F. The most logical route (from a roadway system standpoint) would be to connect the west end of this roadway to Lake of the Woods Road south of Mexico Gravel Road. However, this may be prohibitive due to terrain and existing development. Alternatively, the road could swing to the north and connect to Lake of the Woods Road closer to Mexico Gravel Road. However, the impact of closely spaced intersections on the northern section of Lake of the Woods Road and the future realignment of Lake of the Woods Road to Route PP needs to be considered. The east end of this segment could connect at either Spartan Drive or on the north side of the Merideth Tract. Connecting on the north side of the Merideth Tract would provide an opportunity for a continuous roadway. Connecting to Spartan Drive could result in Segment F being off-set across Battle Avenue. It is possible, depending on how the Merideth Tract develops, that both connections could be provided.

The proposed alignment of Segment F, east of Battle Avenue, is located largely along existing property lines. This alignment was chosen to minimize the impact to adjacent properties. However, existing county ordinances may create a problem in the implementation of this road. Specifically, county ordinance requires that a developer construct a roadway when they are required to dedicate right-of-way for that roadway. Along this alignment each property owner would be required to dedicate one-half of the right-of-way. The first property owners required to dedicate and plat right-of-way would not be able to construct the road (as required by county

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ordinance) because only one-half of the right-of-way would be dedicated at that time. The entire right-of-way (dedicated by property owners on both sides of the road) would be needed to construct the road. Therefore, we recommend that an exception should be given to property owners along Segment F such that they would be able to dedicate the required right-of-way but would not be required to construct the road. Funds from the proposed trip generation fees could be used to construct the road once the full width of right-of-way has been dedicated.

Segments G and H would most likely be developer financed roadways. These roadways would be required to facilitate future commercial development. As such, the development community would most likely be required to construct the roadway to provide connections to their businesses.

Route Z is a state maintained roadway. From a planning standpoint, it is important to consider the connection of County and City roadways to Route Z and the spacing between intersections. Ideally, intersection spacing should be about one-quarter to half mile, which is provided by the proposed plan. Major intersection spacing would be less than one-quarter mile at the I-70 interchange, which is acceptable for freeway interchanges.

The existing intersection of St. Charles Road and Route Z has several geometric deficiencies. The primary problems are 1) poor sight distance and 2) off-set skewed intersection resulting in poor turning radii. School busses can make all turns at the intersection if automobiles stop at the marked stop bars. However, there is a potentially historic barn in the northwest quadrant of the intersection. Eastbound traffic cannot see “around” the barn and tends to move forward past the stop bar. As a result, school busses often cannot make the northbound to westbound left turning movement when there is a vehicle on the eastbound approach. This will become a much bigger issue when the Battle High School opens in 2013 and the future elementary school is opened in the future. Semitrailer trucks with an overall wheelbase of 50 feet (WB-50) cannot make several of the turning movements at the intersection.

As a result of these concerns, in 2012 Boone County and MoDOT were approved for a cost share project to improve Route Z between I-70 and St. Charles Road. The project includes: 1) Reconstruction of the Route Z/I-70 overpass to three lanes, and providing dedicated southbound and eastbound right-turn lanes at the interchange. Serious consideration should be given to constructing the bridge with sufficient width so that it could ultimately be restriped to four lanes of traffic in the future. 2) Adding three foot shoulders to Route Z between I-70 and St. Charles Road. 3) Constructing a roundabout at the intersection of Route Z and St. Charles Road.

MoDOT is working on the design for this project, which is scheduled for a February 2013 letting and completion date prior to the opening of the Battle High School in August 2013. As a part of this project the access from Route Z to Karen Lane should be flipped from Route Z to St. Charles Road. Karen Lane is currently gated on the St. Charles Road end. The gate was put into place to stop cut-through traffic from St. Charles Road to Route Z caused by the issues at the existing intersection. The improvements currently being designed by MoDOT will necessitate this gate to be moved to the Route Z end of Karen Lane thus providing access via St. Charles Road

instead of directly onto Route Z. This is necessary due to the close proximity between the Karen Lane access to Route Z and the new roundabout.

A future Route 740 is expected to utilize the I-70 interchange at Lake of the Woods Road/St. Charles Road. This will result in increased future traffic volumes at the interchange that are likely to exceed the interchange's capacity, thus spurring the need for improvements. Several "triggers" could cause the need to explore improvements to the interchange. When this occurs, a detailed interchange study will be required to select a preferred retrofit/reconstruction alternative. An Access Justification Report (AJR) and accompanying National Environmental Policy Act (NEPA) documentation will likely be required to obtain the Federal approvals to modify the interstate access for the improvements.

2014 and 2034 traffic operations were evaluated by conducting capacity analysis of the roadways and intersections in the study area. These analyses are based on many characteristics, including existing or forecasted traffic volumes, roadway and intersection geometry, and traffic control. 2014 peak period traffic volumes will largely be driven by Battle High School, once it is open to all grades (9-12) in 2014. As such, 2014 traffic forecasts and traffic operations analysis focuses on the school arrival and dismissal periods associated with Battle High School. Trip estimates were based on information provided by the Columbia Public Schools. With the committed improvements along Clark Lane and Route Z in place all study intersections are expected to operate at acceptable conditions in 2014.

2034 traffic forecasts were developed based on the Columbia Area Transportation Study Organization (CATSO) model outputs. Land-use assumptions in the model were reviewed by the project team, including Boone County planning staff, City of Columbia planning and engineering staff and CATSO planning staff. Daily and hourly traffic forecasts were generated utilizing the updated future year (2030) model outputs. By 2034 conditions future capacity problems are likely to be seen at the I-70/St. Charles Road/Lake of the Woods Road interchange as eastern Columbia continues to develop and when Route 740 eventually connects into this interchange. The analysis shows that Clark Lane between the St. Charles Road/Clark Lane roundabout and the St. Charles Road/Lake of the Woods Road roundabout will ultimately need to be widened to 4 lanes. Additionally, St. Charles Road between Clark Lane and the I-70 interchange will likely require widening to 6 lanes. A detailed interchange study should be completed to determine the ultimate configuration of the I-70/St. Charles Road/Lake of the Woods Road interchange. This study should include St Charles Road from I-70 Drive Southeast to the roundabout at Clark Lane and Clark Lane from the roundabout at St. Charles Road to Lake of the Woods Road. The analysis shows that other study intersections will generally operate at acceptable conditions with the improvements recommended in this study.

The methodology used to develop the cost estimates of the planned roadway segment improvements includes the cost of right-of-way, acquisition, easements, construction, engineering, inspection and administration, and contingency. Cost estimates were not based on actual project design quantities because there are no detailed construction plans, geotechnical studies, or surveys available for these roadways. Rather, a standard cost per linear foot was used to estimate the total construction cost. The per lineal foot price for each functional classification

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includes all elements of the typical section, including: grading, aggregate base, pavement, shoulders, curb and gutter, drainage, signing, and striping. The lineal foot price was applied to each of the segment lengths to develop the base cost of the roadway segments. Additionally, a 15% general contingency was added to the total of the roadway segments; 15% was added for Engineering, Surveying, and Permitting; and 9% was added Construction Inspection and Administration - all of which are consistent with mid-Missouri estimates. These percentages allowed for conceptual estimates but should be detailed at the time the project is programmed. An estimate of probable cost for all of the improvements shown in this plan (including engineering fees and administration costs) is on the order of \$35,400,000 to \$39,200,000 in 2014 dollars (\$63,800,000 to \$70,600,000 in 2034 dollars).

Boone County does not currently have a revenue stream to make the necessary transportation improvements needed to support the potential development in this subarea of the county. As such, Boone County is seeking to adopt a methodology to assess trip generation fees in order to generate a revenue stream that would be used to provide appropriate transportation facilities needed to accommodate future growth. This will help to ensure that the County's roadway system is constructed to a standard that can provide safe and efficient service to residents, visitors, and businesses in this part of Boone County as its character evolves from a rural to suburban character.

The trip generation fee framework described in this section is intended to ensure that new development's share of the cost of capacity per unit of development and the associated road improvements necessitated by such development are attributed to the development. Such costs shall be determined and assigned in a manner that: 1) is reasonably related to impacts caused by the development, 2) is roughly proportional to the impacts caused by the development, and 3) is applicable regardless of the jurisdiction in which the development occurs. Collection of these fees does not preclude Boone County or the City of Columbia from applying for federal or state grants for transportation improvements in the future. Fees are broken into three categories: residential (costs based per dwelling unit), educational (cost based per student), and commercial land uses (costs based on square footage of development).

The total 2014 transportation costs were used to calculate the cost per unit. Three segments were removed from this cost calculation. \$9.6 million dollars was removed for the cost of Segment D (the proposed Extension of Battle Avenue south of Clark including the Olivet/Battle Avenue Overpass) since Boone County or the City of Columbia would likely look for other sources to fund this improvement. Additionally, \$1.9 million dollars was removed for the cost of Segment G and \$1.1 million dollars was removed for the cost of Segment H. These will be privately funded roads built as a condition of the development of the land adjacent to the roadway. The total 2012 roadway improvement costs ranges were averaged to \$24.7 million for this study area.

The residential units consisted of 70.3% of the total trips in the CATSO model (56.5% from the single family units and 13.8% from the multi-family units). Assuming that the residential units should help pay for 70.3% of the total roadway improvements, the cost for all the residential land uses is \$17,350,000. There are anticipated to be 2,800 new residential dwelling units in the study area (2,000 single family units and 800 multi-family units). Dividing the total roadway cost for

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the residential land uses by the total forecasted dwelling units, the cost per single family dwelling unit is \$6,975 and the cost per multi-family dwelling unit is \$4,250.

The non-residential land uses forecasted for future development in this area include: retail, non-retail, office, industrial/manufacturing, warehousing/storage, and institutional-elementary school. The total number of employees per non-residential land use was also taken from the CATSO model. The cost per square foot was calculated by dividing the total cost per land use by the estimated square footage per use. Non-residential fees include: retail - \$35.34 / sq ft, non-retail/Gen Office - \$9.08 / sq ft, office - \$9.08 / sq ft, industrial/manufacturing - \$3.10 / sq ft, warehousing - \$2.93 / sq ft, and elementary school - \$1,191.67 /student.

Boone County currently requires property owners to plat and dedicate right of way for CATSO roads when a property owner is platting or undertaking a planned development. However, other forms of land development do not trigger such dedication. Currently Boone County also requires construction of improvements in these dedicated rights of way. The County might consider the simple dedication to be appropriate and sufficient in some cases. One model would be for Boone County to plan for and reserve corridors for new roadways in all cases. This would provide a corridor for these roadways to be constructed in the future (possibly by the City of Columbia).

Two specific recently proposed developments, the Somerset Village and North Battleground subdivisions, were evaluated to determine if the proposed site plans provide an appropriate internal roadway network considering future developments. This assessment reviewed the anticipated ADT volumes within the developments and compared these volumes against the County's functional classification thresholds. Additionally, an evaluation of the impact of the stub roads that would connect to adjoining properties was considered. Special attention was given to determine which roads will become collector roadways by volume and function and where classification changes should occur. According to the County's Roadway Classification Standards a Local Road can accommodate up to 750 vpd and a Collector Road can accommodate between 750 and 2,500 vpd. Roadways with an estimated ADT over 2,500 vpd are classified as Arterial Roads.

The proposed Somerset Village development is located primarily north and west of the St. Charles Road and Battle Avenue intersection. Based on the current site plan, access to the site is proposed via four new streets on Battle Avenue. Several driveways off Battle Avenue are also depicted on the site plan to provide access to the proposed commercial uses on Battle Avenue north of St. Charles Road, in addition to proposed driveways on St. Charles Road both east and west of Battle Avenue. Four stub streets are also depicted on the site plan to provide access to the vacant parcels north and west of the site. The Somerset Village development would consist of approximately 230 single-family homes, 36 condos, 135 apartments, and a mix of retail uses. The average daily traffic generated by the proposed Somerset Village development would be approximately 9,145 trips per day. Although it is acknowledged that some of this traffic would be pass-by in nature and would not add additional traffic to the adjacent roadways, it would create additional turning movements at the access drives and streets. The proposed Somerset Village development would be expected to generate approximately 510 trips during the morning

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peak hour and 905 trips during the evening peak hour. As such, this development should be subject to local traffic trip generation fees to mitigate their impact to local roadways.

A review of the future stub street to the Merideth Tract in addition to the West Creek Tract was considered to evaluate the impact that both of these connections would have on the estimated ADT's within the Somerset Village development. Based on discussions with County staff, it is estimated that a subdivision with approximately 180 homes could be developed on the Merideth Tract. The three points of access to the West Creek Tract were assumed to be via the Somerset Village stub streets. As such, it is estimated that approximately 80% of the Merideth Tract trips (1,440 ADT) would utilize the main southern connection with the remaining 20% split (360 ADT) split between the two northern stub streets. Additionally, with the extension of a main roadway through the Merideth Tract to the West Creek Tract, it is estimated that approximately 70% of the West Creek Tract trips (700 ADT) would utilize this new roadway with the remaining 30% (300 ADT) utilizing the southern Somerset Village connection.

With the development of the West Creek and Merideth Tracts, a collector road would be required all the way through the Somerset Village/Merideth Tract development. The alignment of this collector road is of great importance to the overall transportation plan. It would be desirable to realign this collector road such that it ties into Battle Avenue opposite of Spartan Drive to allow for the future signalization of this intersection. To the west, this collector road should be aligned such that it would connect to a future Segment F running along the north property line of the Merideth Tract between Lake of the Woods Road and Battle Avenue. In the event that a through connection of Segment F is not able to be created along the north property line of the Merideth Tract, this collector roadway could become the future Segment F.

The proposed alignment of Segment F, west of Battle Avenue, is located along the north Somerset Village and Merideth Tract property lines. As such, the Somerset Village Subdivision should dedicate one-half of the right-of-way to create a corridor for the future construction of Segment F. Existing county ordinances require that a developer construct a roadway if they are required to dedicate right-of-way for that roadway. Since the developers of Somerset Village would not be able to construct the road as required by county ordinance (because only one-half of the right-of-way would be dedicated) we recommend that an exception should be given to Somerset Subdivision developers such that they would be able to dedicate one-half of the right-of-way for Segment F but would not be required to construct the road. Funds from the proposed trip generation fees could be used to construct Segment F once the full width of right-of-way has been dedicated.

The size of this development warrants additional access points, which will also be needed to provide for the two emergency responder access/evacuation routes that are required for all subdivisions. As such, it is desirable to provide additional access to Battle Avenue (via side street stop-controlled intersections) at two locations: 1) between Spartan Drive and Segment F (across from the easement that has been provided for access to the future park and Elementary School), and between Spartan Drive and St. Charles Road (approximately midway between Spartan Drive and St. Charles Road). While the revised site plan shows these additional connections, we recommend that the north connection be moved approximately 100 to 150 feet

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to the south to connect to Battle Avenue across from the easement that has been provided for access to the future park and Elementary School. A cursory review of the estimated turning movements at these intersections found that auxiliary turn lanes would likely be necessary to accommodate the future traffic volumes. Additionally, it may be desirable to provide access to the Somerset Village subdivision from future segment F. This access could possibly be provided via cross-access to the Merideth Tract or via the extension of one of the cul-de-sacs within the Somerset Village Subdivision to Segment F.

Additional access would likely be requested for the proposed commercial lots near the intersection of Battle Avenue and St. Charles Road. Driveway access control is based upon the type of driveway and functional classification of the roadway on which access is requested. Full access driveways on collector and arterial roadways should be spaced at least 220 and 330 feet apart, respectively. Right-in right-out driveways on collector and arterial roadways should be spaced at least 110 and 165 feet apart, respectively. In no cases should driveways be placed adjacent to mainline turn-lanes. Corner clearance for driveway access should meet or exceed the minimum driveway spacing requirements for that roadway. When minimum spacing requirements cannot be met due to lack of frontage, all means should be undertaken to provide shared access drives or cross access easements

Based on the revised site plan, there is approximately 850 feet between St. Charles Road and the first roadway serving the Somerset Village development shown on the plans. As such, there may be sufficient distance for an additional full access driveway on Battle Avenue between this southern roadway and St. Charles Drive to serve the retail portion of the development. However, it is likely this access would require separate left-turn lanes on Battle Avenue. As this planning process does not represent a detailed traffic study, it is recommended that a detailed traffic evaluation of the access drives for the Somerset Village be completed to more completely address the development and its specific impact. This traffic study should consider the queues from the adjacent traffic signals at St. Charles Road and at Spartan Drive (in the future) to determine if additional full access on Battle Avenue can be accommodated between St. Charles Road and Spartan Drive. Likewise, it is anticipated that the developer would request access to the commercial lots directly off St. Charles Road.

The proposed North Battleground development is located on the north side of St. Charles Road approximately one half mile west of Route Z. Initially, access to the site is proposed via two curb cuts on St. Charles Road. One stub street to the vacant parcel west of the site and two stub streets to the vacant parcels east of the site are also planned in order to provide connectivity to the adjoining properties. The North Battleground development would consist of approximately 92 single-family homes and would generate approximately 920 trips per day.

Assuming access is only provided off St. Charles Road, the ADT on Traveller Drive just north of Manassas Drive would be 460 vpd. Given that the estimated volumes on the roadways within the North Battleground development are all estimated to be less than 750 vpd, the roadways within the development would all be classified as Local Roads.

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A cursory review of the estimated turning movements at the intersections of Traveller Drive and Manassas Drive with St. Charles Road, found that auxiliary turn lanes would not be necessary to accommodate the North Battleground development. However, the subdivision will contribute nearly 920 new trips on the local roadway system and should be subject to local trip generation fees to mitigate their impact to local roadways. Additionally, two access routes for all homes within the subdivision will be required to provide for emergency responder access/evacuation. Any of the future stub streets would allow for this second access to the homes in the northern half of the subdivision, north of the Traveller Drive and Manassas Drive intersection at such time as the adjoining properties are developed. Finally, a future Segment H and Segment G would tie into St. Charles Road near the Traveller Drive intersection. It would be appropriate to construct a roundabout to accommodate the intersection of St. Charles Road, Segment H, Segment G, and Traveller Drive.

As discussed in the “Segment F” section, the proposed alignment of Segment F, east of Battle Avenue, is located largely along existing property lines. The north property line of the North Battleground subdivision lies along the proposed Segment F alignment. As such, the North Battleground Subdivision should dedicate one-half of the right-of-way to create a corridor for the future construction of Segment F. Also, as stated in the Segment F section, existing county ordinances require that a developer construct a roadway if they are required to dedicate right-of-way for that roadway. Since the developers of North Battleground Subdivision would not be able to construct the road as required by county ordinance (because only one-half of the right-of-way would be dedicated) we recommend that an exception be given to North Battleground Subdivision developers so they would be able to dedicate one-half of the right-of-way for Segment F but would not be required to construct the road. Funds from the proposed trip generation fees could be used to construct Segment F once the full width of right-of-way has been dedicated.

This transportation plan is intended to be used as a guide for transportation improvements and is meant to be a living document. It is a document intended to be used as a regulatory tool and periodically reviewed and updated as development occurs and transportation improvements and funding changes. This plan should be reviewed, and amended if necessary, on a cycle of every five years at minimum.

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Appendix

- Appendix A: Excerpt from Boone County Design Standards
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Introduction

Northeast Boone County has come under increased development pressure, and as a result, Boone County and partnering agencies have created a transportation plan for the northeast subarea. The limits of this subarea are shown in **Exhibit 1**. Agencies partnering to create this transportation plan include Boone County, City of Columbia, Columbia Area Transportation Study Organization (CATSO), and the Missouri Department of Transportation (MoDOT). This transportation plan is intended to assist coordination between the partner agencies, who throughout the plan's development have been considering various transportation projects and development proposals affecting the subarea. Thus, this subarea transportation plan is intended to ensure that transportation decisions result in a cohesive and connected transportation network. Known previous studies and programmed improvements are coordinated in this plan.

The overall goal of this Boone County Northeast Transportation Plan is to *'Identify the needed transportation improvements for the area, linking all agency and potential development needs together, and create a plan for everyone to use as a tool.'* The purpose is ultimately to provide agencies and developers a guide for further coordination on transportation improvements in this subarea.

The overarching objectives of this Boone County Northeast Transportation Plan are:

- Forecast the traffic generated from all potential future developments over the next 20 years.
- Identify how much traffic will be distributed on local roadways.
- Identify what roadway improvements are needed to accommodate all forecasted future travel demands.
- Identify the cost needed for these improvements.
- Develop and identify possible funding mechanisms for these improvements.

Comprehensive planning is an important management tool for promoting a strong and healthy community. This transportation plan is intended to be used as a guide for transportation improvements and is meant to be a living document. It is a document intended to be used as a regulatory tool and periodically reviewed and updated as development occurs and transportation improvements and funding changes. This plan should be reviewed, and amended if necessary, on a cycle of every five years at minimum.



Exhibit 1: Study Area

Existing Documentation

Exhibit 2 is a more detailed view of the study area and shows the existing physical traits of the existing roadways. **Exhibit 3** shows committed roadway improvements and **Exhibit 4** shows future connections per the CATSO 2030 plan.

Previous Studies and Plans

Northeast Boone County has a significant amount of land (on the order of 1,800 acres) available for future development. CATSO land use forecasts show nearly 2,800 new dwelling units and more than 1,900 new jobs in this subarea by 2030. If all of this development occurs, the existing roadway infrastructure will not be able to support the generated traffic. Ultimately, the purpose of this plan is to take a comprehensive look at this subarea and identify the roadways required to support the future traffic associated with the multiple anticipated land-use changes as this area builds out over time.

The study area is currently in unincorporated Boone County, just outside the Columbia city limits. There is significant interest in development in the area due to the amount of open land, proximity to the City of Columbia, and access to I-70. Known proposed developments in this subarea were reviewed as part of this effort, including:

- Battle High School (*Traffic Impact Study for the Proposed Columbia Public High School, St. Charles, Road, Columbia, Missouri*, 2009)
- North Battleground Subdivision (Traffic Impact Study 2011)
- Somerset Village Subdivision
- Proposed Elementary School
- Proposed New Community Park

Battle High School

The Battle High School traffic impact study was completed in 2009 by CBB. The new high school is expected to open to students in the fall of 2013. Major transportation investments made specifically in support of the school include the first phase of Battle Avenue (from St. Charles Road north to the north property line of the future elementary school) including signalization of the St. Charles Road/Battle Avenue intersection. It is noteworthy that this is the first traffic signal on the Boone County system. Other roadway improvement projects (discussed in detail in the “Committed Roadway Improvements” section) are expected to be complete before Battle High school opens. Ongoing projects that will support high school traffic include improvements along Clark Lane being constructed by the City of Columbia and improvements to Route Z being completed through a cost share agreement between MoDOT and Boone County.

North Battleground Subdivision

The North Battleground Subdivision is proposed north of St. Charles Road east of the new Battle High School and Copper Creek Subdivision, as shown in **Exhibit 5**. This subdivision has two proposed access points along St. Charles Road, both of which are anticipated to be controlled with stop signs on the side-streets. An evaluation of access to the North Battleground Subdivision is discussed in the “Subdivision Studies” section.

Somerset Village

The Somerset Village Subdivision includes residential units west of Battle Avenue and north of St. Charles Road. Because of the layout of the land and adjacent roadways, access to the West Creek Tract and Merideth Tracts from Battle Avenue will ultimately need to be provided through the Somerset Village Subdivision. As such, the Somerset Village Subdivision roadway network needs to be planned in such a way as to facilitate access of the West Creek Tract and Merideth Tracts to Battle Avenue. **Exhibit 6** shows a preliminary drawing for this proposed residential development. Several access points are proposed off of the new Battle Avenue roadway to serve subdivision traffic. An evaluation of access to the Somerset Village Subdivision, West Creek Tract, and Merideth Tracts is discussed in the “Subdivision Studies” section.

Proposed Elementary School and Community Park

There is a proposed elementary school and community park located to the north of the Battle High School property. Primary access to these facilities will be from Battle Avenue. Although traffic impact studies have not been completed for these facilities, these are known future developments. The Somerset Village, future elementary school, and park access points need to be coordinated in order to maintain effective access management on Battle Avenue. Therefore, it is important to consider how access will be provided to these facilities, in the future, when determining an overall access plan for Somerset Village and Battle Avenue.

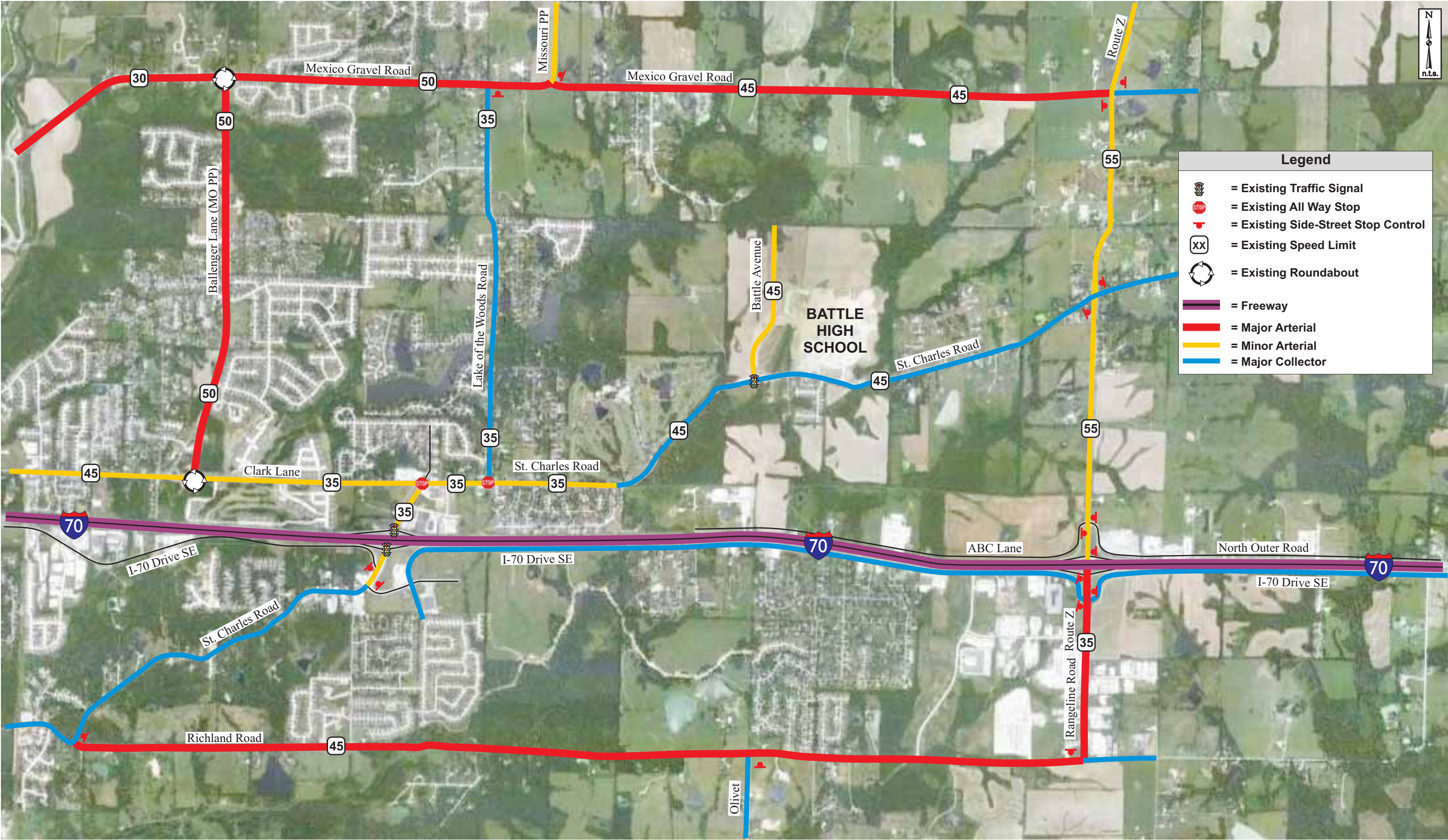


Exhibit 2: Existing Study Area Roadways



Exhibit 3: Committed Roadway Improvements in the Study Area

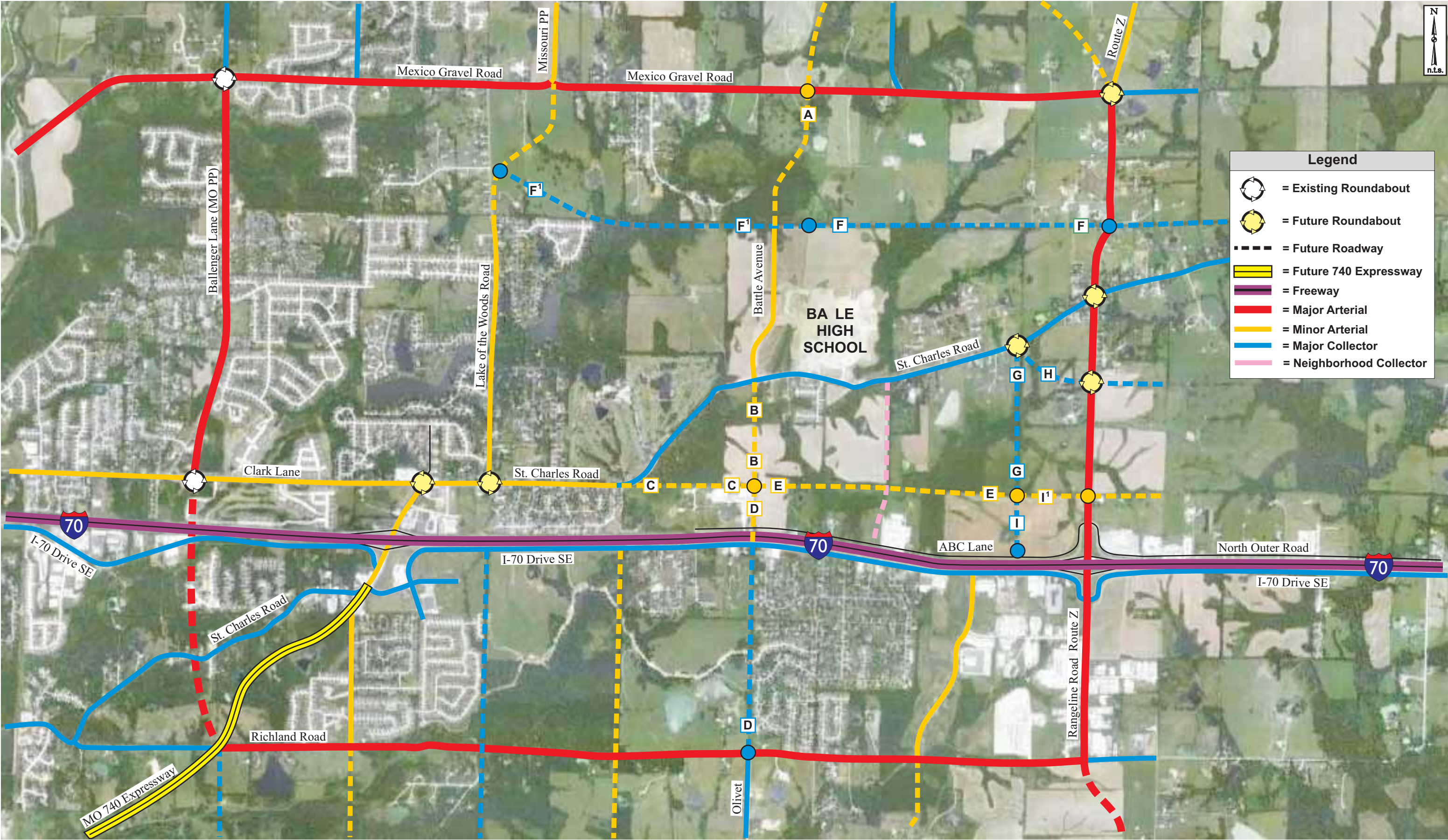


Exhibit 4: Future Study Area Roadways per the 2030 CATSO Roadway Plan

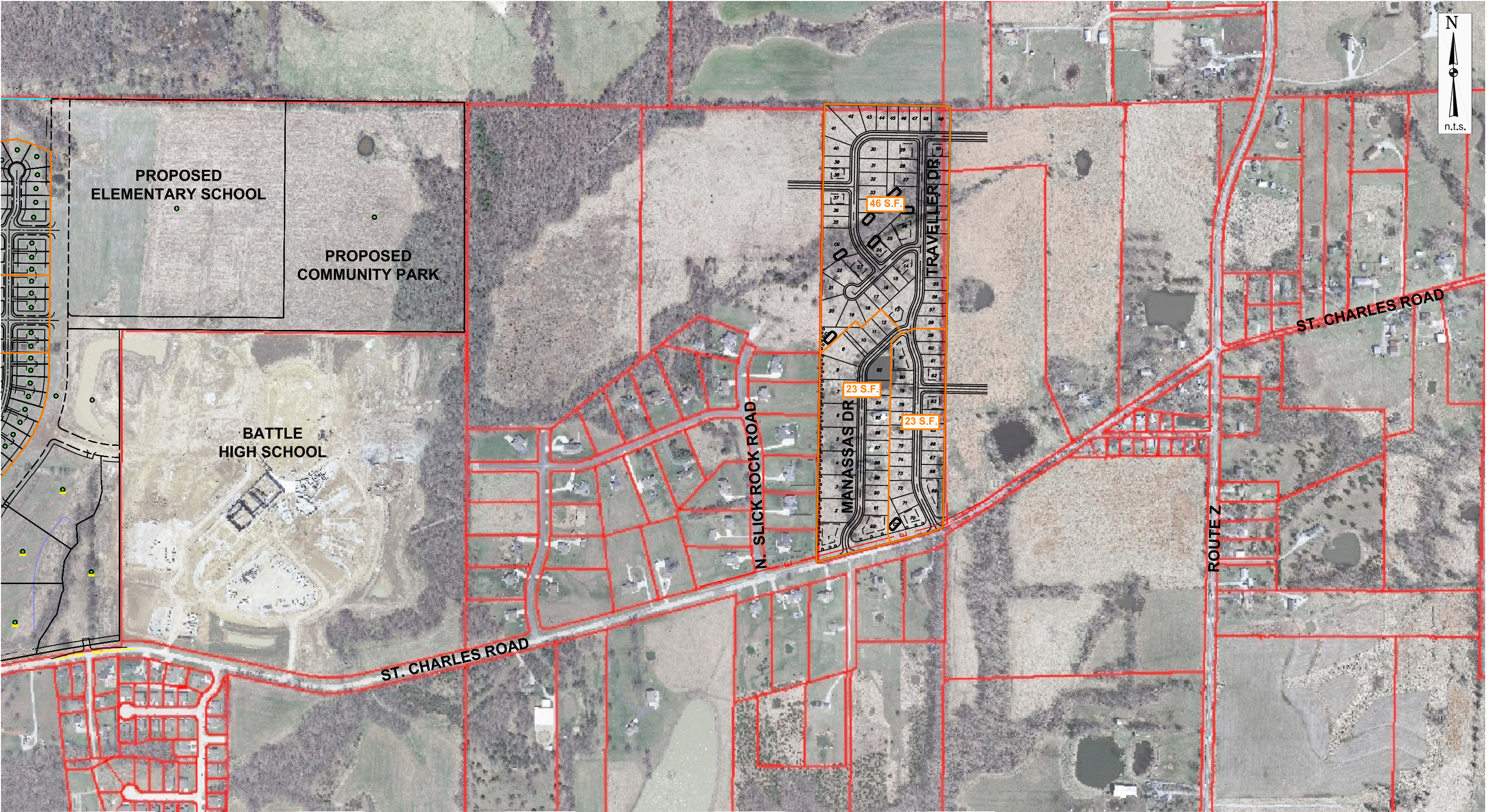


Exhibit 5: North Battleground Subdivision as Proposed by Developer

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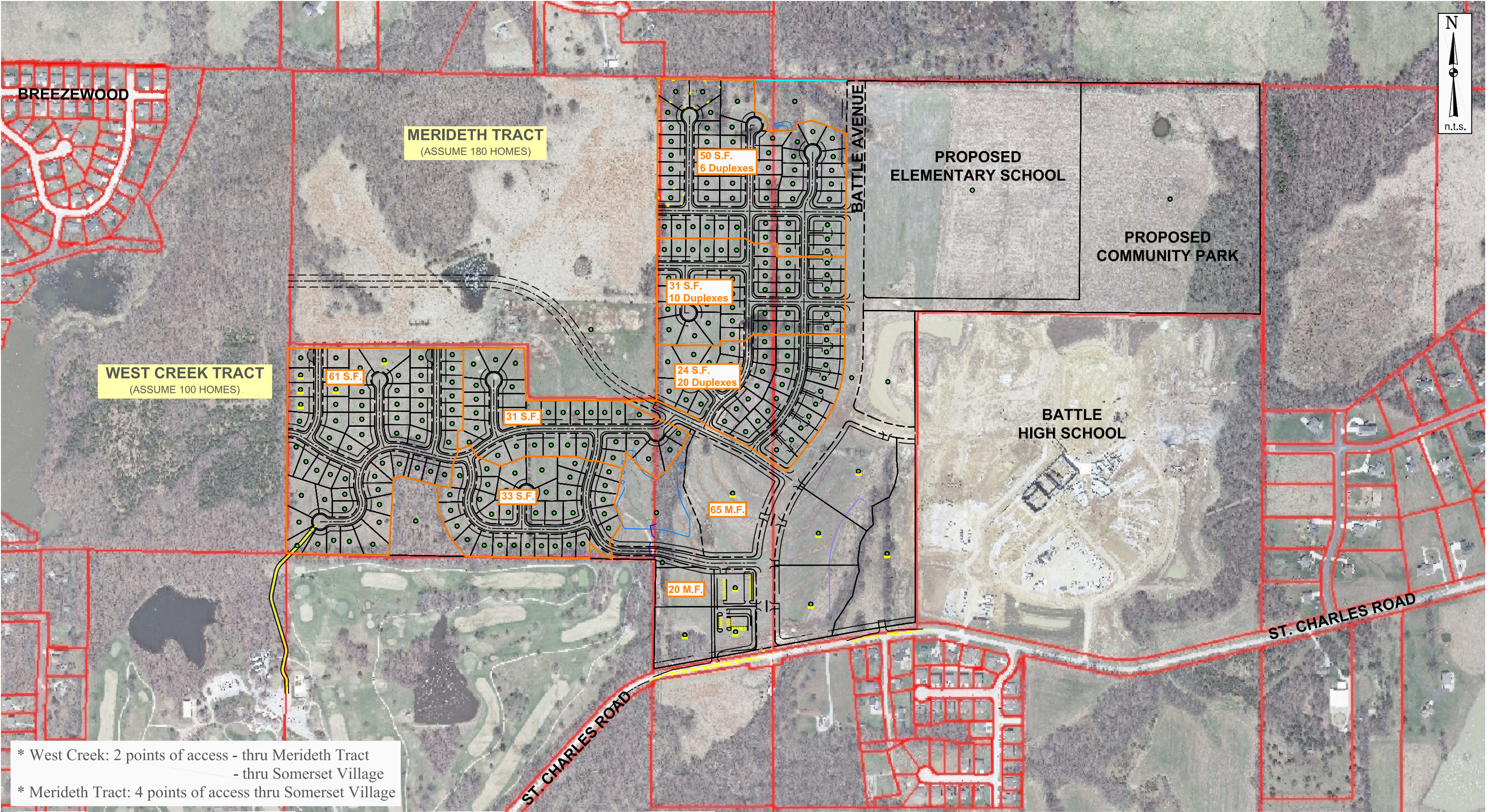


Exhibit 6: Somerset Village, West Creek Tract & Merideth Tract as Proposed by Developer

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Several other studies and plans have impacts on this study area. Recommended roadway improvements were compared to studies already completed to cross-reference for consistency with other plans. Previous studies reviewed include:

- CATSO Long Range Transportation Plan
- CATSO TIP – FY 2013-2016
- Route 740 Environmental Impact Study
- Improve I-70 (statewide) Study
- Northeast Columbia Area Plan

CATSO Long Range Transportation Plan (2030)

CATSO completed a long range transportation plan for 2030 which was further amended and updated in 2012. **Exhibit 7** shows the CATSO Roadway Plan (March 2008) and future functional classification as proposed in the original long range plan. **Exhibit 8** shows the amended portion of the plan as relevant to this northeast study area (2012). This transportation plan shows a new roadway running north-south, crossing I-70 from the new Battle High School to Richland Road, also known as the Olivet Extension. The amended portion of the plan combines a neighborhood connector with Battle Avenue, ultimately making a minor arterial out of Battle Avenue. Other minor arterials and neighborhood future connections were amended slightly, all shown in **Exhibit 8**. **Exhibit 9** shows the resulting updated CATSO 2030 roadway plan (2012).

CATSO Transportation Improvement Plan (TIP) – FY 2013-2016

The TIP was reviewed to identify where funding has already been allocated and what priorities were included within the study area in the near future. Projects relevant to this study that are shown in the TIP include the following:

- 2013-3: (5S3004) Route Z - Scoping for capacity improvements; Engineering
- 2010-23: (5S2194) Improvements to Route Z bridge over Interstate 70, bridge L0909; Engineering/Construction
- 2010-20: (5S0636) MO 740 - Scoping for extension of corridor, Route 63 to I-70 at Lake of the Woods; Engineering

Route 740 Environmental Impact Study

A future extension of Route 740 will connect to the I-70/Lake of the Woods Road Interchange, as shown in **Exhibit 10**. No improvements at the interchange were identified as a part of the EIS, as shown in **Exhibit 11**. The “Traffic Operations” section discusses the need to study the I-70/Lake of the Woods Road Interchange in order to determine improvements that will be required in the future once this connection is made.

Improve I-70 Study

The Improve I-70 Study investigated the I-70 corridor between St. Louis and Kansas City. This study looked at needed improvements along I-70. The study recommended an ultimate I-70 cross-section of six lanes between St. Louis and Kansas City, with further recommendations to increase the cross-section to eight lanes, four in each direction with two truck only lanes both

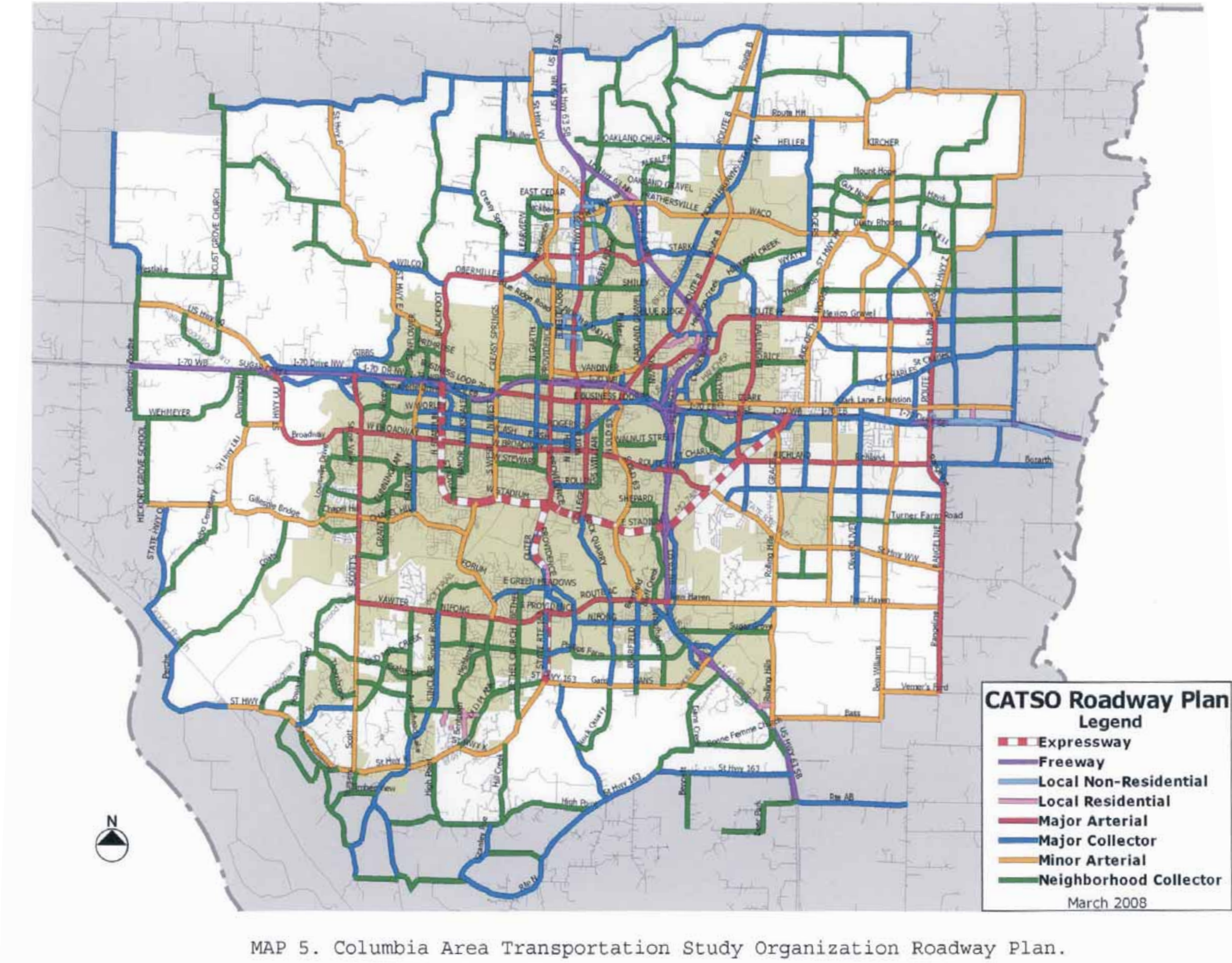
eastbound and westbound¹. Traffic analysis shows that, without improvements, I-70 in the Columbia metro region will operate at LOS F by 2030 during the peak hours². Further study investigated needed improvements to the Lake of the Woods Road and Route Z interchanges, illustrated in **Exhibits 12 and 13**. It is noteworthy that the Improve I-70 investigations were completed before the Route 740 Environmental Impact Study recommended a future extension of Route 740 to the I-70/Lake of the Woods Road Interchange. As such, these investigations did not consider a future extension of Route 740 to the I-70/Lake of the Woods Road Interchange.

Northeast Columbia Area Plan

Boone County and the City of Columbia completed a land-use plan for the same study area as this transportation plan. This plan considered the roughly 3,100 acres bounded by I-70 to the south, one-half mile east of Route Z to the east, Mexico Gravel Road to the north, and Lake of the Woods Road to the west. Existing land uses are predominately agriculture with a growing residential component and Battle High School, which is under construction. Ultimately, the plan forecasted future land uses for the study area, which are shown in **Exhibit 14**. The plan also includes a map showing proposed roadways to accommodate the future land uses and developments as discussed in the plan, shown in **Exhibit 15**.

¹ <http://www.improvei70.org/>

² http://www.improvei70.org/pdf/Environmental_Doc/SIU4/FEIS/1_Purpose_and_Need_Statement.pdf



MAP 5. Columbia Area Transportation Study Organization Roadway Plan.

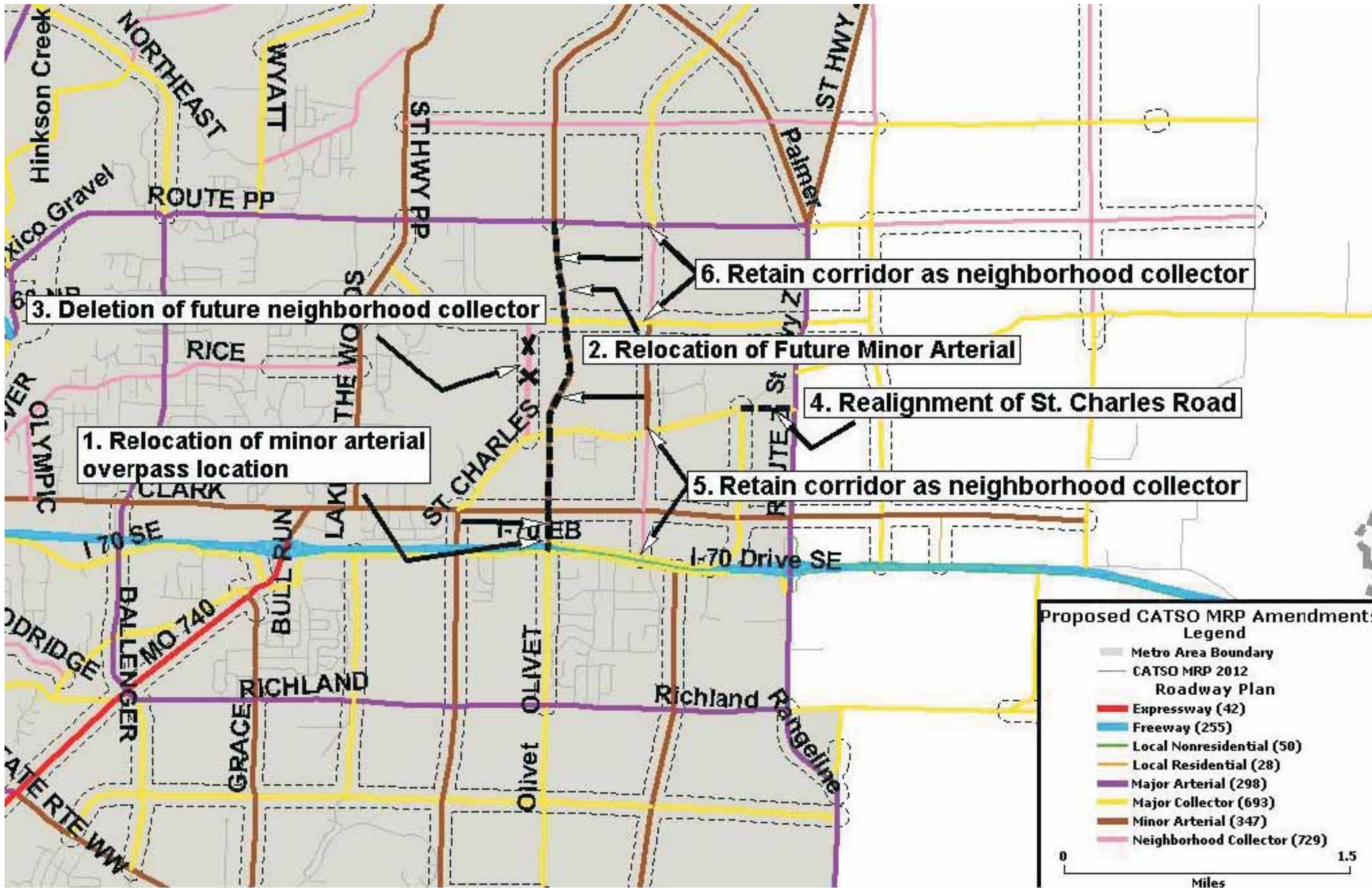


Exhibit 8: CATSO Proposed Ammendments 2030 (2012)

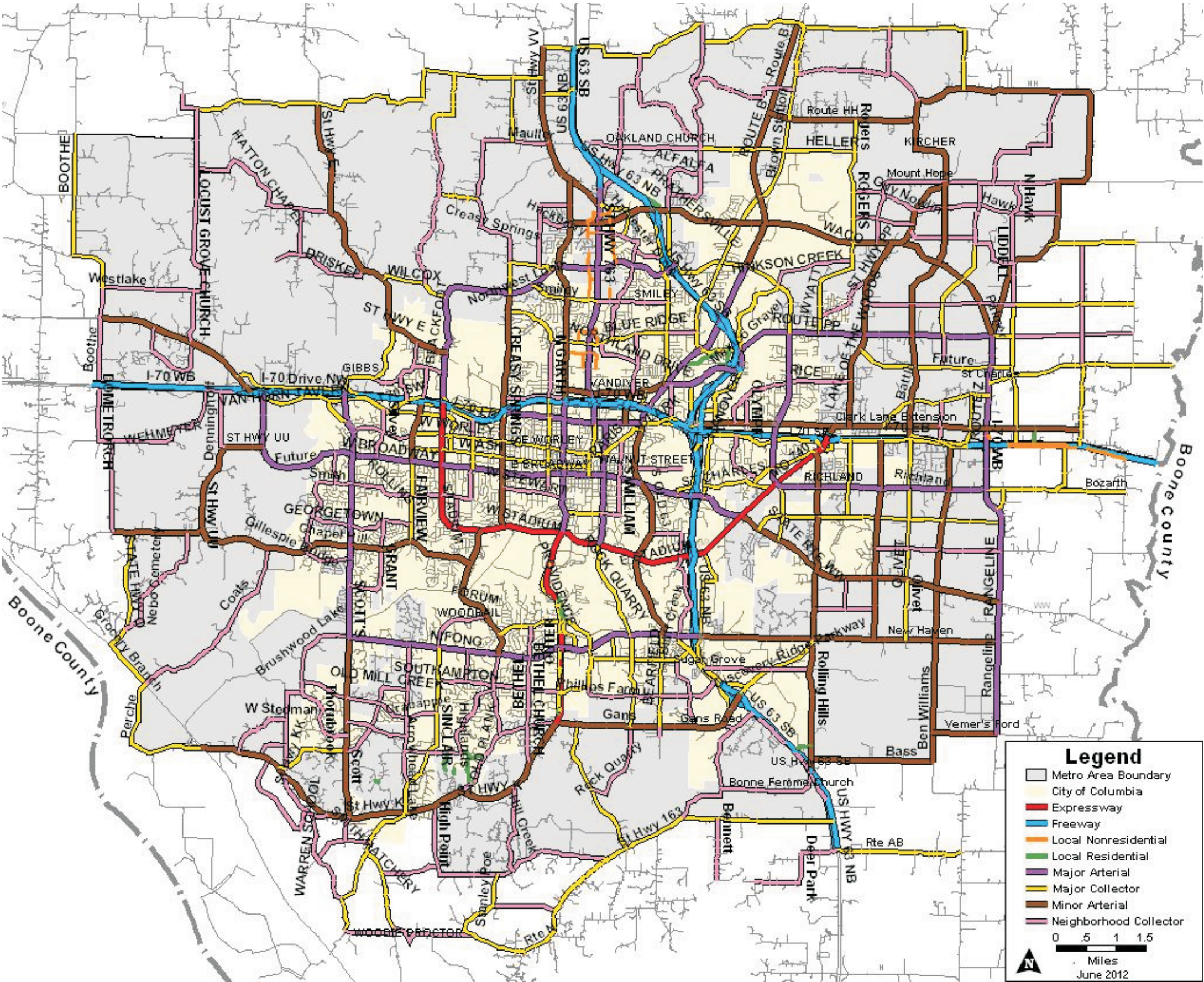


Exhibit 9: CATSO 2030 Roadway Plan (Revised 2012)

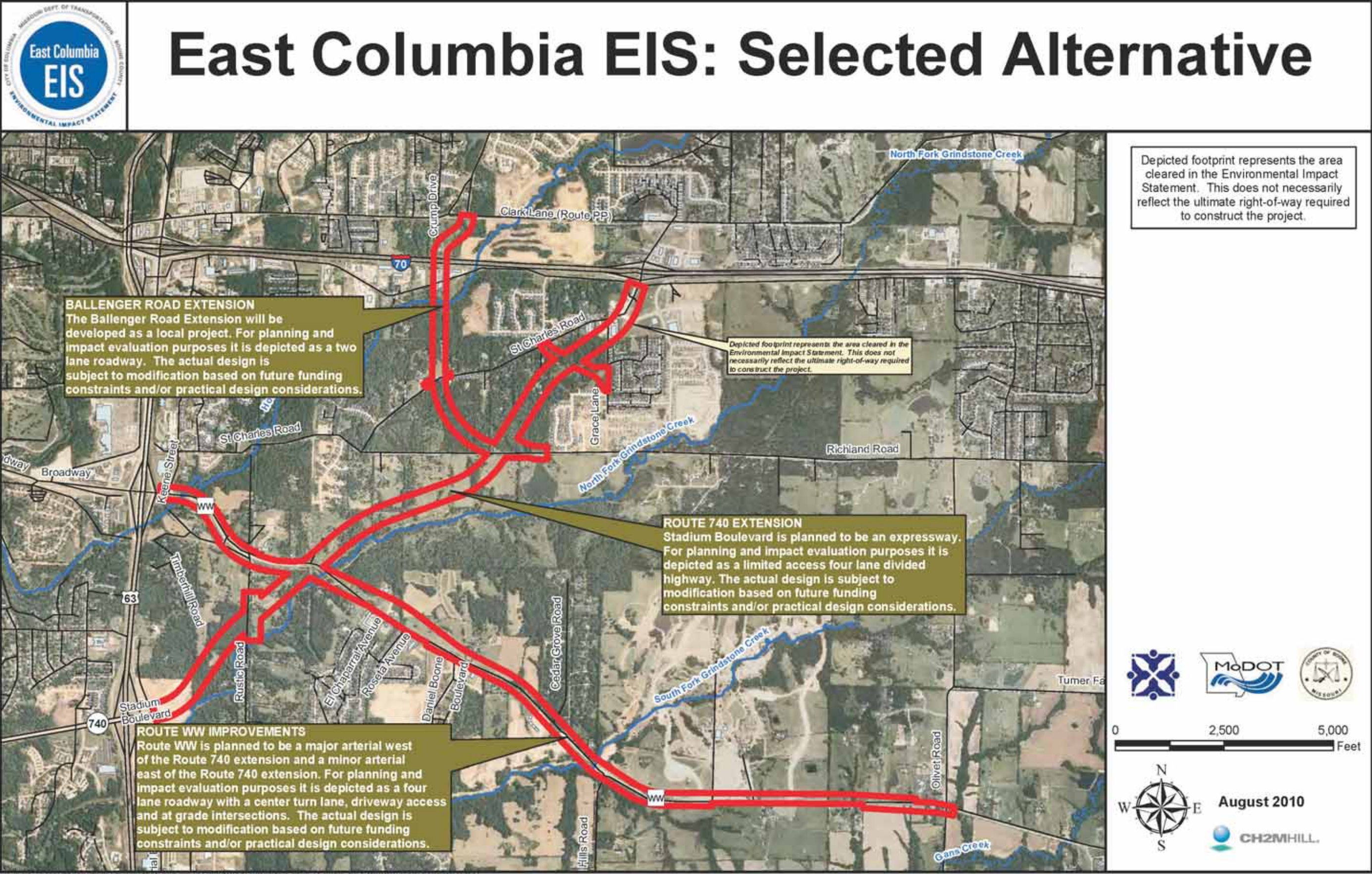
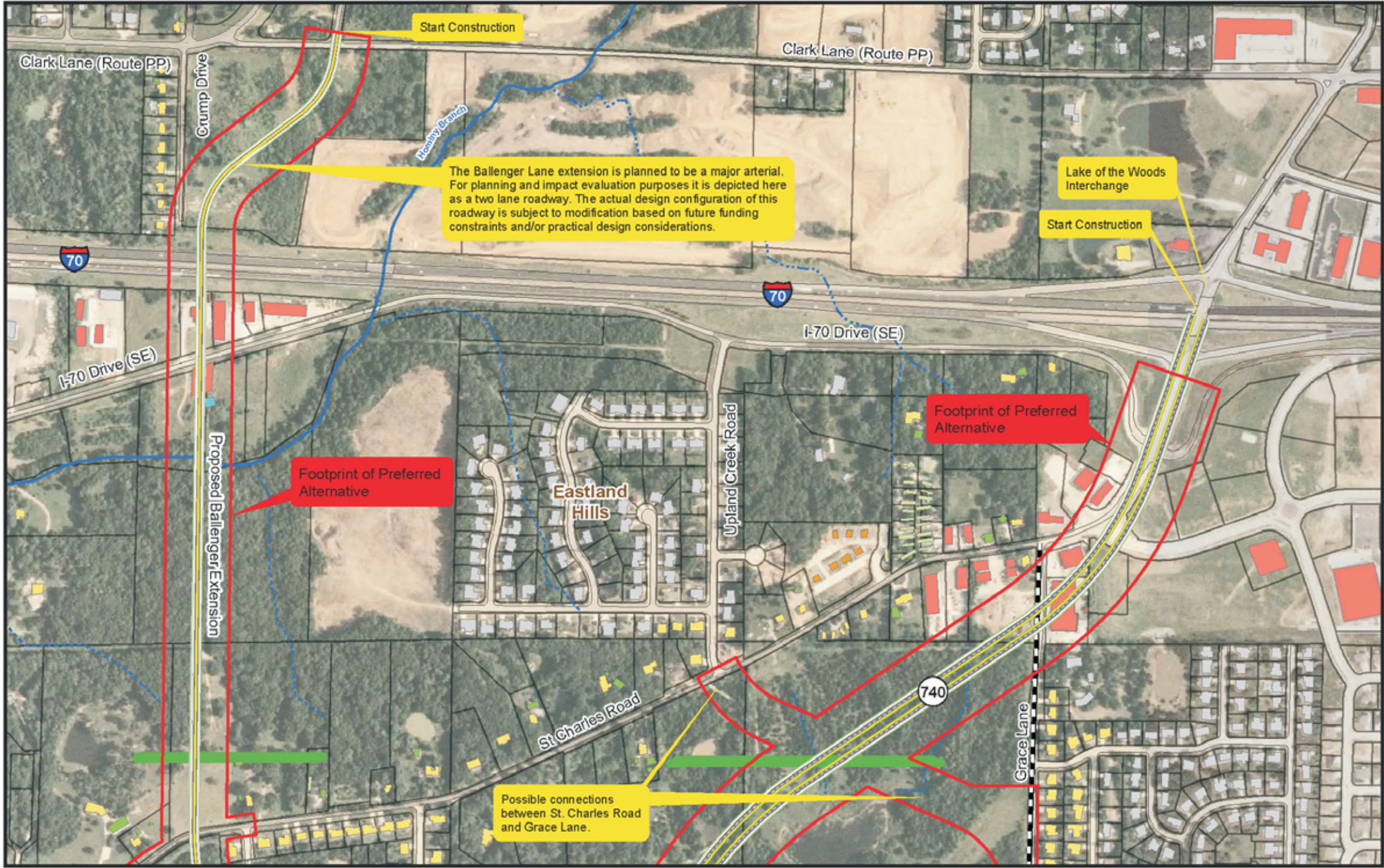
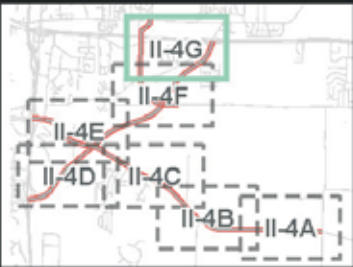


Exhibit 10: Route 740 Extension



Exhibit II-4G Preferred Alternative Map



Legend

- New Roadway
- Future Road Improvements
- Roads
- Parcel Boundary
- Parks

Buildings

- Agricultural
- Commercial Outbuilding
- Commercial
- Industrial
- Industrial Outbuilding
- Infrastructure
- Institutional
- Institutional Outbuilding
- Public
- Public Outbuilding
- Single Family Residential
- Multi-Family Residential
- Mobile Home
- Residential Outbuilding
- Outside of Survey Area

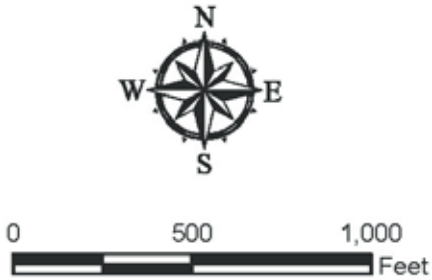


Exhibit II-4G Preferred Alternative Map

Exhibit 11: Zoomed in View of Route 740 Extension

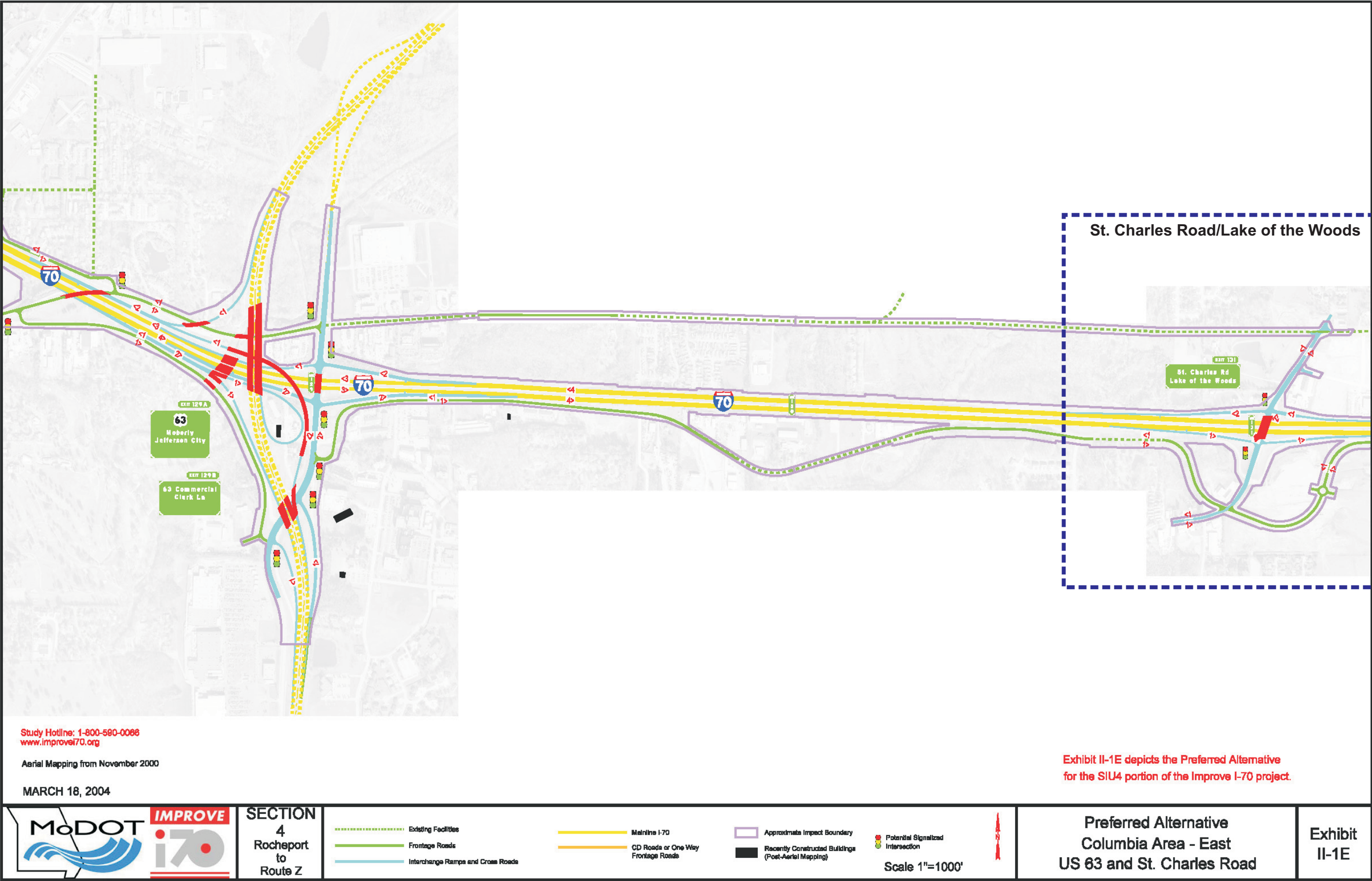


Exhibit 12: Improve I-70 Lake of the woods Interchange Alternative

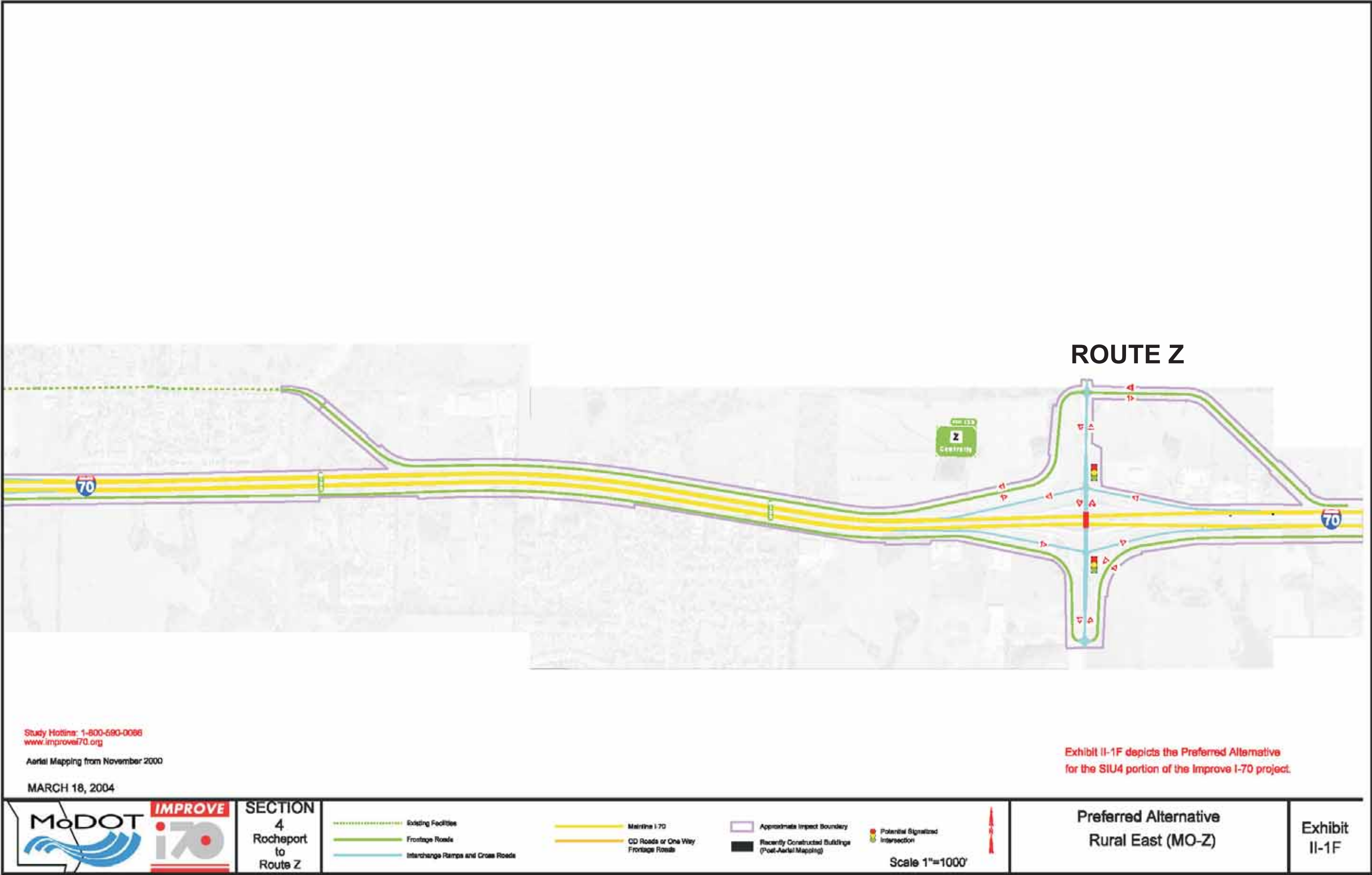


Exhibit 13: Improve I-70 Route Z Interchange Alternative

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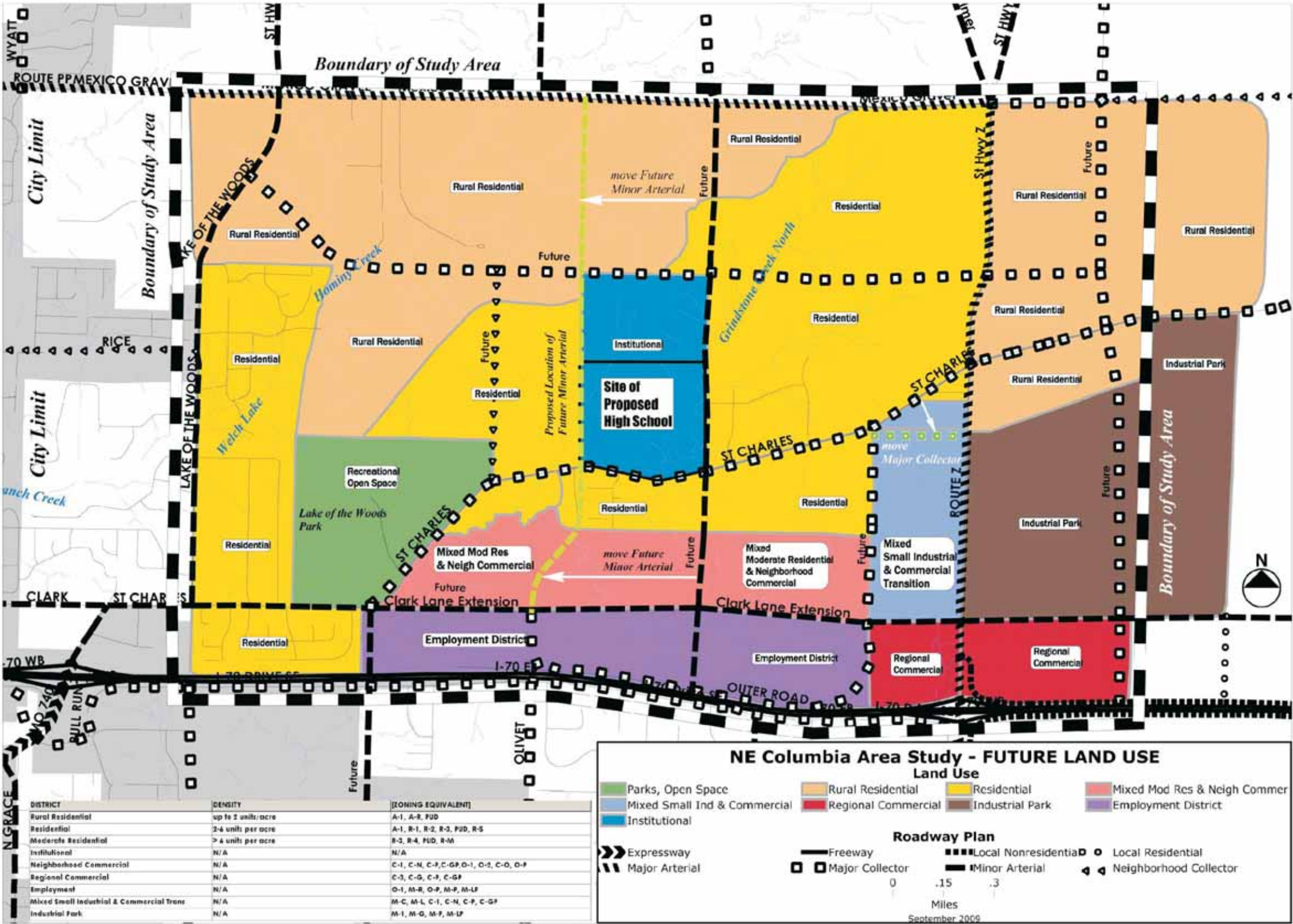


Exhibit 14: Northeast Columbia Area Land Use Plan Map

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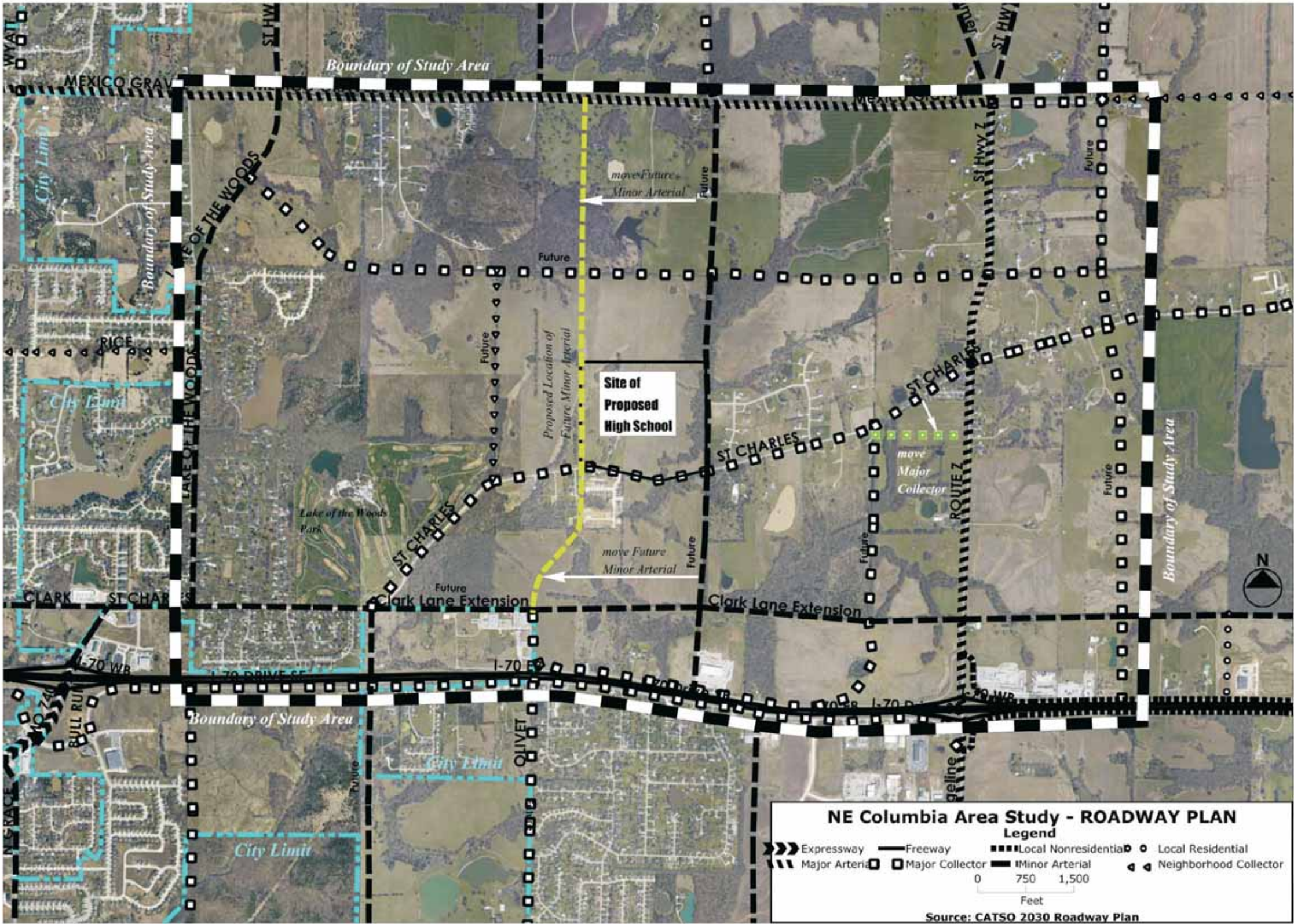


Exhibit 15: Northeast Columbia Area Roadway Plan Map

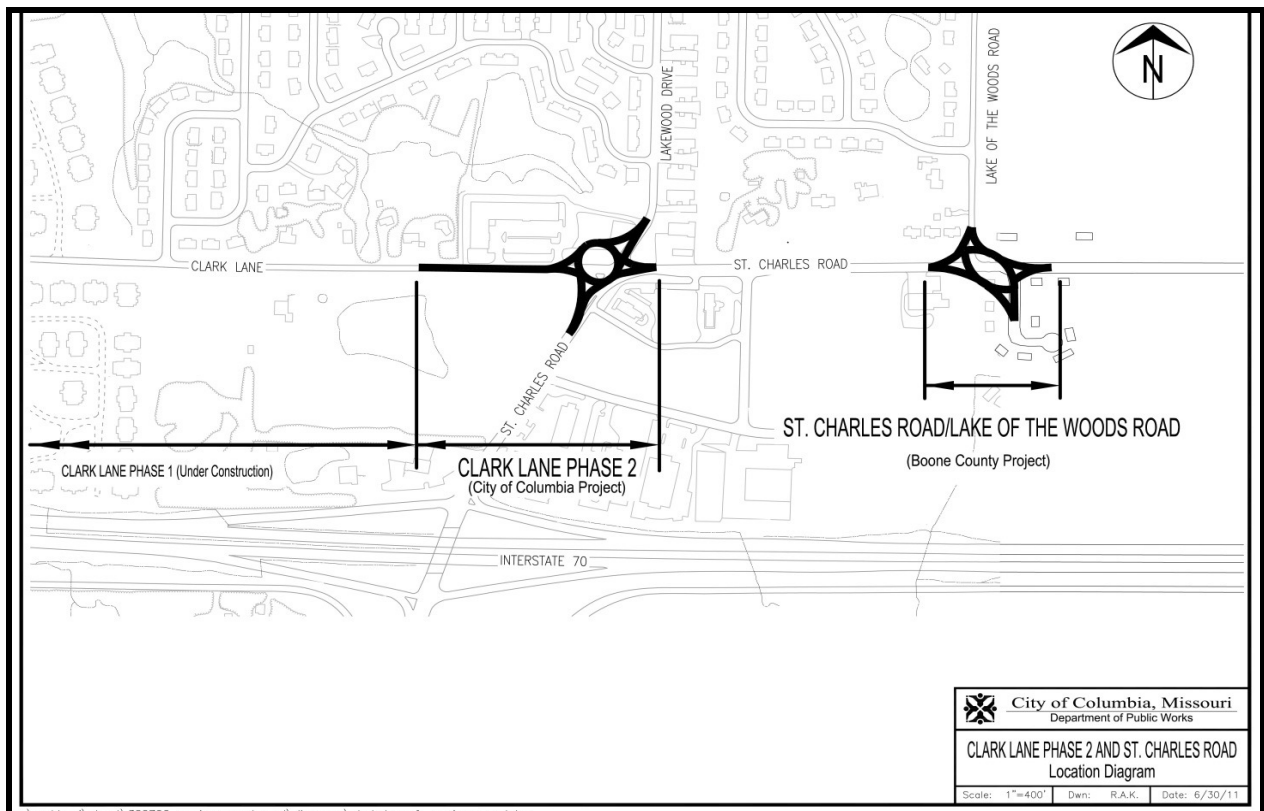
Committed Roadway Improvements

Committed area roadway improvements are shown in **Exhibit 3**. Although the specifics of some of these improvements may evolve through the project development process, we assumed existing plans as a baseline for the committed network.

Clark Lane

The City of Columbia is currently improving Clark Lane from Ballenger Lane to west of St. Charles Road. The project consists of constructing new concrete street pavement with two divided lanes, bike lanes, and both concrete and grass center medians. An 8-foot concrete sidewalk is being constructed on the south side and a 5-foot sidewalk is being constructed on the north side. In addition to this project, the intersections of St. Charles Road at Clark Lane and St. Charles Road at Lake of the Woods Road are programmed to be reconstructed as roundabouts, as shown in **Figure 1**. These roundabouts are being constructed to ultimately accommodate two lanes of traffic in the future. However, they will be striped as one-lane roundabouts until future traffic volumes warrant the higher capacity of a multi-lane roundabout. A more detailed drawing of the roundabouts and the roadway is shown in **Exhibit 16**.

Figure 1: St. Charles Road and Clark Lane Extension Roundabouts



Battle Avenue

As previously discussed, the first phase of Battle Avenue (from St. Charles Road north to the north property line of the future elementary school), including signalization of the St. Charles Road/Battle Avenue intersection, has been constructed to accommodate Battle High School traffic when the school opens in fall 2013. A photograph of the intersection of Battle Avenue and St. Charles Road is provided in **Figure 2**.

Figure 2: New Traffic Signal at St. Charles Road and Battle Avenue



Route Z

In 2012 Boone County and MoDOT were approved for a cost share project to improve Route Z between I-70 and St. Charles Road. The project includes:

- Reconstruction of the Route Z/I-70 overpass to three lanes, and providing dedicated southbound and eastbound right-turn lanes at the interchange. Serious consideration should be given to constructing the bridge with sufficient width so that it could ultimately be restriped to four (4) lanes of traffic in the future.
- Adding three foot shoulders to Route Z between I-70 and St. Charles Road; and
- Constructing a roundabout at the intersection of Route Z and St. Charles Road.

The plans submitted with the cost share application are shown in **Exhibit 17**. MoDOT is working on the design for this project. The project is scheduled for a February 2013 letting with a completion date prior to the opening of the Battle High School in August 2013. The total cost for the project is anticipated to be between \$2,000,000 and \$2,500,000. A breakdown for the cost share application is provided in **Table 1**.

Table 1: Route Z Cost Share Breakdown

	Cost
MoDOT Cost Share	\$555,646
MoDOT Central District	\$951,070
Boone County	\$757,144
Total Cost	\$2,263,860

Roadway Design Standards

The study area is currently under the control of unincorporated Boone County. However, it is likely that the City of Columbia will annex this part of the County in the future. Boone County and the City of Columbia have different design standards for roadway geometrics and cross-sections. Because of the potential for annexation, consideration should be made to ensure that any new roadways would be compatible with either Boone County or the City of Columbia's systems. It is noteworthy that MoDOT owns some of the facilities in the study area (Route Z and I-70/Lake of the Woods/St. Charles Road interchanges). MoDOT's design standards can be found in MoDOT's Engineering Policy Guide at <http://epg.modot.org>. Roadway design standards for Boone County and the City of Columbia are summarized below and excerpts are also provided in **Appendix A and B**, respectively.

Boone County Street Design Standards

Boone County has minimum standards for county facilities that follow **Table 2**.

Table 2: Boone County Roadway Standards

	Arterial	Collector	Local	Commercial/ Industrial
ADT	>2,500	750-2,500	<750	By Land Use
Right of Way Width	100 ft	66 ft	50 ft	66 ft
Cul-de-sac ROW. Radius	N/A		47 ft	66 ft
Paving	Yes			
Curb and Gutter	See Appendix A			Yes
Design Speed	40 mph	30 mph	30 mph	30 mph

City of Columbia Street Design Standards

The City of Columbia has minimum design standards for city facilities, as shown in **Table 3**.

Table 3: City of Columbia Roadway Standards

	Major Arterial	Minor Arterial	Major Collector	Neighborhood Collector	Residential	Local Non-Residential
ADT	>15,000	7,500 to 20,000	3,500 to 8,500	1,500 to 3,500	<1,500	<1,500
Right of Way Width	106 ft	84 ft	66 ft	60 ft	50 ft	60 ft
Cul-de-sac ROW. Radius	N/A				94 ft	94 ft
Paving	Yes					
Curb and Gutter		Optional	No	Optional	Yes	
Design Speed	See City Code					



Exhibit 16: Committed Roundabout Roadway Improvements on St. Charles Road

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10/29/12



Area Wide Existing Conditions

This subarea contains roughly 3,100 acres (including over 1,800 developable acres) and the potential to support an estimated 2,800 new dwelling units and 1,900 new jobs. If all of this development occurs, the existing roadway infrastructure cannot support the generated traffic. If infrastructure improvements are not made and development occurs, the roadway system would operate at poor levels of service. The county identified the need to take a comprehensive look at this subarea to identify the total traffic associated with anticipated land-use changes over the next twenty years. The following section describes some of the overarching conditions within the study area.

General Description of Study Roadways

Roadways in the study area were generally constructed for the rural land uses that historically predominated until more recent suburban development. As such, roads tend to be narrow (and without shoulders), windy, and follow the terrain vertically. Intersections tend to be stop controlled and often include undesirable geometric conditions such as intersection skews. Sight distance is limited at many locations. Updating of the study area roadways to suburban standards is necessary as the land uses continue to evolve from rural uses to suburban uses.

Emergency Response

Emergency response is a critical service for any community. A key need for emergency responders is redundant and efficient roadway access to major centers. Redundancy is required to provide alternate access in the event the primary access route is blocked, or to provide the ability to evacuate civilians from an area while simultaneously deploying emergency responders. Emergency response to the northeast subarea is currently provided by way of the Boone County Lake of the Woods Fire Station (Station 1) near the intersection of St. Charles Road and Lake of the Woods Road. This fire station serves the entire study area. Fire district officials have expressed concern about access routes to Battle High School and the proposed elementary school using existing roads. **Exhibit 18** shows the emergency routes, distances, and approximate time it takes the fire trucks to respond to an incident at Battle High School or the proposed elementary school. If St. Charles Road is not drivable between the fire station and the high school, the emergency responders would need to travel on I-70 or I-70 Drive Southeast and go north on Route Z, accessing the schools from St. Charles Road east of Battle Avenue. This trip would take nearly 9 minutes without accounting for traffic. That alternate route is nearly three times longer than the primary route using St. Charles Road from the west. As such, the Boone County Fire District is interested in improvements that would provide efficient secondary access to Battle High School and the proposed elementary school.

2012 Base Traffic Volumes

No new traffic counts were conducted specifically for this study. Instead, traffic counts were used from previous studies. Intersection turning counts were taken from a traffic impact study completed for Battle High School and Average Annual Daily Traffic (AADT) counts were used from Boone County's website. **Exhibit 19** shows the base traffic volumes.

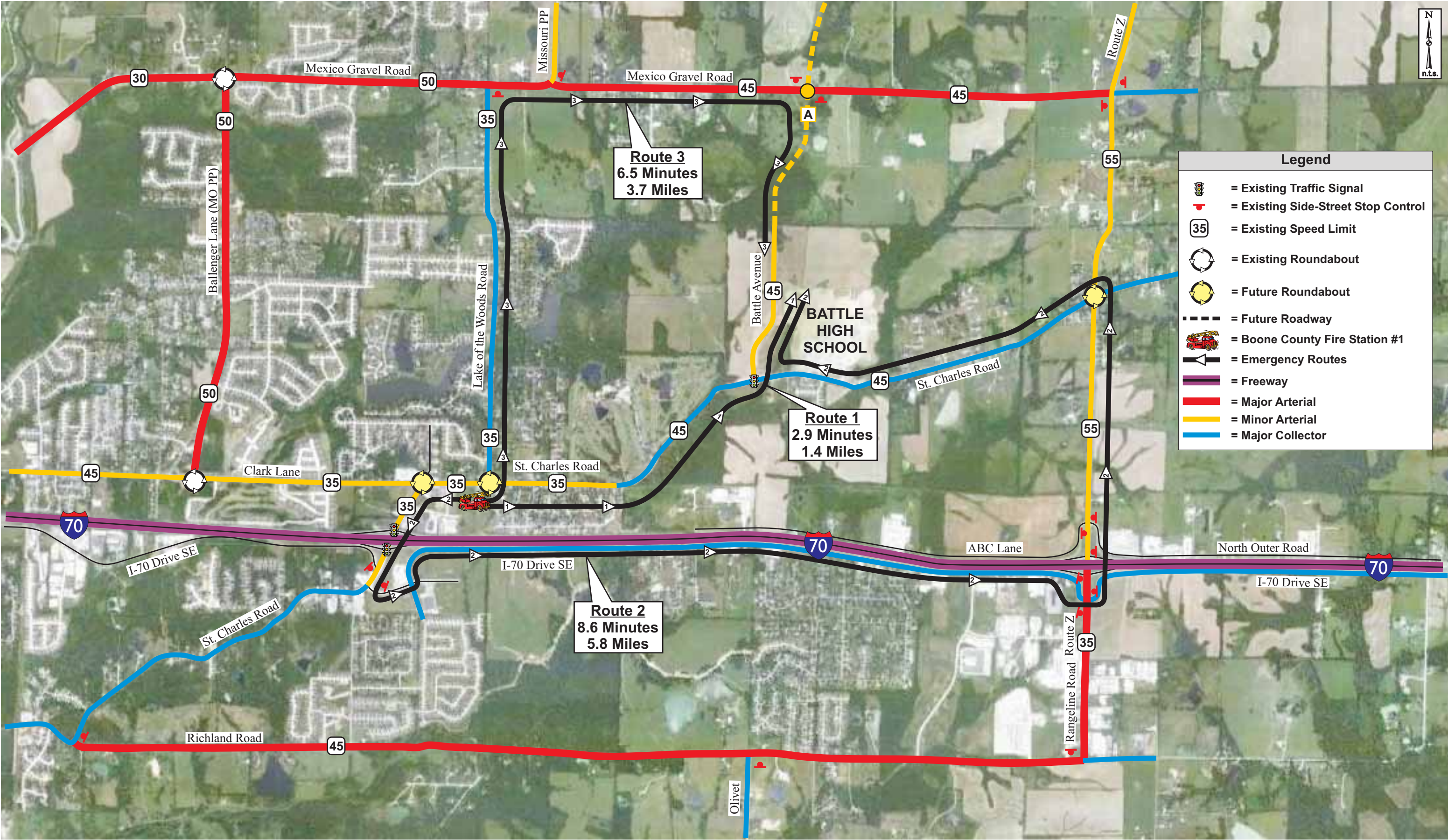


Exhibit 18: Emergency Routes for Boone County Fire Station #1

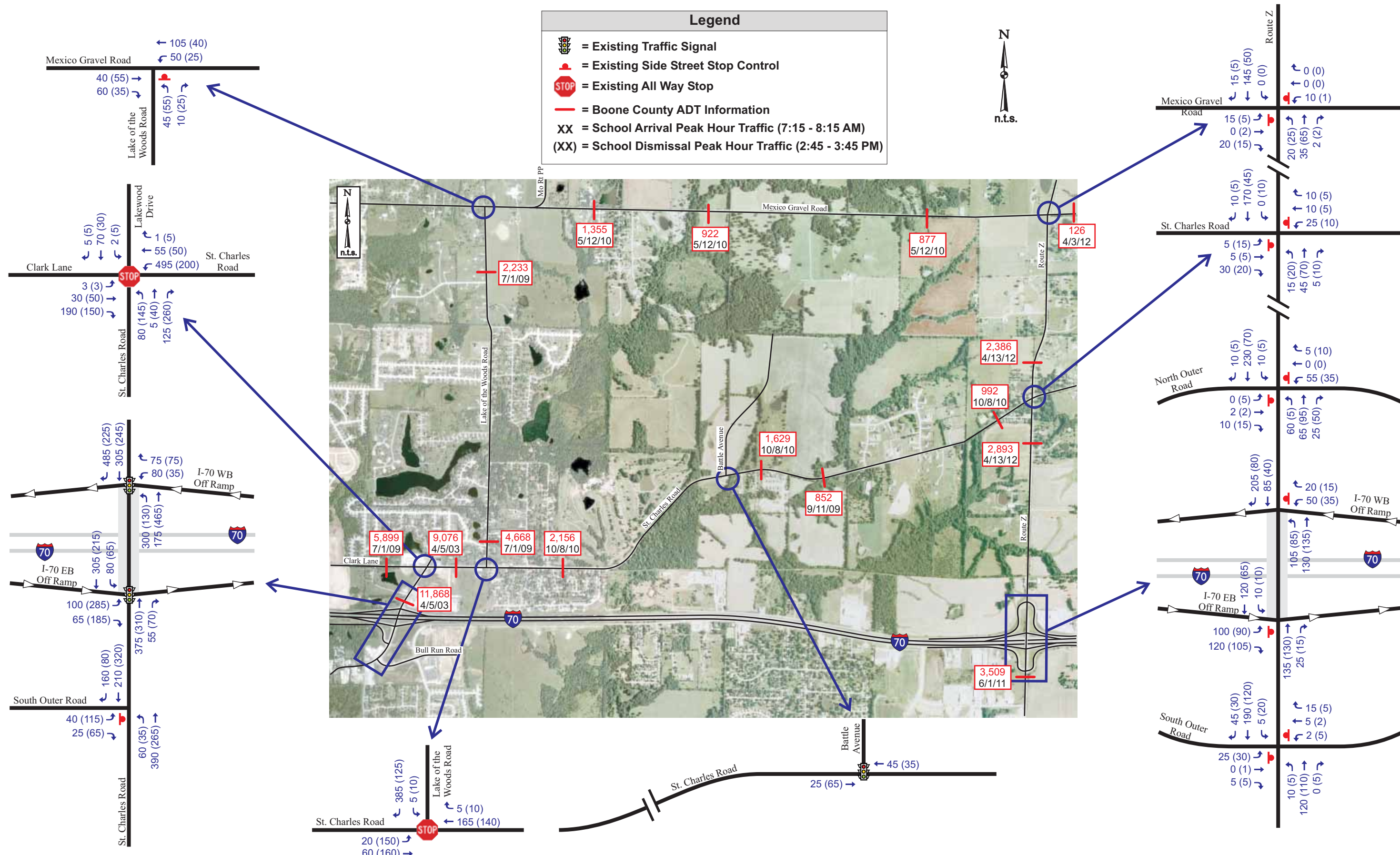


Exhibit 19: 2012 Base Traffic Volumes (Most Recent ADT Volumes and Turning Movement Counts)

Future Traffic Projections

2014 Forecasted Traffic Volumes

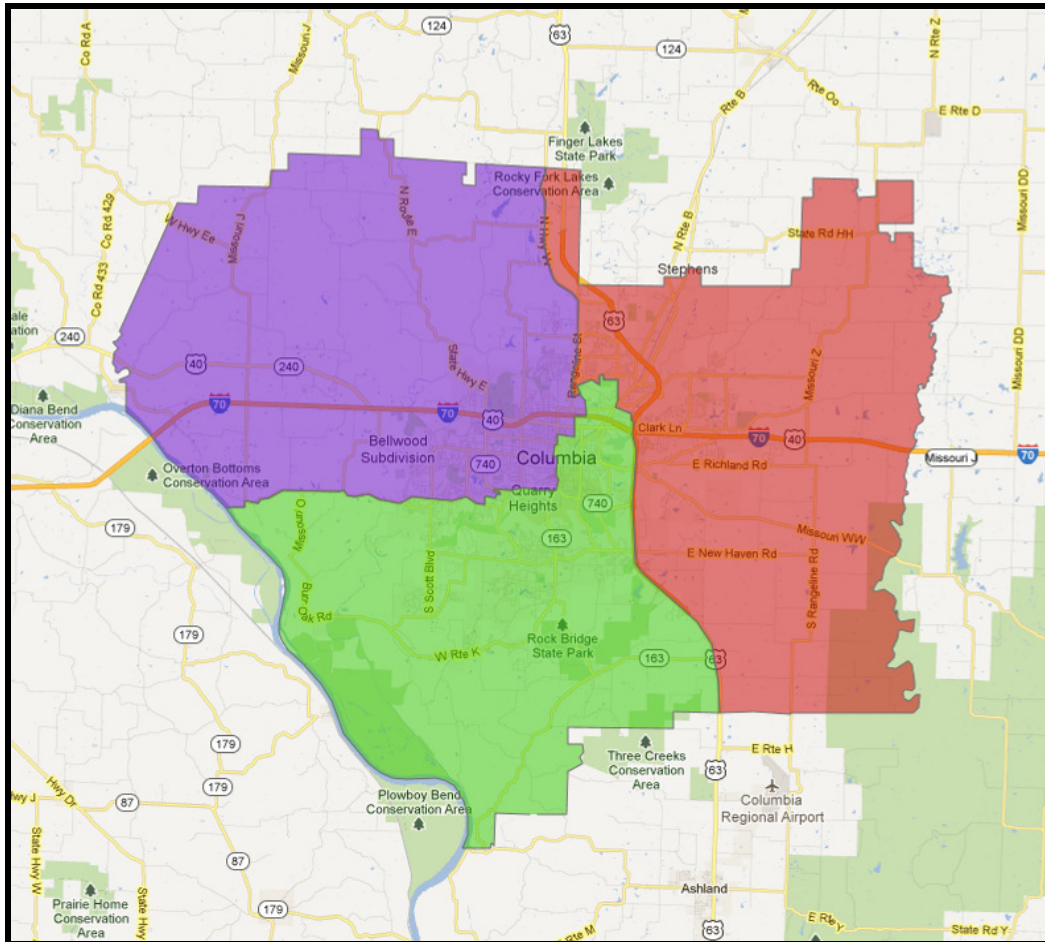
2014 peak period traffic volumes will largely be driven by Battle High School, once it is open to all grades (9-12) in 2014. As such, 2014 traffic forecasts and traffic operations analysis focuses on the school arrival and dismissal periods. This section of the report presents the traffic generation associated with Battle High School, as well as the assignment of the school's traffic to the area road system. It should be noted that the trip generation calculations and directional distribution estimates utilized in this portion of the study have been updated since the *Traffic Impact Study for the Proposed Columbia Public High School* prepared by CBB in 2009. The revised trip generation and directional distribution estimates are based on information provided by the Columbia Public Schools related to the number of students, staff, student drivers, parent drop-off and pick-up and the general distribution of the students to the surrounding area based on where the enrollment lives.

Site Generated Traffic Volumes

The City of Columbia is broken into three high school districts, as shown in **Figure 3**. The number of trips that would be generated by Battle High School (area shown in red on **Figure 3**) was estimated for the school arrival and dismissal hours. School district officials anticipate the high school would serve approximately 1,600 students and employ 175 staff/faculty members once all four grades occupy the school in the fall of 2014. The district anticipates the high school to start around 7:50 a.m. with dismissal around 3:00 p.m. However, the school district has indicated that the start and dismissal time could shift five to ten minutes depending on the final bell schedule.

The trip forecast for the second year of operation (1,600 students and 175 staff) was estimated based on the anticipated characteristics of the high school itself. Trips to and from the school during the a.m. arrival and dismissal peak hour are primarily made up of student drivers, parent pick-up/drop-off, employee/staff members and buses. Based upon information provided by the school district, it was estimated that approximately 600 of the students would drive with several of these student drivers expected to have other classmates riding with them. It was estimated that approximately 50 of the students would be dropped-off/picked-up by a parent, with the remaining students riding the bus. It is estimated that approximately 15% of the students/staff would not exit during the school dismissal peak hour due to after school activities.

Figure 3: Current Columbia High School Boundaries



Given the above, the estimated trip generation for each of these modes of travel is as follows:

- Based upon information provided by the school district, it is estimated that Battle High School will require approximately 20 buses to transport the students. It was also assumed that buses would not be stored on campus; and therefore, each bus would exit in the morning after dropping-off students and would arrive in the afternoon prior to picking-up students. Consequently, each bus would count for two trips during the morning arrival peak hour and two trips during the afternoon dismissal peak hour. In short, 40 bus trips (20 in and 20 out) would be expected during each peak hour.
- Approximately 600 students would drive to school. Therefore, a total of 600 student cars would be expected during the morning arrival peak. In order to account for after school activities, the dismissal peak hour traffic was reduced by 15%.
- Based upon information provided by the school district, it is estimated that approximately 50 students would be dropped-off and picked-up by a vehicle not remaining on campus (i.e., parent drop-off). Similar to the buses, each of these vehicles would generate two

trips during each peak hour. Hence, student drop-offs would generate 100 trips during the morning arrival and school dismissal peak hours.

- It was assumed that 60% of the faculty/staff would arrive by personal vehicle during the morning peak hour for a total of 105 vehicles entering. In order to account for after-school activities, the dismissal peak hour traffic was reduced by an additional 15% for a total of 90 vehicles exiting. A token amount of employee/staff trips were assumed to exit out in the arrival peak hour and enter during the dismissal peak.

Table 4 summarizes the number of trips that would be generated by the high school during the first year of all four grades occupying the school. The morning arrival and afternoon dismissal peak hours for a typical weekday are shown based upon the characteristics outlined above. As detailed in the table, the future high school would generate approximately 850 trips during the arrival peak hour and 745 trips during the dismissal peak hour.

Table 4: Year 2014 Site Generated Traffic for Battle High School

Arrival Mode	School Arrival Peak Hour (7:15 – 8:15)			School Dismissal Peak Hour (2:45 – 3:45)		
	In	Out	Total	In	Out	Total
Grades 9-12 ~ 1600 Students						
Buses	20	20	40	20	20	40
Student Drivers	600	0	600	0	510	510
Pick-Up/ Drop-Off	50	50	100	50	50	100
Faculty/Staff Member	105	5	110	5	90	95
Total Trips	775	75	850	75	670	745

Ultimately, the high school is targeted to achieve a student capacity of 1,850 students and 200 staff/faculty members. Since the timeframe for filling the school to capacity is unknown, this study assumes 1,600 students and 175 staff/faculty members for the 2014 analysis and 1,850 students and 200 staff/faculty members for the 2034 analysis. With respect to calculating the traffic generation based upon the school's anticipated operations, similar assumptions were made for the design year forecast (2034) as applied previously to the year 2014. The modal split may change slightly in the future due to students that would opt to walk or bike to school from the additional residential development immediately surrounding the proposed school. However, in order to be conservative, no adjustments in the vehicular patterns were accounted for in the trip generation estimates.

Table 5 summarizes the number of trips that would be generated by the high school during the design year in the morning arrival and afternoon dismissal peak hours for a typical weekday. As detailed in the table, the high school is expected to generate approximately 985 vehicular trips during the arrival peak hour and 860 vehicular trips during the dismissal peak hour.

Table 5: 2034 Site Generated Traffic for Battle High School

Arrival Mode	School Arrival Peak Hour (7:15 – 8:15)			School Dismissal Peak Hour (2:45 – 3:45)		
	In	Out	Total	In	Out	Total
Grades 9-12 ~ 1850 Students						
Buses	25	25	50	25	25	50
Student Drivers	690	0	690	0	585	585
Pick-Up/ Drop-Off	60	60	120	60	60	120
Faculty/Staff Member	120	5	125	5	100	105
Total Trips	895	90	985	90	770	860

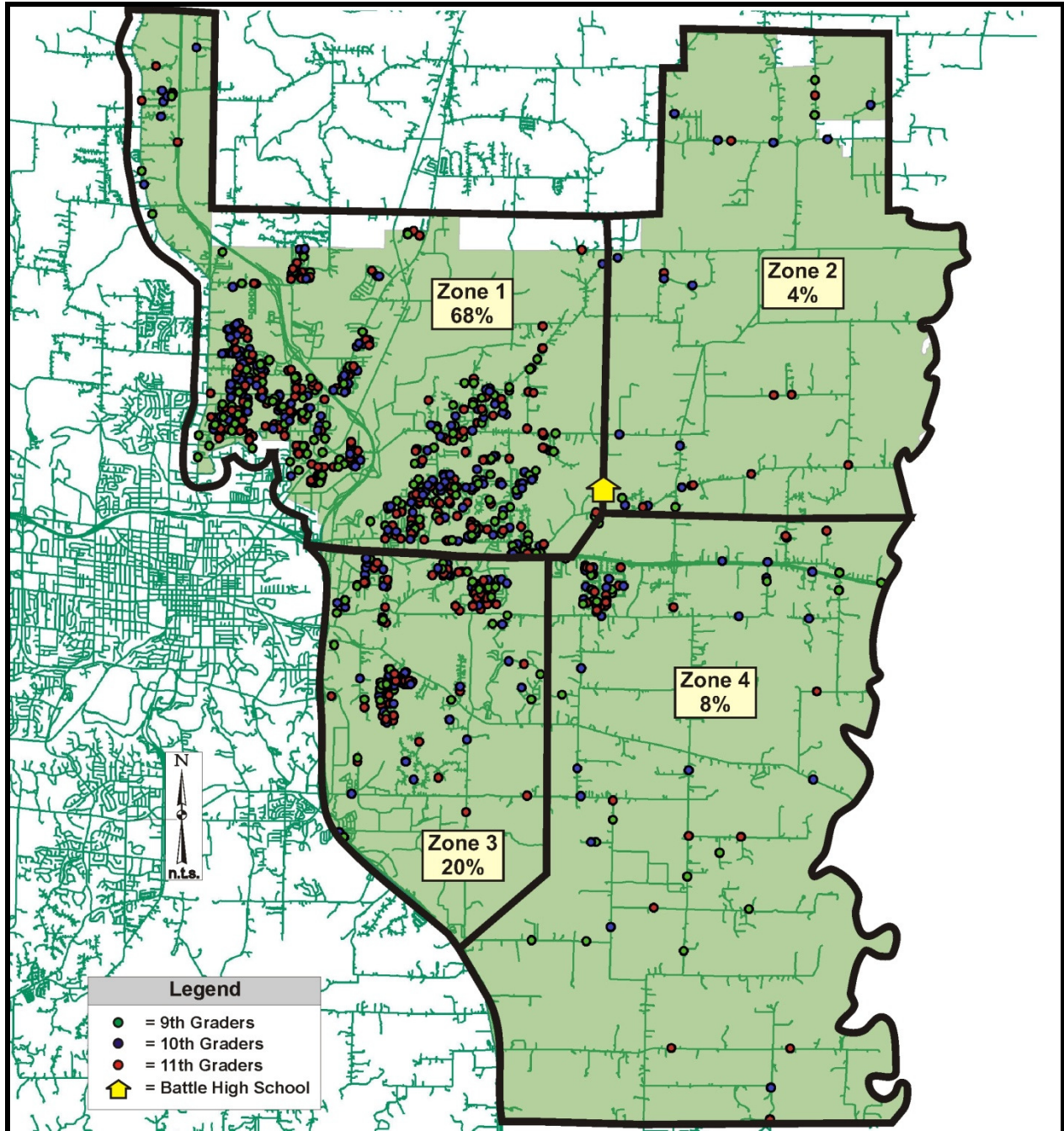
Site-Generated Traffic Assignment

Access to the high school is being provided via Spartan Drive, which connects to Battle Avenue; a new North/South connector road that initially extends from St. Charles Road to the north edge of the proposed elementary school's property line. Ultimately, Battle Avenue would extend north to Mexico Gravel Road and eventually south across I-70. Access to the school is also being provided via a full access driveway onto St. Charles Road approximately one third mile east of Battle Avenue.

The Columbia School District provided student population information within the Battle High School boundary area to assist in determining where students would be coming from. **Figure 4** identifies the school boundary area in green with the anticipated student population represented by dots on the map. The school boundary area was divided into four zones with the estimated percentage of students for each zone depicted in the figure. As shown, Zone 1 is estimated to contain approximately 68 percent of the student population, with Zone 2 at four percent, Zone 3 at 20 percent and Zone 4 at eight percent. Assuming students would take the most direct route to the school, the distribution would result in approximately 80 percent of the students arriving from the west on St. Charles Road with the remaining 20 percent of the students arriving from the east on St. Charles Road.

However, many of the employees and students of the school in Zone 3 will likely take Richland Road to Route Z (approaching from the south) in order to avoid the heavier traffic conditions along Clark Lane and St. Charles Road. Likewise, many of the employees and students of the school in Zone 1 may take Mexico Gravel Road to Route Z (approaching from the north) in order to avoid the heavier traffic conditions along Clark Lane and Lake of Woods. As such, the a trip distribution was modified to show approximately 60 to 65 percent of the students arriving from the west on St. Charles Road with the remaining 35 to 40 percent of the students arriving from the east on St. Charles Road. Once Battle Avenue is connected to the north to Mexico Gravel Road, most of this “diverted” traffic will shift directly to Battle Avenue and no longer travel out of their way to utilize Route Z to access the school.

Figure 4: Battle High School Student Population Distribution



In order to arrive at the approximate 35 to 40 percent of the trips to and from the east on St. Charles Road, the following assumptions were made:

- 20% of Zone 1 (13% of total trips) would utilize Mexico Gravel to Route Z to St. Charles Road to Battle High School

- 100% of Zone 2 (4% of total trips) would utilize Route Z to St. Charles Road to Battle High School
- 50% of Zone 3 (10% of total trips) would utilize Richland Road to Route Z to St. Charles Road to Battle High School
- 100 % of Zone 4 (8% of total trips) would utilize Route Z to St. Charles Road to Battle High School

Based upon the previously discussed assumptions, the directional distribution summarized in **Table 6** was used for the year 2014 when the high school would be occupied by all four grades.

Table 6: Year 2014 Anticipated Directional Distribution for Battle High School

Direction of Travel		Percentage of Total Trips
Zone 1 To & from the northwest – 68% of total trips	via Clark Lane/St. Charles Road West	25%
	via Lake of the Woods/ St. Charles Road West	28%
	via Mexico Gravel Road/Route Z/ St. Charles Road East	11%
	via I-70/Route Z/ St. Charles Road East	4%
Zone 2 To & from the northeast – 4% of total trips	via St. Charles Road East	4%
Zone 3 To & from the southwest – 20% of total trips	via St. Charles Road West	10%
	via Richland Road/ Route Z/ St. Charles Road East	10%
Zone 4 To & from the southeast – 8% of total trips	via Route Z/ St. Charles Road East	8%

The new trips generated by the high school were assigned to and from the school and along the adjoining roadways using the distribution percentages noted in **Table 6**. The resulting assignment of the site-generated high school trips onto the road system for the year 2014 is summarized on **Exhibit 20**. The distribution of trips between the two High School entrances was determined based upon likely circulation patterns given direction of approach to (or exit from) the school, parking lot designations, and the location of destination parking/drop-off areas. The traffic generated by the Battle High School was aggregated with the 2012 Base Traffic Volumes to reflect the 2014 Build (or forecasted) operating conditions following the opening of the high school. **Exhibit 21** is the resulting Year 2014 Build Traffic Volumes

2034 Forecasted Traffic Volumes

2034 traffic forecasts were developed based on the Columbia Area Transportation Study Organization (CATSO) model outputs. Land-use assumptions in the model were reviewed by the project team, including Boone County planning staff, City of Columbia planning and engineering staff and CATSO planning staff. Adjustments to the future year land uses were made to accommodate the addition of Battle High School and the proposed elementary school. Additionally, residential land use assumptions in the model were cross-checked with known subdivision proposals to ensure validity of the model's assumptions. An updated roadway network was developed based on the recommended thoroughfare plan. Daily and hourly traffic forecasts were generated utilizing the updated future year (2030) model outputs. **Exhibit 22** shows the 2034 forecasted traffic volumes assuming full build out for the study area using the land-uses shown in the CATSO travel demand model, which also correlates to the land uses shown in **Exhibit 14**.

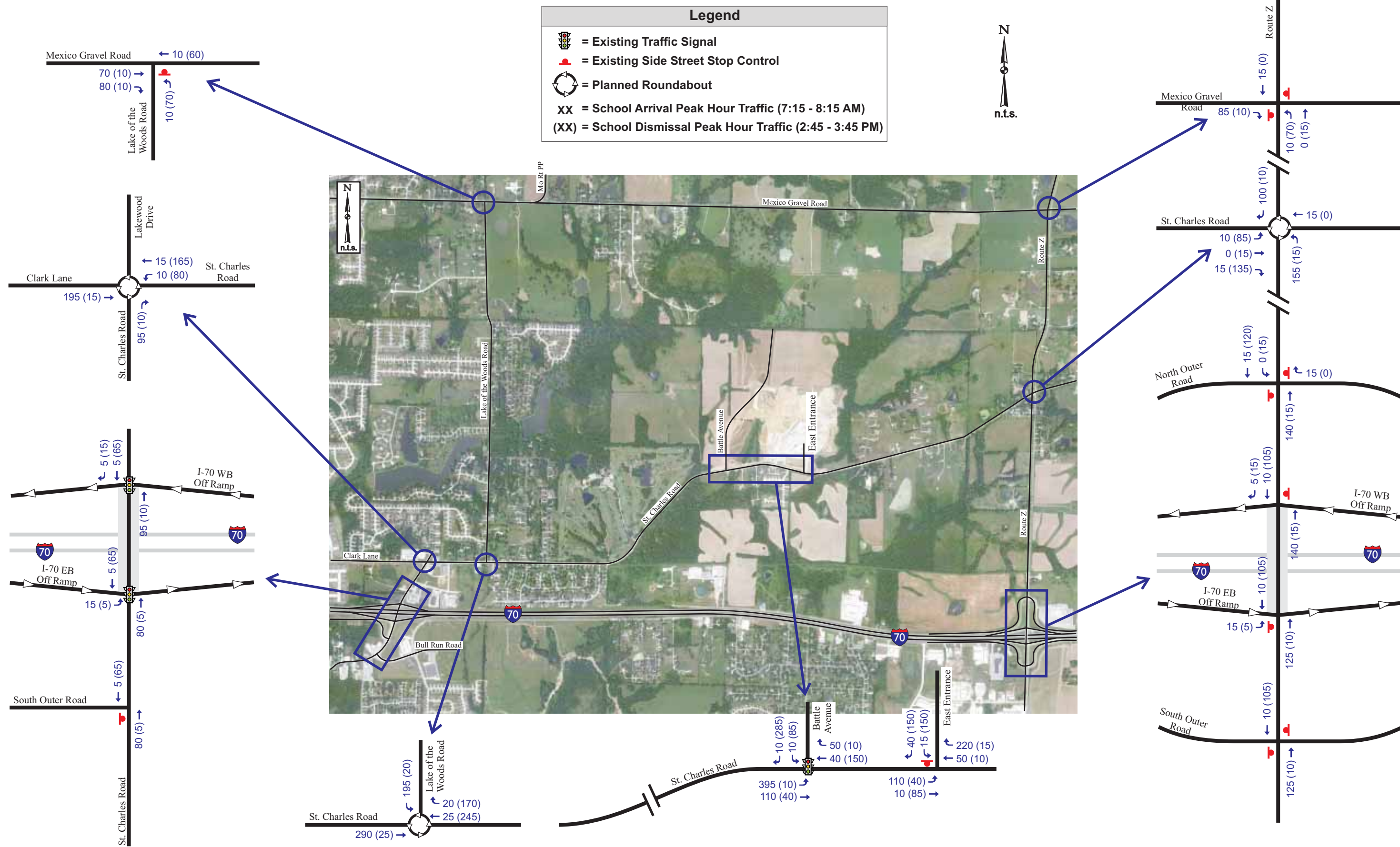


Exhibit 20: 2014 Battle High School Site-Generated Trips

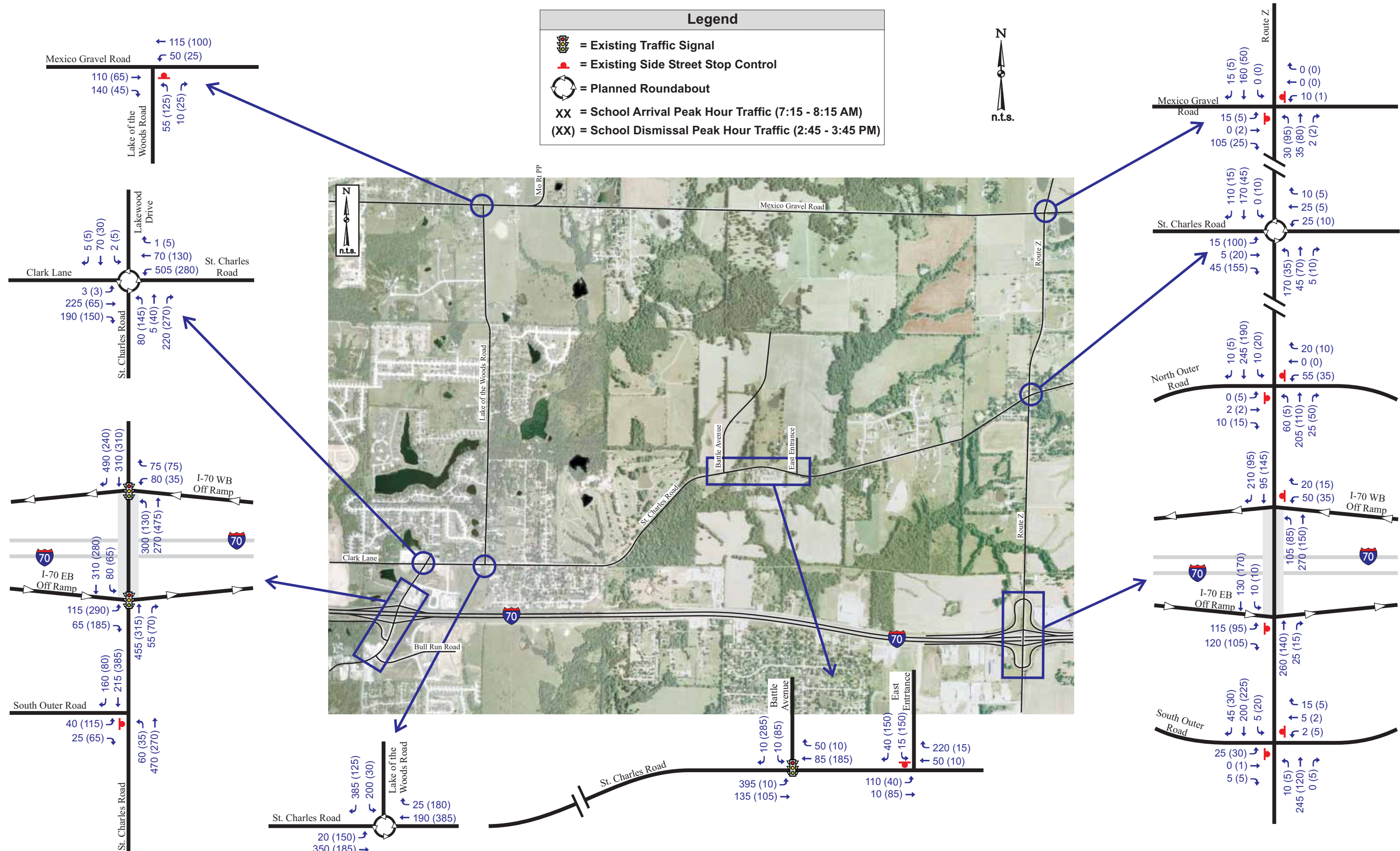


Exhibit 21: 2014 Traffic Volumes (with Battle High School)

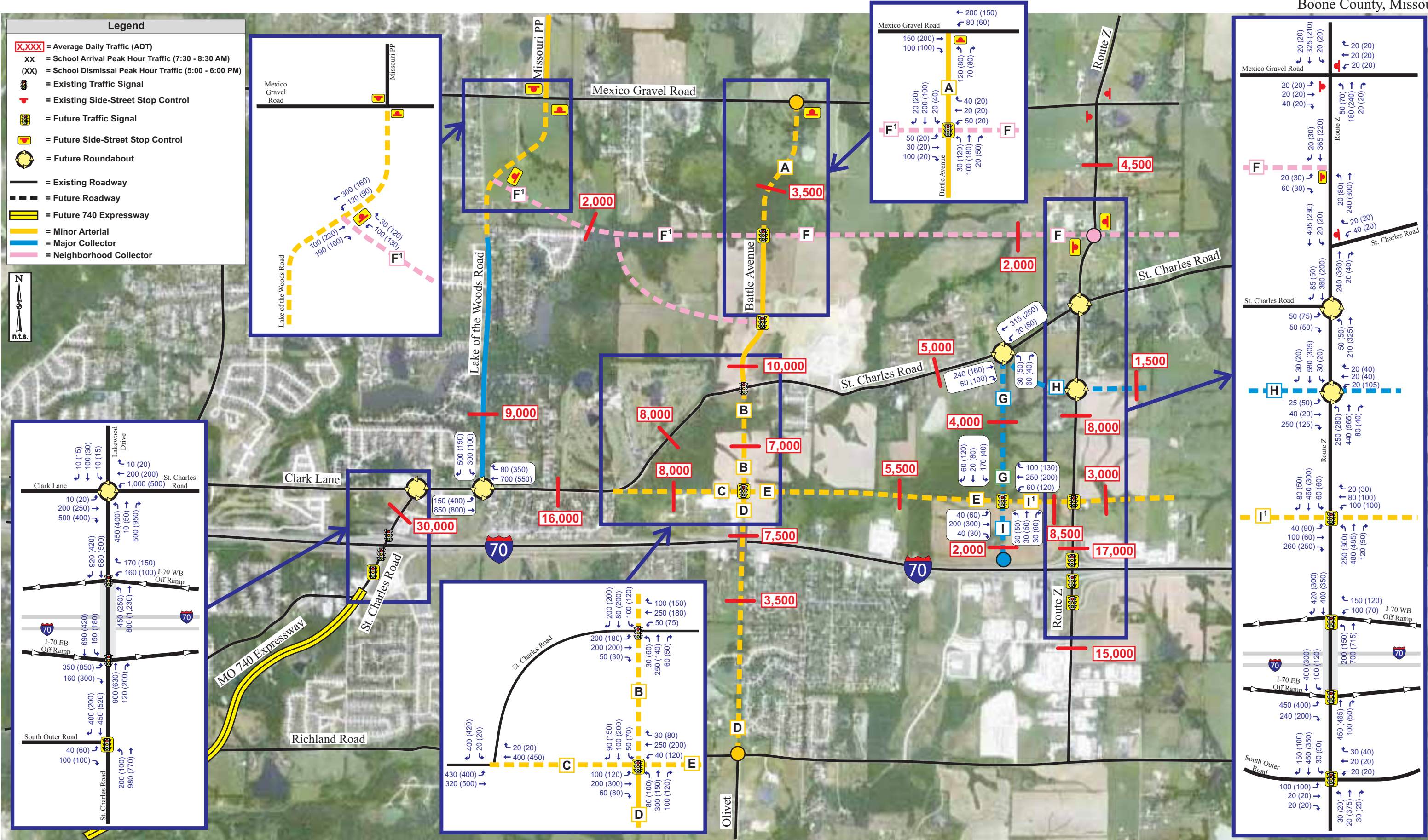
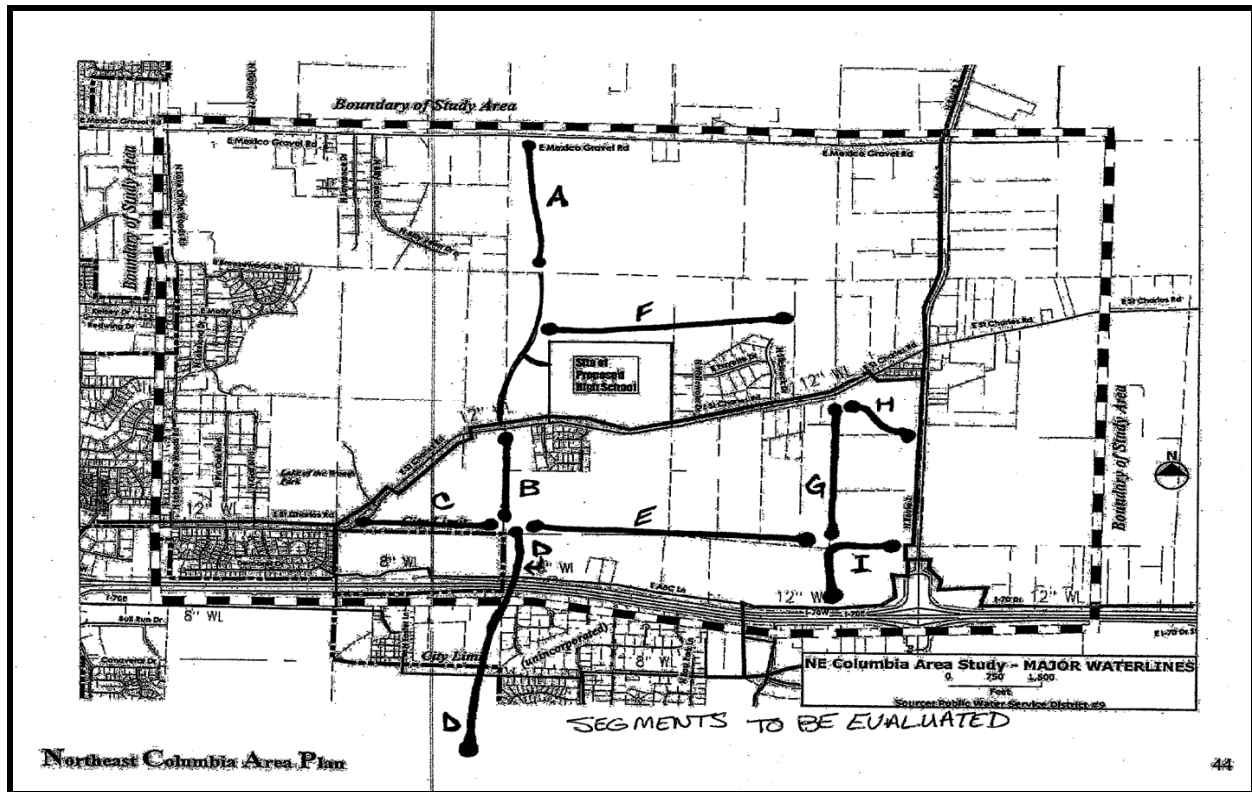


Exhibit 22: Year 2034 Forecasted Traffic Volumes

Roadway Segments

To discuss improvements and new facilities, roadways were broken up into segments. **Figure 5** shows the original segments from the beginning of the study. Some of the original segments were expanded or modified during the planning process. The discussion of each segment includes a description about each segment, changes that were made during the planning process, what is assumed by the year 2034 for geometrics, and a conceptual cost. Additional information about the methodology to generate the cost estimates can be found in the “Cost Estimate Methodology” section.

Figure 5: Starting Roadway Segments used in the Planning Process



Boone County currently requires property owners to plat and dedicate right of way for CATSO roads when a property owner is platting or undertaking a planned development. However, other forms of land development do not trigger such dedication. Currently Boone County also requires construction of improvements in these dedicated rights of way. The County might consider the simple dedication to be appropriate and sufficient in some cases. One model would be for Boone County to plan for and reserve corridors for new roadways in all cases. This would provide a corridor for these roadways to be constructed in the future (possibly by the City of Columbia).

“Rolling Hills” was put forward as an example of how an intergovernmental agreement such as this could work. In this case Boone County and the City of Columbia shared the cost to build a roadway outside of the City’s Limits (in Boone County) because the roadway would be important for the City as development and annexation occur. A discussion of each of the roadway segments is provided in the following section.

Battle Avenue Extension (Segments A, B, and D)

In discussions with the partner agencies the extension of Battle Avenue consistently surfaced as one of the highest priority improvements in the study area. The extension of Battle Avenue was broken down into three segments. Segment A would connect the recently constructed segment near Battle High School north to Mexico Gravel Road. Segment B is between St. Charles Road and the future Clark Extension. Segment D, also known as the Olivet overpass, runs between Clark Avenue and Richland Road. When fully built out, Battle Avenue will be a north-south arterial roadway serving the high school, future elementary school, and will connect neighborhoods north and south of I-70.

Extend Battle Avenue north to Mexico Gravel Road (Segment A)

Projected 2034 ADT: 3,500 vehicles per day

Classification: Minor Arterial

Anticipated Speed Limit: 45 miles per hour

Number of Lanes: 3 (2 through lanes and left turn lanes as warranted)

Traffic Control at Intersections:

- Mexico Gravel Road: Side Street Stop Control
- Segment F: Traffic Signal

Roadway Width: 52’

Right of Way Width: 100’ Right of Way with 20’ Utility Easement on both Sides

Estimate of Probable Cost (2014 Dollars): \$2.5 - \$2.7 million

Estimate of Probable Cost (2034 Dollars): \$4.5 - \$4.9 million

Anticipated Funding: A partnership between the City of Columbia and Boone County is critical to getting this portion of segment ‘A’ constructed. This segment is highly likely to be fully publically funded, although developer participation is possible.

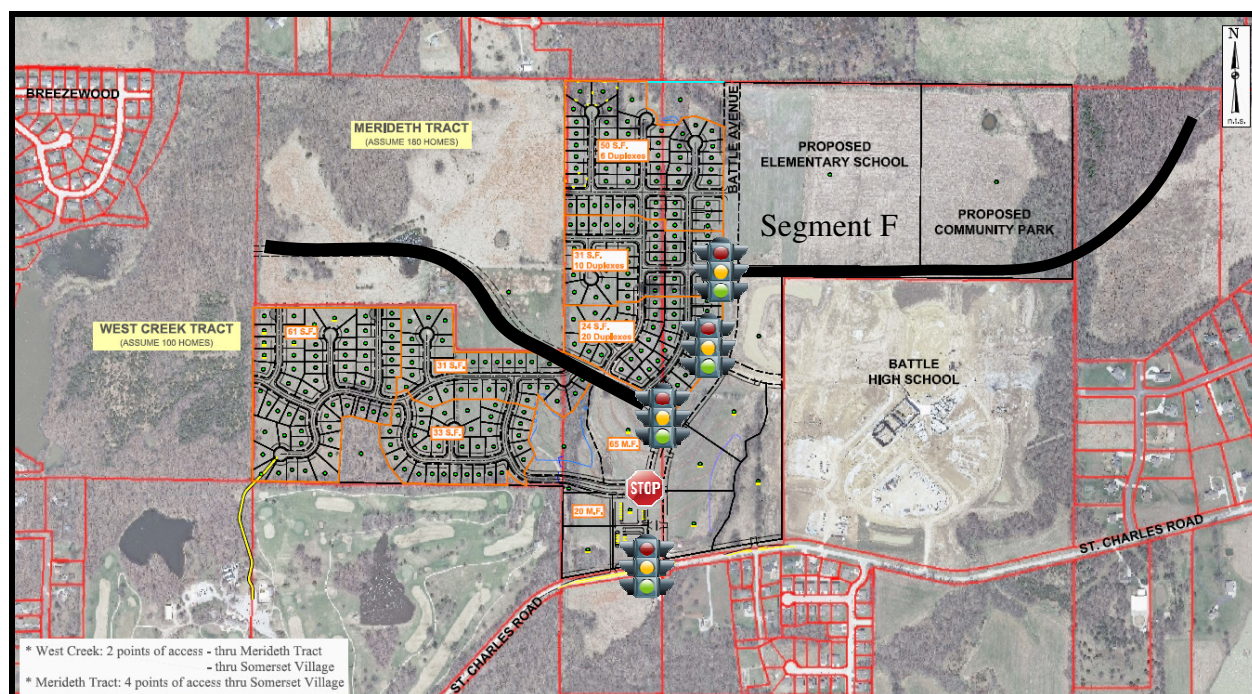
Segment A, the extension of Battle Avenue to Mexico Gravel Road consistently surfaced as a top priority during discussions with partner agencies. The roadway would provide access to Battle High School and the future elementary school from the north. This would allow many school related trips to access the academic campus area without traveling on other congested roadways

The Boone County Fire District has indicated this improvement is its highest priority for roadway improvements in the study area. This segment offers the fire district secondary access to the academic campus from the north. This redundancy is required to provide alternate access in the event the primary access route is blocked, or to provide the ability to evacuate one or both schools while simultaneously deploying emergency responders. Emergency response to the northeast subarea is currently provided by way of the Boone County Lake of the Woods Fire Station (Station 1) near the intersection of St. Charles Road and Lake of the Woods Road. As shown in **Exhibit 18** alternate emergency response routes from the Lake of the Woods Fire Station to the academic campus are:

- Primary Access Route (St. Charles Road): Approximately 2.9 minutes
- South Secondary Access Route (I-70): Approximately 8.6 minutes
- North Secondary Access Route (Mexico Grave Road): Approximately 6.5 minutes

A review of current site plans highlighted the need to evaluate access management along the section of Battle Avenue between St. Charles Road and the north property line of the elementary school. Of specific concern is the alignment of Segment F and a planned collector roadway serving Somerset Village/the West Creek and Merideth tracts. As originally conceived, the current site plans showed five separate intersections proposed within about 1,800 feet (or about 450 feet between intersections). Traffic signals will eventually be needed at several of these intersections as is shown in **Figure 6**. If the original alignment concepts were constructed, the layout would result in traffic signals that are located too close together.

Figure 6: Segment “A” Intersections per Original Alignment Concepts (Not Recommended)

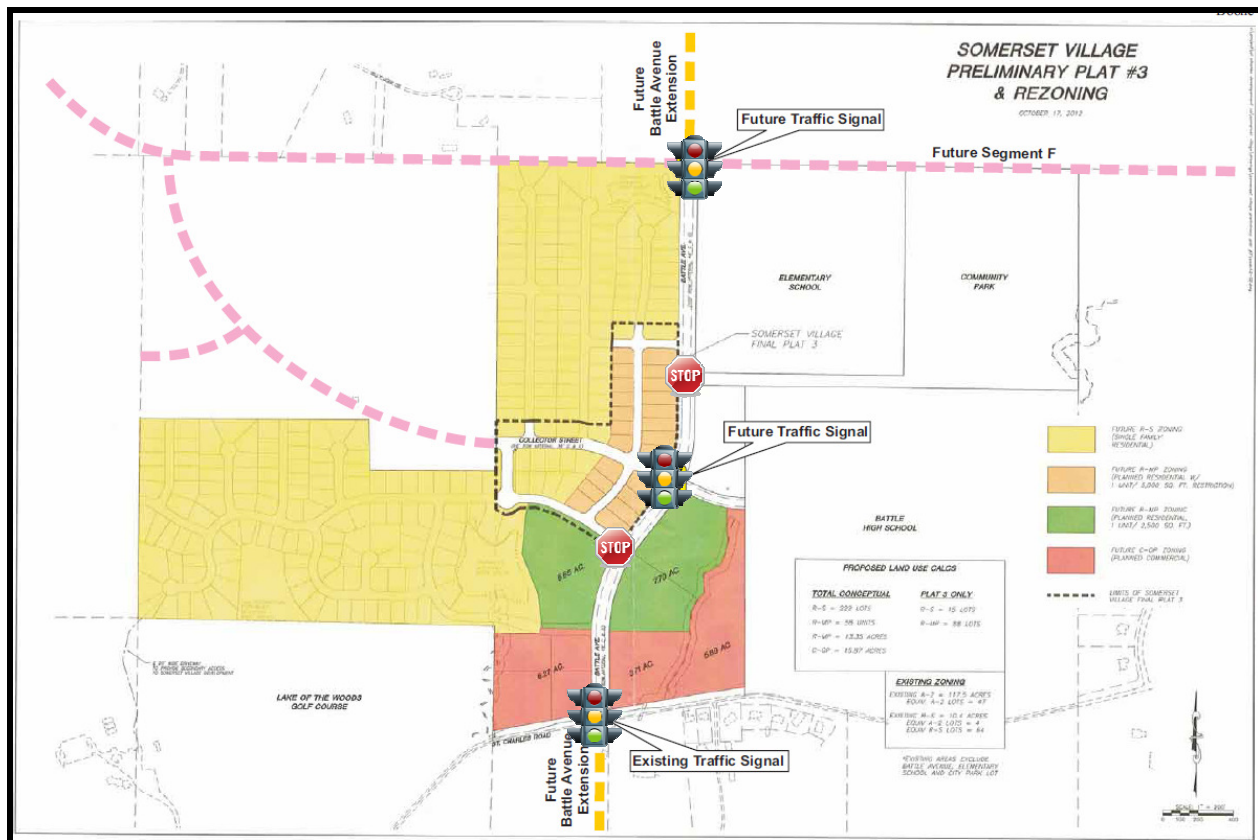


During discussions with partner agencies, it was determined that it would be better to show Segment F relocated on the north side of the elementary school and reconfigure the Somerset Village collector so that it ties in across from Spartan Drive (Battle High School). This would result in traffic signals at St. Charles Road, Spartan Drive (Battle High School)/relocated Somerset Village collector, and relocated Segment F. This would provide about 1,500 feet spacing between these traffic signals. Additional unsignalized intersections could be provided at:

- A second Somerset Village access point (between St. Charles Road and the Spartan Drive/relocated Somerset Village collector), and
- The proposed park access road (between relocated Segment F and Spartan Drive/relocated Somerset Village collector).

This configuration would result in more desirable intersection spacing, as shown in **Figure 7**.

Figure 7: Relocated Access Points along Battle Avenue (Recommended)



Extend Battle Avenue south to connect with an extension of Clark Lane (Segment B)

Projected 2034 ADT: 7,000 vehicles per day

Classification: Minor Arterial

Anticipated Speed Limit: 45 miles per hour

Number of Lanes: 3 (2 through lanes and left turn lanes as warranted)

Traffic Control at Intersections: Traffic Signal at Battle Avenue and Clark Lane

Roadway Width: 52'

Right of Way Width: 100' Right of Way with 20' Utility Easement on both Sides

Estimate of Probable Cost (2014 Dollars): \$2.0 - \$2.2 million

Estimate of Probable Cost (2034 Dollars): \$3.6 - \$3.9 million

Anticipated Funding: This project may require a Boone County/City of Columbia intergovernmental agreement. Primarily a public project, but may have a private developer component.

Segment B would provide a critical connection between Segment D (Battle Avenue over I-70 as discussed below) and existing Battle Avenue. Coupled with Segment D, this roadway would provide access to Battle High School and the future elementary school from the south. This would allow school related trips approaching from south of I-70 to access the academic campus without traveling through the Lake of the Woods/St. Charles Road and Route Z interchanges.

This segment, in conjunction with the Clark Lane extension, would carry most of the traffic currently on the corresponding section of St. Charles Road. The intersection of Battle Avenue and Clark Lane would be a prominent and highly traveled part of the landscape in the subarea, providing an opportunity for high-quality commercial development. As such, there may be opportunities, such as the formation of a Transportation Development District (TDD), to fund a part of this roadway in partnership with the City and/or County. Special consideration should be paid to the design of this intersection as it may present an opportunity for a “gateway” type treatment into the subarea.

Extend Battle Avenue south with Olivet Overpass to Richland Road (Segment D)

Projected 2034 ADT: 7,500 vehicles per day north of I-70/3,500 vehicles per day south of I-70

Classification: Minor Arterial

Anticipated Speed Limit: 45 miles per hour

Number of Lanes: 3 (2 through lanes and left turn lanes as warranted)

Traffic Control at Intersections: Traffic Signal at Battle Avenue and Clark Lane

Roadway Width: 52'

Right of Way Width: 100' Right of Way with 20' Utility Easement on both Sides

Estimate of Probable Cost (2014 Dollars): \$9.2 - \$10.1 million

Estimate of Probable Cost (2034 Dollars): \$16.5 - \$18.2 million

Anticipated Funding: This project may require intergovernmental agreements between Boone County, the City of Columbia, and/or MoDOT. The bridge across I-70 may provide opportunities for participation in state/federal funding programs. Separate studies will be required to obtain MoDOT and Federal Highway Administration (FHWA) permits for the overpass.

Segment D would provide a critical connection to Battle Avenue north of I-70. Coupled with Segment B, this roadway would provide access to Battle High School and the future elementary school from the south. This would allow school related trips approaching from south of I-70 to access the academic campus without traveling through the Lake of the Woods/St. Charles Road and Route Z interchanges. Due to its strategic location Segment D could reduce trips at the Lake of the Woods/St. Charles Road and Route Z interchanges by about 10-15%. This volume

reduction would reduce the pressure to enhance those interchanges. Because of these reasons, Segment D consistently surfaced as a high priority during discussions with partner agencies.

Of note is that the original concept for Segment D also called for a parallel road called the Olivet Extension. The most recent CATSO plan amendment combines the Olivet Extension and Battle Avenue Extension, creating the minor arterial described in this section.

A critical design element of Segment D is the connections to ABC Lane (North I-70 Frontage Road) and I-70 Drive Southeast. These frontage roads are currently located within 50 feet of I-70, so special design provisions will be required to bring the roadway elevations together in order to create intersection connections. Two options are 1) swing the frontage roads away from I-70 in the vicinity of the overpass to allow distance for Battle Avenue to come back down to grade in order to create a connection with the frontage road or 2) create a “jug-handle” connection between Battle Avenue and the frontage roads. A design study should be undertaken to determine the preferred alignment of these connections so that Boone County or the City of Columbia can reserve the right-of-way needed to create these connections in the future. The type of traffic control most appropriate at the connections between Battle Avenue and ABC Lane (North I-70 Frontage Road)/I-70 Drive Southeast should be determined based on this design study.

Clark Lane Extension (Segments C, E, and I)

An extension of Clark Lane to Route Z is needed for two primary reasons: 1) to facilitate commercial development and 2) to provide an east-west minor arterial relieving traffic volumes on St. Charles Road. The area that will be served by the extension of Clark Lane is ideal for commercial development. However, a new roadway is necessary to provide access in order for this development to occur. Moreover, this roadway extension is needed to alleviate future traffic volumes on St. Charles Road. St. Charles Road is narrow and has poor geometrics to serve as an arterial roadway. It would be difficult to straighten or widen St. Charles Road without major right-of-way and utility impacts. The Clark Lane extension corridor provides a good corridor for an east-west arterial roadway in this part of the study area.

Clark Lane, particularly at the intersection of Battle Avenue, would be a prominent and highly traveled part of the subarea’s landscape, providing an opportunity for high-quality commercial development. Land uses abutting the extension would be mostly commercial. As such, there may be opportunities such as the formation of a Transportation Development District (TDD) to fund a part of this roadway. In this light, the Clark Lane extension is most likely initially to be constructed as a collector roadway in order to providing access to new businesses developing along the route. Developers would be required to plat and dedicate right-of-way for an ultimate arterial roadway cross-section, but initially construct a collector roadway. A future project could then be put into place to upgrade to an arterial roadway when conditions warrant.

The type of traffic control at the intersection of Clark Lane and St. Charles Road will be based on what treatments are made to existing St. Charles Road after Segment C is constructed. If existing St. Charles Road is maintained in its current condition such that it provides high-quality service to Battle Avenue, it will most likely still carry a significant amount of traffic. In that case

a higher type of traffic control would be required (i.e., a traffic signal or roundabout). However, if traffic calming measures are applied to existing St. Charles Road in a deliberate attempt to divert traffic to Clark Lane (lanes are narrowed, speed limits are lowered, etc.), then the majority of traffic destined to Battle Avenue would likely stay on Clark Lane. In that case a lower type of traffic control (e.g., side street stop control) would likely be appropriate for the intersection.

Extend Clark Lane east to connect with an extension of Battle Avenue (Segment C)

Projected 2034 ADT: 8,000 vehicles per day

Classification: Minor Arterial

Anticipated Speed Limit: 35 miles per hour

Number of Lanes: 3 (2 through lanes and left turn lanes as warranted)

Traffic Control at Intersections:

- Battle Avenue and Clark Lane: Traffic Signal
- Clark Lane and St. Charles Road: To be determined based on treatments made to existing St. Charles Road

Roadway Width: 52'

Right of Way Width: 100' Right of Way with 20' Utility Easement on both Sides

Estimate of Probable Cost (2014 Dollars): \$2.8 - \$3.1 million

Estimate of Probable Cost (2034 Dollars): \$5.1 - \$5.7 million

Anticipated Funding: This project may require a Boone County/City of Columbia intergovernmental agreement. Primarily a public project, but may have a private developer component. This project is a potential candidate for the formation of a Transportation Development District (TDD).

Extend Clark Lane from Segment C to Segment G (Segment E)

Projected 2034 ADT: 5,500 vehicles per day

Classification: Minor Arterial

Anticipated Speed Limit: 35 miles per hour

Number of Lanes: 3 (2 through lanes and left turn lanes as warranted)

Traffic Control at Intersections: Traffic Signal at Clark Lane and Segment I/G

Roadway Width: 52'

Right of Way Width: 100' Right of Way with 20' Utility Easement on both Sides

Estimate of Probable Cost (2014 Dollars): \$4.7 - \$5.2 million

Estimate of Probable Cost (2034 Dollars): \$8.5 - \$9.3 million

Anticipated Funding: Developer driven for initial connection. Initially developers would likely be required to plat and dedicate right-of-way for an arterial roadway but construct a collector roadway to provide for their immediate access needs. A future project could be undertaken to upgrade to the roadway to arterial standards. This project is a potential candidate for the formation of a Transportation Development District (TDD).

Relocate I-70 NOR/ABC Drive (Segment I)

Segment I would provide for a relocation of the North Outer Road, which is important for Route Z/I-70 interchange operations. The relocation of the North Outer Road would provide better spacing between the I-70 interchange westbound ramp terminal intersection and the north outer

road intersection. This connection should be placed to provide for an enhanced connection to the Columbia Area Jobs Foundation (CAJF) site and private developable land to the east of Route Z.

Segment I

Projected 2034 ADT: 2,000 vehicles per day

Classification: Commercial Collector

Anticipated Speed Limit: 35 miles per hour

Number of Lanes: 3 (2 through lanes and left turn lanes as warranted)

Traffic Control at Intersections: Traffic signal at Clark Lane and Segment I/G

Roadway Width: 42'

Right of Way Width: 66' Right of Way with 20' Utility Easement on both Sides

Segment I Estimate of Probable Cost (2014 Dollars): \$720,000 - \$800,000

Segment I Estimate of Probable Cost (2034 Dollars): \$1.4 - \$1.5 million

Anticipated Funding: This project would provide for a relocation of the North Outer Road, which is important for Route Z/I-70 interchange operations. As such, the project would serve as an important link in the overall transportation plan. Because of the location at the Route Z/I-70 interchange, the project could be developer initiated. In that case developers would be required to plat and dedicate right-of-way and also construct a collector roadway to provide for their immediate access needs. A future project may be required to upgrade the roadway. This project is a potential candidate for the formation of a Transportation Development District (TDD).

Segment I'

Projected 2034 ADT: 8,500 vehicles per day

Classification: Minor Arterial

Anticipated Speed Limit: 35 miles per hour

Number of Lanes: 3 (2 through lanes and left turn lanes as warranted)

Traffic Control at Intersections:

- Clark Lane and Segment I/G: Traffic Signal
- Segment I' and Route Z: Traffic Signal

Roadway Width: 52'

Right of Way Width: 100' Right of Way with 20' Utility Easement on both Sides

Segment I' Estimate of Probable Cost (2014 Dollars): \$1.4 – \$1.5 million

Segment I' Estimate of Probable Cost (2034 Dollars): \$2.5 – \$2.8 million

Anticipated Funding: Developer driven for initial connection. Initially developers would likely be required to plat and dedicate right-of-way for an arterial roadway but construct a collector roadway to provide for their immediate access needs. A future project could be undertaken to upgrade to the roadway to arterial standards. This project is a potential candidate for the formation of a Transportation Development District (TDD).

Proposed Collector Roadways (Segments F and G)

East/west collector across Copper Creek to Battleground property (Segment F)

Projected 2034 ADT: 2,000 vehicles per day

Classification: Neighborhood Collector

Anticipated Speed Limit: 35 miles per hour

Number of Lanes: 3 (2 through lanes and left turn lanes as warranted)

Traffic Control at Intersections:

- Segment F and Lake of the Woods Road: Side Street Stop
- Segment F and Battle Avenue: Traffic Signal
- Segment F and Route Z: Two-Way Stop Control

Roadway Width: 38'

Right of Way Width: 66' Right of Way with 20' Utility Easement on both Sides

Segment F Estimate of Probable Cost (2014 Dollars): \$4.1 – \$4.5 million

Segment F Estimate of Probable Cost (2034 Dollars): \$7.3 - \$8.0 million

Segment F' Estimate of Probable Cost (2014 Dollars): \$4.0 – \$4.4 million

Segment F' Estimate of Probable Cost (2034 Dollars): \$7.3 – \$8.0 million

Anticipated Funding: The western end of Segment F is anticipated to have high construction costs due to terrain, making it less attractive for developers. Segment F could be a shared project with partial public funding and developer responsibility. For instance, a developer could be asked to build the roadway with a public agency taking responsibility for major culverts and/or any required bridges. East of Battle Avenue, this road will most likely be a primarily developer financed roadway

Planning for Segment F was expanded from its original limits (between Battle Avenue and North Battleground Subdivision) to new limits (between Lake of the Woods Road and Route Z). This was partly due to concerns about allowing subdivision cross-access between the Merideth/West Creek Tracts and Breezewood/Molly Lane. It was believed that if this cross-access were allowed to occur without a designated collector roadway in place it could result in these local roadways becoming “default” collector roadways. People are likely to use the local connections if they are in place and there is not a better alternative route. Breezewood and Molly Lane were not designed to collector roadway specifications and increased traffic volumes would be a problem for the residents along these routes. Therefore, extending Segment F as a collector roadway to Lake of the Woods Road would provide a connection between Battle Avenue and Lake of the Woods Road.

Segment F is needed for connectivity and was broken into sub areas for evaluation. Segment F will most likely be implemented in pieces (each with independent utility and different challenges) as funding becomes available.

The western end of Segment F is critical to avoid overloading Battle Avenue north of St. Charles Road and connecting to Lake of the Woods Road. The western part of Segment F would provide a connection between Lake of the Woods and Battle High School/the future elementary school.

The western end of Segment F is anticipated to have high construction costs due to terrain, making it less attractive for developers. Segment F could be a shared project with partial public funding and developer responsibility. For instance, a developer could be asked to build the roadway with a public agency taking responsibility for major culverts and/or any required bridges. A location study needs to be conducted to set the alignment for the western portion of Route F. The most logical route (from a roadway system standpoint) would be to connect the west end of this roadway to Lake of the Woods Road south of Mexico Gravel Road. However,

this may be prohibitive due to terrain and existing development. Alternatively, the road could swing to the north and connect to Lake of the Woods Road closer to Mexico Gravel Road. However, the impact of closely spaced intersections on the northern section of Lake of the Woods Road and the future realignment of Lake of the Woods Road to Route PP needs to be considered.

The east end of this segment could connect at either Spartan Drive or on the north side of the Merideth Tract. Connecting on the north side of the Merideth Tract would provide an opportunity for a continuous roadway. Connecting to Spartan Drive could result in Segment F being off-set across Battle Avenue. It is possible, depending on how the Merideth Tract develops, that both connections could be provided.

East of Battle Avenue, Segment F should be located on the north side of the elementary school. As discussed in the Battle Avenue Section, this alignment would result in better intersection spacing along Battle Avenue between St. Charles Road and Segment F. This alignment would also provide an opportunity for a continuous roadway.

West of Battle Avenue, Segment F should be aligned along the north property line of the Merideth Tract. In the event that a through connection of Segment F is not able to be created in this location, the Somerset Village collector roadway (connecting to Spartan Drive) could serve as Segment F through this section of the corridor. The major drawback, however, of this alignment is that it would not provide for a continuous roadway through Battle Avenue.

The proposed alignment of Segment F, east of Battle Avenue, is located largely along existing property lines. This alignment was chosen to minimize the impact to adjacent properties. However, existing county ordinances may create a problem in the implementation of this road. Specifically, county ordinance requires that a developer construct a roadway when they are required to dedicate right-of-way for that roadway. Along this alignment each property owner would be required to dedicate one-half of the right-of-way. The first property owners required to dedicate and plat right-of-way would not be able to construct the road (as required by county ordinance) because only one-half of the right-of-way would be dedicated at that time. The entire right-of-way (dedicated by property owners on both sides of the road) would be needed to construct the road. Therefore, we recommend that an exception should be given to property owners along Segment F such that they would be able to dedicate the required right-of-way but would not be required to construct the road. Funds from the proposed trip generation fees could be used to construct the road once the full width of right-of-way has been dedicated.

North/south collector road (Segment G)

Projected 2034 ADT: 4,000 vehicles per day

Classification: Commercial Collector

Anticipated Speed Limit: 35 miles per hour

Number of Lanes: 3 (2 through lanes and left turn lanes as warranted)

Traffic Control at Intersections:

- Segment G and St. Charles Road: Roundabout
- Clark Lane and Segment I/G: Traffic Signal

Roadway Width: 42'

Right of Way Width: 66' Right of Way with 20' Utility Easement on both Sides

Segment G Estimate of Probable Cost (2014 Dollars): \$1.8 - \$2.0 million

Segment G Estimate of Probable Cost (2034 Dollars): \$3.3 - \$3.6 million

Anticipated Funding: This project would most likely be a developer financed roadway. The roadway would be required to facilitate future commercial development. As such, the development community would most likely be required to construct the roadway to provide connections to their businesses.

Relocated St. Charles Road (Segment H)

Projected 2034 ADT: 5,000 vehicles per day

Classification: Commercial Collector

Anticipated Speed Limit: 45 miles per hour

Number of Lanes: 3 (2 through lanes and left turn lanes as warranted)

Traffic Control at Intersections:

- Segment G, H, and St. Charles Road: Roundabout
- Segment H and Route Z: Roundabout or Traffic Signal

Roadway Width: 42'

Right of Way Width: 66' Right of Way with 20' Utility Easement on both Sides

Segment H Estimate of Probable Cost (2014 Dollars): \$1.1 – \$1.2 million

Segment H Estimate of Probable Cost (2034 Dollars): \$1.9 – \$2.1 million

Anticipated Funding: This project would most likely be a developer financed roadway. The roadway would be required to facilitate future commercial development. As such, the development community would most likely be required to construct the roadway to provide connections to their businesses. The connection to existing St. Charles Road would best be made via a roundabout. The connection to Route Z would be made via a roundabout or Traffic Signal.

Route Z

Route Z is a state maintained roadway. From a planning standpoint, it is important to consider the connection of County and City roadways to Route Z and the spacing between intersections. Ideally, intersection spacing should be about one-quarter to half mile. The proposed plan allows for one-quarter to one-half mile spacing of most major intersections (future traffic signals or roundabouts) between St. Charles Road and ABC/Lane/Segment I' (north outer road). Major intersection spacing would be less than one-quarter mile at the I-70 interchange, between the north outer road and the I-70 Drive Southeast, which is considered acceptable for freeway interchanges.

The existing intersection of St. Charles Road and Route Z has several geometric deficiencies. The primary problems are 1) poor sight distance and 2) off-set skewed intersection resulting in poor turning radii. School busses can make all turns at the intersection if automobiles stop at the marked stop bars. However, there is a potentially historic barn in the northwest quadrant of the intersection. Eastbound traffic cannot see “around” the barn and tends to move forward past the stop bar. As a result, school busses often cannot make the northbound to westbound left turning movement when there is a vehicle on the eastbound approach. This will become a much bigger issue when the Battle High School opens in 2013 and the future elementary school is opened in

the future. Semitrailer trucks with an overall wheelbase of 50 feet (WB-50) cannot make several of the turning movements at the intersection. Moreover, the fire district considers improving the St. Charles Road/Route Z intersection as a high priority. The Fire district considers this intersection as a dangerous condition given the Battle High School opening in 2013. As a result of these concerns, in 2012 Boone County and MoDOT were approved for a cost share project to improve Route Z between I-70 and St. Charles Road. The project includes:

- Reconstruction of the Route Z/I-70 overpass to three lanes, and providing dedicated southbound and eastbound right-turn lanes at the interchange. Serious consideration should be given to constructing the bridge with sufficient width so that it could ultimately be restriped to four (4) lanes of traffic in the future.
- Adding three foot shoulders to Route Z between I-70 and St. Charles Road; and
- Constructing a roundabout at the intersection of Route Z and St. Charles Road.

MoDOT is working on the design for this project, which is scheduled for a February 2013 letting and completion date prior to the opening of the Battle High School in August 2013. As a part of this project the access from Route Z to Karen Lane should be flipped from Route Z to St. Charles Road. Karen Lane is currently gated on the St. Charles Road end. The gate was put into place to stop cut-through traffic from St. Charles Road to Route Z caused by the issues at the existing intersection. The improvements currently being designed by MoDOT will necessitate this gate to be moved to the Route Z end of Karen Lane thus providing access via St. Charles Road instead of directly onto Route Z. This is necessary due to the close proximity between the Karen Lane access to Route Z and the new roundabout.

Improvements from St. Charles Road to Mexico Gravel Road could be submitted to MoDOT's Cost Share/Economic Development program as the second phase of Route Z improvements.

St. Charles Road/Lake of the Woods Interchange

A future Route 740 is expected to utilize the I-70 interchange at Lake of the Woods Road/St. Charles Road. This will result in increased future traffic volumes at the interchange that are likely to exceed the interchange's capacity, thus spurring the need for improvements. Several "triggers" could cause the need to explore improvements to the interchange. When this occurs, a detailed interchange study will be required to select a preferred retrofit/reconstruction alternative. An Access Justification Report (AJR) and accompanying National Environmental Policy Act (NEPA) documentation will likely be required to obtain the Federal approvals to modify the interstate access for the improvements. Several retrofit/reconstruction options to improve the interchange should be considered as a part of this detailed study (considering items such as traffic volumes/patterns, bridge structure type/condition, and lane balance between Route 740 to the south and Clark Lane on the north). Very high level evaluations show that Double Cross-over Diamond (DCD) or Single Point Urban (SPUI) Interchanges could be viable conceptual alternatives at this location.

Traffic Operations

2014 and 2034 traffic operations were evaluated by conducting capacity analysis of the roadways and intersections in the study area. These analyses are based on many characteristics, including existing or forecasted traffic volumes, roadway and intersection geometry, and traffic control. Two different traffic evaluation packages (Synchro 7 and Sidra) were utilized in the analysis, capitalizing on the strengths of each software tool.

The Highway Capacity Manual (HCM) provides the basis for all methodologies used in this analysis. Synchro 7 is a software implementation of the HCM methodologies for traffic signals and stop controlled intersections. Synchro is recognized as the most widely-used tool in the traffic engineering field for analyzing and optimizing traffic flows at signalized intersections. Likewise Sidra implements these methodologies for roundabout analysis.

Several Measures of Effectiveness (MOE) were used in this evaluation including LOS, volume to capacity ratio (v/c), and vehicular delay. Operating conditions were graded in accordance with six levels of traffic service (Level A "Free Flow" to Level F "Fully Saturated") established by the HCM 2010. Levels of service (LOS) are measures of traffic operations which consider speed, delay, traffic interruptions, safety, driver comfort, and convenience. LOS C, which is normally used for design, represents a roadway with volumes ranging from 70% to 80% of its capacity. LOS D is generally considered acceptable for peak periods in urban and suburban areas.

For intersections, LOS is directly related to control delay. At signalized intersections, the LOS criteria differ from those at unsignalized intersections primarily because different transportation facilities create different driver expectations. The expectation is that a signalized intersection is designed to carry higher traffic volumes and, consequently, may experience greater delay than an unsignalized intersection. **Table 7** summarizes the LOS thresholds used in the analysis for intersections.

Table 7: Intersection Level of Service Thresholds

Level of Service (LOS)	Control Delay per Vehicle (seconds per vehicle)	
	Signalized Intersections	Unsignalized Intersections
A	≤ 10	≤ 10
B	$> 10 - 20$	$> 10 - 15$
C	$> 20 - 35$	$> 15 - 25$
D	$> 35 - 55$	$> 25 - 35$
E	$> 55 - 80$	$> 35 - 50$
F	> 80	> 50

In addition to LOS, v/c ratios provide an important measure of intersection operations. Intersection movements can operate an acceptable LOS (D or better) yet still have unacceptably high v/c ratios. In general, a v/c ratio of approximately 0.9 corresponds to occasional queuing and cycle failure, and a v/c ratio between 0.9 and 1.0 corresponds to frequent queuing and cycle

failure. A v/c ratio greater than 1.0 results in general failure of the movement. Therefore, v/c ratios were considered in addition to LOS and vehicular delay when evaluating an intersection's operations.

Year 2014 Build Traffic Conditions

The intersections within the study area were evaluated in order to quantify the anticipated traffic operations within the study area upon opening of Battle High School (traffic volumes as shown in **Exhibit 21**). **Table 8** summarizes the forecasted operations for the Year 2014 Build conditions. The reader is reminded that for efficiency's sake, the summary tables presented in this report provide level of service results by approach and for the intersection as a whole at signalized, roundabouts and all-way stop controlled intersections. At unsignalized intersections with side-street stop control, the level of service results are presented for the approach under stop control as well as for the critical left-turning movements/approach from the mainline. This table shows that with the committed improvements along Clark Lane and Route Z in place all study intersections are expected to operate at acceptable conditions. Committed improvements are described in detail in the "Committed Improvements" section and include:

- Improving Clark Lane from Ballenger Lane to west of St. Charles Road,
- Constructing a roundabout at St. Charles Road/ Clark Lane,
- Constructing a roundabout at St. Charles Road/Lake of the Woods Road,
- Reconstruction of the Route Z/I-70 overpass to three lanes,
- Adding three foot shoulders to Route Z between I-70 and St. Charles Road, and
- Constructing a roundabout at Route Z/St. Charles Road.

Year 2034 Traffic Conditions

The intersections within the study area were again evaluated in order to quantify the anticipated traffic operations within the study area for 2034 conditions (traffic volumes as shown in **Exhibit 22**). **Table 9** provides the results of this analysis.

This table shows that future capacity problems that are likely to be seen at the I-70/St. Charles Road/Lake of the Woods Road interchange as eastern Columbia continues to develop and when Route 740 eventually connects into this interchange. The analysis shows that Clark Lane between the St. Charles Road/Clark Lane roundabout and the St. Charles Road/Lake of the Woods Road roundabout will ultimately need to be widened to 4 lanes. Additionally, St. Charles Road between Clark Lane and the I-70 interchange will likely require widening to 6 lanes. A detailed interchange study should be completed to determine the ultimate configuration of the I-70/St. Charles Road/Lake of the Woods Road interchange. This study should include St Charles Road from I-70 Drive Southeast to the roundabout at Clark Lane and Clark Lane from the roundabout at St. Charles Road to Lake of the Woods Road.

Table 9 further shows that other study intersections will generally operate at acceptable conditions with the improvements recommended in this study.

Table 8: 2014 Forecasted Operating Conditions (Synchro/Sidra)

Synchro Intersection/Movement	School Arrival (7:15 – 8:15)			School Dismissal (2:45 – 3:45)		
	LOS	Delay	Max. V/C ICU	LOS	Delay	Max. V/C ICU
St. Charles Road at I-70 Drive Southeast (Side-Street Stop Control)						
Eastbound Left-Turn	C	18.8	0.15	C	23.3	0.41
Eastbound Right-Turn	A	8.5	0.17	A	8.7	0.09
Northbound Left-Turn	A	0.0	0.17	A	0.0	0.18
St. Charles Road at I-70 Eastbound Ramps (Traffic Signal)						
Eastbound Approach	C	20.3	0.45	B	18.9	0.71
Northbound Approach	B	12.0	0.33	B	15.7	0.32
Southbound Approach	A	3.0	0.25	A	6.4	0.36
Overall Intersection	B	10.2	0.61	B	14.1	0.58
St. Charles Road at I-70 Westbound Ramps (Traffic Signal)						
Westbound Approach	C	20.3	0.47	B	15.0	0.37
Northbound Approach	B	14.8	0.75	A	6.3	0.39
Southbound Approach	A	6.4	0.53	A	6.5	0.33
Overall Intersection	B	11.1	0.61	A	7.3	0.58
St. Charles Road at Clark Lane (Roundabout)						
Eastbound Approach	A	8.9	0.42	A	7.4	0.46
Westbound Approach	B	11.0	0.59	B	10.5	0.51
Northbound Approach	B	11.8	0.23	B	10.8	0.11
Southbound Approach	D	37.4	0.90	A	7.9	0.34
Overall Intersection	B	18.1	0.90	A	8.9	0.51
St. Charles Road at Lake of the Woods Road (Roundabout)						
Eastbound Approach	A	5.4	0.17	A	7.2	0.55
Westbound Approach	B	10.6	0.61	B	10.6	0.22
Southbound Approach	A	7.5	0.41	A	8.6	0.27
Overall Intersection	A	8.5	0.61	A	8.2	0.55
St. Charles Road at Battle Avenue (Traffic Signal)						
Eastbound Approach	A	9.6	0.72	A	7.3	0.20
Westbound Approach	B	14.2	0.29	B	11.7	0.39
Southbound Approach	B	15.2	0.06	A	5.3	0.47
Overall Intersection	B	10.6	42%	A	7.2	36%
St. Charles Road at Battle High School Drive (Side-Street Stop Control)						
Eastbound Approach	A	8.6	0.15	A	7.4	0.06
Westbound Approach	A	0.0	0.20	A	0.0	0.01
Southbound Approach	B	12.4	0.06	B	12.3	0.32

Table 8: 2014 Forecasted Operating Conditions (Synchro/Sidra) (Continued)

St. Charles Road at Route Z (Roundabout)						
Eastbound Approach	A	8.4	0.12	A	8.1	0.28
Northbound Approach	B	10.7	0.29	A	8.6	0.15
Southbound Approach	B	12.2	0.49	B	10.6	0.08
Overall Intersection	B	11.1	0.49	A	8.7	0.28
Route Z at I-70 Drive Southeast Road (Side-Street Stop Control)						
Eastbound Approach	B	14.6	0.11	B	13.6	0.12
Westbound Approach	B	11.5	0.06	B	11.7	0.05
Northbound Approach	A	0.4	0.01	A	0.3	0.01
Southbound Approach	A	0.2	0.00	A	0.7	0.02
Route Z at I-70 Eastbound Ramps (Side-Street Stop Control)						
Eastbound Approach	C	17.6	0.54	B	14.0	0.38
Southbound Approach	A	0.7	0.01	A	0.5	0.01
Route Z at I-70 Westbound Ramps (Side-Street Stop Control)						
Westbound Approach	C	17.7	0.22	C	15.3	0.16
Northbound Approach	A	3.0	0.10	A	3.5	0.09
Route Z at ABC Lane (Side-Street Stop Control)						
Eastbound Approach	B	12.1	0.05	B	10.7	0.05
Westbound Approach	C	24.8	0.37	B	12.7	0.11
Northbound Approach	A	2.3	0.07	A	0.3	0.00
Southbound Approach	A	0.4	0.01	A	0.9	0.02
Route Z at Mexico Gravel Road (Side-Street Stop Control)						
Eastbound Approach	B	10.8	0.19	A	9.8	0.06
Westbound Approach	B	14.8	0.03	B	13.5	0.01
Northbound Approach	A	3.7	0.04	A	4.4	0.09
Southbound Approach	A	0.0	0.00	A	0.0	0.00
Mexico Gravel Road at Lake of the Woods (Side-Street Stop Control)						
Westbound Approach	A	2.7	0.05	A	1.7	0.02
Northbound Approach	B	12.9	0.15	B	13.1	0.33

Table 9: 2034 Forecasted Operating Conditions (Synchro/Sidra)

Synchro Intersection/Movement	Morning Peak Hour			Afternoon Peak Hour		
	LOS	Delay	Max. V/C ICU	LOS	Delay	Max. V/C ICU
St. Charles Road at I-70 Drive Southeast (Traffic Signal)						
Eastbound Approach	B	19.8	0.45	C	21.7	0.42
Northbound Approach	A	3.2	0.49	A	2.7	0.32
Southbound Approach	A	5.8	0.45	A	6.1	0.36
Overall Intersection	A	5.2	50%	A	5.8	40%
St. Charles Road at I-70 Eastbound Ramps (Traffic Signal) – NO IMPROVEMENTS AT THE EXISTING INTERCHANGE						
Eastbound Approach	D	38.1	0.85	F	492.5	1.80
Northbound Approach	C	33.4	0.75	C	26.8	0.67
Southbound Approach	D	46.3	0.64	B	17.6	0.63
Overall Intersection	D	38.7	115%	F	225.7	115%
St. Charles Road at I-70 Westbound Ramps (Traffic Signal) – NO IMPROVEMENTS AT THE EXISTING INTERCHANGE						
Westbound Approach	F	110.5	1.08	E	55.7	0.83
Northbound Approach	D	46.4	1.07	F	96.5	0.99
Southbound Approach	F	80.4	1.10	B	10.5	0.53
Overall Intersection	E	71.3	115%	E	62.3	115%
St. Charles Road at Battle Avenue (Traffic Signal)						
Eastbound Approach	C	31.8	0.87	C	34.8	0.88
Westbound Approach	D	43.6	0.89	D	40.2	0.88
Northbound Approach	D	47.9	0.86	C	27.0	0.53
Southbound Approach	B	15.8	0.57	C	30.0	0.85
Overall Intersection	D	33.3	0.69	C	33.5	0.71
Route Z at I-70 Drive Southeast (Traffic Signal)						
Eastbound Approach	B	15.0	0.54	B	14.6	0.53
Westbound Approach	A	7.4	0.24	A	6.9	0.26
Northbound Approach	B	13.2	0.59	B	10.4	0.48
Southbound Approach	B	13.7	0.67	A	9.0	0.55
Overall Intersection	B	13.3	64%	B	10.2	64%
Route Z at I-70 Eastbound Ramps (Traffic Signal)						
Eastbound Approach	C	29.2	0.90	C	24.3	0.84
Northbound Approach	C	23.4	0.73	C	28.5	0.78
Southbound Approach	B	15.7	0.52	B	17.6	0.54
Overall Intersection	C	23.8	92%	C	23.9	79%

Table 9: 2034 Forecasted Operating Conditions (Synchro/Sidra) (Continued)

Route Z at I-70 Westbound Ramps (Traffic Signal)						
Westbound Approach	B	32.5	0.74	C	26.7	0.66
Northbound Approach	C	10.5	0.57	A	8.5	0.55
Southbound Approach	A	9.8	0.44	A	6.7	0.35
Overall Intersection	B	13.0	92%	A	9.8	79%
Route Z at Clark Lane Extension (Traffic Signal)						
Eastbound Approach	C	30.6	0.80	B	15.4	0.61
Westbound Approach	C	26.3	0.53	C	26.2	0.52
Northbound Approach	C	25.3	0.77	B	18.7	0.64
Southbound Approach	D	37.4	0.88	C	21.9	0.57
Overall Intersection	C	30.0	83%	B	19.6	73%
Segment F at Battle Avenue (Traffic Signal)						
Eastbound Approach	A	5.2	0.26	A	7.8	0.10
Westbound Approach	A	6.1	0.13	A	6.6	0.10
Northbound Approach	A	5.4	0.14	A	3.4	0.18
Southbound Approach	A	6.1	0.25	A	3.2	0.09
Overall Intersection	A	5.7	39%	A	4.0	34%
Clark Avenue Extension at Battle Avenue (Traffic Signal)						
Eastbound Approach	B	18.7	0.46	C	22.4	0.69
Westbound Approach	C	24.9	0.61	C	20.8	0.55
Northbound Approach	B	20.0	0.66	B	16.1	0.47
Southbound Approach	B	12.6	0.34	C	20.7	0.66
Overall Intersection	B	19.5	59%	C	20.2	66%
Clark Avenue Extension at Segment I (Traffic Signal)						
Eastbound Approach	B	13.7	0.37	B	14.0	0.42
Westbound Approach	B	13.8	0.50	B	11.9	0.39
Northbound Approach	B	14.6	0.17	B	12.1	0.23
Southbound Approach	B	11.4	0.31	B	12.9	0.41
Overall Intersection	B	13.3	49%	B	12.8	52%
St. Charles Road at Clark Lane (Roundabout)						
Eastbound Approach	B	19.6	0.92	B	6.7	0.58
Westbound Approach	C	28.8	0.92	B	12.7	0.53
Northbound Approach	B	9.3	0.55	D	44.8	1.01
Southbound Approach	D	48.5	0.78	B	13.2	0.20
Overall Intersection	B	1936	0.92	C	25.8	1.01
St. Charles Road at Lake of the Woods Road (Roundabout)						
Eastbound Approach	A	6.9	0.66	B	11.8	0.71
Westbound Approach	D	35.4	0.95	B	12.7	0.25
Southbound Approach	C	27.9	0.99	B	8.6	0.69
Overall Intersection	C	23.9	0.99	B	10.3	0.71

Table 9: 2034 Forecasted Operating Conditions (Synchro/Sidra) (Continued)

St. Charles Road at Clark Avenue Extension (Roundabout)						
Eastbound Approach	B	11.6	0.58	B	12.1	0.64
Westbound Approach	B	12.7	0.61	C	15.1	0.68
Southbound Approach	B	9.4	0.55	B	8.5	0.65
Overall Intersection	B	10.8	0.61	B	11.0	0.68
St. Charles Road at Segment G (Roundabout)						
Eastbound Approach	A	6.6	0.29	A	7.5	0.30
Westbound Approach	B	11.8	0.36	B	12.6	0.38
Northbound Approach	B	10.3	0.16	B	10.4	0.14
Southbound Approach	B	11.4	0.11	B	11.5	0.12
Overall Intersection	A	9.8	0.36	B	10.5	0.38
St. Charles Road at Route Z (Roundabout)						
Eastbound Approach	B	12.1	0.60	B	9.2	0.27
Northbound Approach	B	9.7	0.66	B	9.5	0.66
Southbound Approach	C	20.0	0.70	B	14.0	0.38
Overall Intersection	B	13.2	0.70	B	10.4	0.66
Route Z at Segment H (Roundabout)						
Westbound Approach	C	24.6	0.11	D	28.2	0.43
Northbound Approach	A	0.0	0.28	A	0.0	0.36
Southbound Approach	A	8.7	0.37	A	9.0	0.20
Route Z at Segment F (Side-Street Stop Control)						
Eastbound Approach	B	14.6	0.10	C	16.0	0.09
Northbound Approach	A	8.2	0.15	A	8.0	0.19
Route Z at Mexico Gravel Road (Side-Street Stop Control)						
Eastbound Approach	C	24.8	0.35	D	27.5	0.31
Westbound Approach	D	27.8	0.32	D	28.0	0.32
Northbound Approach	A	2.4	0.08	A	2.6	0.10
Southbound Approach	A	0.7	0.02	A	0.9	0.02
Mexico Gravel Road at Lake of the Woods (Side-Street Stop Control)						
Eastbound Approach	A	0.0	0.23	A	0.0	0.26
Westbound Approach	A	3.3	0.12	A	3.6	0.09
Northbound Approach	D	26.7	0.51	D	30.8	0.71
Mexico Gravel Road at Battle Avenue (Side-Street Stop Control)						
Eastbound Approach	A	0.0	0.10	A	0.0	0.13
Westbound Approach	A	8.0	0.13	A	8.1	0.10
Northbound Approach	C	15.9	0.28	B	13.8	0.18
Segment F at Lake of the Woods (Side-Street Stop Control)						
Westbound Approach	B	13.2	0.20	B	14.1	0.05
Northbound Approach	A	0.0	0.06	A	0.0	0.19
Southbound Approach	A	7.5	0.19	A	8.3	0.12

Driveway Access Management

Good access management enhances the safety and efficiency of roadways by properly spacing interchanges, public road intersections, traffic signals, and driveways. The Federal Highway Administration (FHWA) and Missouri Department of Transportation (MoDOT) have published a wealth of information for state and local governments to use to control access to highways, major arterials, and other roadways. MoDOT's Access Management Guidelines are provided in the Appendix. Some basic tenants of good access management are listed below:

- **Access Spacing:** increasing the distance between traffic signals improves the flow of traffic on major arterials, reduces congestion, and improves air quality for heavily traveled corridors
- **Driveway Spacing:** fewer driveways spaced further apart allow for more orderly merging of traffic and presents fewer challenges to drivers.
- **Safe Turning Lanes:** dedicated left- and right-turn, indirect left-turns and U-turns, and roundabouts keep through-traffic flowing. Roundabouts represent an opportunity to reduce an intersection with many conflict points or a severe crash history (T-bone crashes) to one that operates with fewer conflict points and less severe crashes (sideswipes) if they occur.
- **Median Treatments:** two-way left-turn (TWLTL) and non-traversable, raised medians are examples of some of the most effective means to regulate access and reduce crashes.
- **Right-of-Way Management:** as it pertains to R/W reservation for future widening, good sight distance, access location, and other access-related issues.

The best way to maximize the traffic capacity and safety of a road system, particularly arterials, is to carefully manage and minimize conflicting traffic movements. These conflicting movements are most likely to occur at points of vehicular access which generate cross traffic and turning movements both onto and off of the roadway. This applies not only to intersecting streets, but also to driveways leading to individual parcels of land.

A well-planned access management program results in benefits to roadway capacity, congestion, and safety. In addition to the efficiency and safety of the roadway, its aesthetics can also be improved. Access management involves the thoughtful planning and design of points of access to the public roadway system. Failure to properly manage access can result in safety concerns and diminish the public's investment in the roadway system.

The implementation of access management requires a common set of standards for the development community to follow, and also a mechanism to implement these standards. A suggested set of access management standards is provided below. Uniform standards are intended to improve the safety, effectiveness, and efficiency of the road system. However, engineering judgment should be used in the application of the recommended dimensions, if warranted by specific traffic conditions.

Driveways Location/Design Standards

A driveway should have adequate throat length to accommodate on-site storage of queued vehicles without interfering with street traffic. Adequate sight distance should be provided for a passenger vehicle entering or exiting from a driveway. In addition, a number of factors should be considered in determining the appropriate location of driveway access:

- Characteristics of the proposed land use;
- Existing traffic flow conditions and the future traffic demand anticipated on the development and the adjacent street system;
- Location of the property;
- Size of the property;
- Orientation of structures on the site;
- Number of driveways needed to accommodate anticipated traffic;
- Number and location of driveways on existing adjacent and opposite properties;
- Location and carrying capacity of intersections;
- Proper geometric design of driveways;
- Spacing between opposite and adjacent driveways;
- Internal circulation between driveways;
- Speed of traffic on the adjacent roadway; and
- Pedestrians, cyclists, and other modes of transportation.

After determining the appropriate location of a driveway, the following criteria should be applied to the design and configuration of the access:

- Driveway access for commercial or multi-family developments should not be permitted for parking or loading areas that require backing maneuvers in a public street right-of-way.
- One curb cut should be allowed for access to single family and duplex residential tracts.
- For corner tracts, access to residential tracts should be provided from the lesser (lowest classification) street. The determination as to the lesser (or greater) street should be based on the functional street classification and traffic.
- Driveways should not be permitted adjacent to mainline turn-lanes.
- When a commercial or multi-family development abuts more than one public street, access to each abutting street may be allowed only if the following criteria are met:
 - It is demonstrated that additional access is required to adequately serve driveway volumes and would not be detrimental or unsafe to traffic operations on public streets;
 - The minimum requirements for corner clearance for commercial or multi-family driveways are met; and/or
 - The proposed access does not promote cut-through traffic.

Access control is based upon the type of driveway and functional classification of the roadway on which access is requested. Full access driveway spacing should be measured from the centerline of the proposed driveway pavement to the centerline of the nearest driveway (either

the same side or opposite side of the street). Right-in right-out access driveway spacing should be measured from the centerline of the proposed driveway pavement to the centerline of the nearest driveway on the same side of the street.

- Full access driveways on arterial roadways should be spaced at least 330 feet apart
- Right-in right-out driveways on arterial roadways should be spaced at least 165 feet apart
- Full access driveways on collector roadways should be spaced at least 220 feet apart
- Right-in right-out driveways on collector roadways should be spaced at least 110 feet apart

Corner Clearance

Corner clearance for driveway access should meet or exceed the minimum driveway spacing requirements for that roadway (see section above). When minimum spacing requirements cannot be met due to lack of frontage, all means should be undertaken to provide shared access drives or cross access easements

Shared or Cross Access

A joint private access easement should be considered between adjacent lots fronting on arterial and collector streets in order to minimize the total number of access points along those streets and to facilitate traffic flow between lots. Private cross-access easements should be considered across any lot fronting on an arterial or collector street in order to minimize the number of access points and facilitate access between and across individual lots.

Cost Estimate Methodology

The methodology used to develop the cost estimates of the planned roadway segment improvements includes the cost of right-of-way, acquisition, easements, construction, engineering, inspection and administration, and contingency. Cost estimates were not based on actual project design quantities because there are no detailed construction plans, geotechnical studies, or surveys available for these roadways. Rather, a standard cost per linear foot was used to estimate the total construction cost.

The proposed roadway network was grouped into functional classification based on connectivity and forecasted ADT, and using the Boone County and City of Columbia roadway standards. The following three functional classifications make up the future roadways and changes in the study area.

- Minor Arterial
- Commercial/Major Collector
- Neighborhood/Minor Collector

The functional classifications were compared to the pavement widths from Boone County and typical sections from the City of Columbia, shown in **Appendices A and B**. Based on the pavement widths and typical sections, per lineal foot prices were developed for each. The per lineal foot price for each functional classification includes all elements of the typical section, including:

- Grading,
- Aggregate base,
- Pavement,
- Shoulders,
- Curb and gutter,
- Drainage,
- Signing, and
- Striping.

The lineal foot price was applied to each of the segment lengths to develop the base cost of the roadway segments.

Right-of-way acreage was calculated based on the typical sections for the functional classification and \$7,500 per acre, which is a rough standard used. Easement acreage was also calculated based on the typical sections of the functional classification and estimated at \$5,000 per acre and 20 foot easement width along the corridor. Additional line item costs were added to the total project cost for major drainage culverts and bridges and overpasses. These additional costs were based on field observations and aerial photography, no survey was done as a part of this planning level cost estimate.

Additionally, a 15% general contingency was added to the total of the roadway segments; 15% was added for Engineering, Surveying, and Permitting; and 9% was added Construction

Inspection and Administration - all of which are consistent with mid-Missouri estimates. These percentages allowed for conceptual estimates but should be detailed at the time the project is programmed.

Several of the study intersections will most likely require traffic signal control to offer sufficient capacity and acceptable traffic operations. These signals, listed below, were not included in the segment cost estimates because it was more efficient to summarize them together and put as a per unit cost for the signals. Only the signals specifically listed below were included in the total project cost. The rough unit cost of \$200,000 to \$275,000 per signal was used to offer a conservative estimate for construction. An additional ten percent was added for design fees.

- Clark Lane/Battle Avenue
- Clark Lane and Segment I/G
- Clark Lane and Route Z
- Battle Avenue and Spartan Drive
- Battle Avenue and Segment F

An estimate of probable cost for all of the improvements shown in this plan (including engineering fees and administration costs) is on the order of \$35,400,000 to \$39,200,000 in 2014 dollars (\$63,800,000 to \$70,600,000 in 2034 dollars). **Table 10** provides a breakdown for these costs.

Table 10: Total Cost Estimates

	2014	2034
Segment A Cost Range	\$2.5 - \$2.7 million	\$4.5 - \$4.9 million
Segment B Cost Range	\$2.0 - \$2.2 million	\$3.6 - \$3.9 million
Segment C Cost Range	\$2.8 - \$3.1 million	\$5.1 - \$5.7 million
Segment D Cost Range	\$9.2 - \$10.1 million	\$16.5 - \$18.2 million
Segment E Cost Range	\$4.7 - \$5.2 million	\$8.5 - \$9.3 million
Segment F Cost Range	\$4.1 - \$4.5 million	\$7.3 - \$8.0 million
Segment F' Cost Range	\$4.0 - \$4.4 million	\$7.3 - \$8.0 million
Segment G Cost Range	\$1.8 - \$2.0 million	\$3.3 - \$3.6 million
Segment H Cost Range	\$1.1 - \$1.2 million	\$1.9 - \$2.1 million
Segment I Cost Range	\$0.7 - \$0.8 million	\$1.3 - \$1.4 million
Segment I' Cost Range	\$1.4 - \$1.5 million	\$2.5 - \$2.8 million
Signals	\$1.1 - \$1.5 million	\$2.0 - \$2.7 million
Total	\$35.4 - \$39.2 million	\$63.8 - \$70.6 million

Trip Generation Fees

Boone County does not currently have a revenue stream to make the necessary transportation improvements needed to support the potential development in this subarea of the county. As such, Boone County is seeking to adopt a methodology to assess trip generation fees in order to generate a revenue stream that would be used to provide appropriate transportation facilities needed to accommodate future growth. This will help to ensure that the County's roadway system is constructed to a standard that can provide safe and efficient service to residents, visitors, and businesses in this part of Boone County as its character evolves from a rural to suburban character.

The trip generation fee framework described in this section is intended to ensure that new development's share of the cost of capacity per unit of development and the associated road improvements necessitated by such development are attributed to the development. Such costs shall be determined and assigned in a manner that:

- Is reasonably related to impacts caused by the development,
- Is roughly proportional to the impacts caused by the development, and
- Is applicable regardless of the jurisdiction in which the development occurs.

Collection of these fees does not preclude Boone County or the City of Columbia from applying for federal or state grants for transportation improvements in the future.

This report has discussed the amount of growth associated with the study area and the anticipated roadway improvements needed to accommodate the forecasted traffic associated with this growth. This section describes a methodology to apply a trip generation fee for the planned development in the study area. These fees are broken into three categories: residential (costs based per dwelling unit), educational (cost based per student), and commercial land uses (costs based on square footage of development).

Examples of Trip Generation Fees

Camden County

Trip impact fees are not uncommon in Missouri. As one example, Camden County charges Road Development Fees in the areas near the Lake of the Ozarks in order to distribute the cost of road maintenance among developers. Camden County developed their fee structure based on anticipated maintenance requirements to their roadways as a direct result of ongoing development in the lake area. The road development charges are not intended to replace the need for developers to construct the off-site improvements needed for the safe and efficient traffic flow to their development. Rather, the purpose of these charges is to off-set the cost of additional roadway maintenance due to wear and tear on the County's roadways as a direct result of construction activities. Prior to implementation of Road Development Fees, Camden County had implemented a road bonding procedure. This meant that the developer would put up a bond to cover any damage to the roadway caused by construction activities. However, many disagreements occurred between the developers and the County as to what damage actually

occurred and who was responsible. Problems with the road bonding program was the impetus for Camden County's Road Development Fees.

In order to implement the road development charges, Camden County created sub-district service areas based on geography and existing road structure to allow a fair allocation of the funds. Camden County developed their fee schedule by estimating that roughly 10 percent of the County's 225 miles of asphalt road would need repair each year at an estimated cost of \$1,125,000. The County further estimated that 800 new units would be constructed in Camden County each year, resulting in an average recovery cost per unit at \$1,406.25. The County further considered the fact that smaller units would require less construction traffic and lighter loads. Thus, the County's fees range between \$700 for smaller units to \$2,500 for larger units.

St. Louis County

As another example, St. Louis County imposes traffic generation assessments on new developments to finance the costs of roadway improvements that are necessary to relieve the impact of new development traffic. Traffic generation assessments are used for infrastructure road improvements and may include lane widening, geometric improvements, traffic signal facilities, bridges, overlays, purchase of off-site right-of-way, on County and State roads. Within a road trust fund area, the traffic generation assessment is computed for a development as part of the road improvement requirements established by a site specific zoning ordinance approved by the St. Louis County Council. The ordinance for the development may or may not describe in detail what roadway improvements are to be accomplished with the traffic generation assessment. The traffic generation assessment is calculated by a dollar amount per measurable unit, typically per parking/loading space. The number of parking/loading spaces is determined from the St. Louis County zoning ordinance. Credit is given for road improvements to County and State roads. Right-of-way dedication requirements along State and County roads are not credited towards the developer's traffic generation assessment except where right-of-way widening requirements of an existing public roadway exceed a width of twenty feet. In cases where excessive right-of-way widening is required, the developer is given credit commensurate with the market value of the property prior to development. In addition, credit is given for interior road improvements which exceed collector road requirements of a sixty foot right-of-way and thirty-nine foot pavement. The cost of allowable portions of the improvements is credited towards the developer's traffic generation assessment. Current rates are available on the St. Louis County website³

Methodology

The CATSO model forecasts land use changes from the existing year to 2030. Anticipated residential development includes the addition of approximately 2,800 new residential dwelling units (2,000 single family units and 800 multi-family units) with about 21,150 associated new daily trips (17,000 trips attributed to single family units and 4,150 trips associated with multi-family units). In addition, new retail, non-retail, office, industrial and manufacturing, warehouse/storage and institutional/educational uses are anticipated, resulting in an estimated 1,900 new jobs and 600 students. These non-residential uses would generate on the order of

³ [http://www.stlouisco.com/Portals/8/docs/Document Library/highways/Design_Criteria/sec75_10.pdf](http://www.stlouisco.com/Portals/8/docs/Document%20Library/highways/Design_Criteria/sec75_10.pdf)

8,925 new trips. Because Battle High School has already been approved and is currently under construction it would not be appropriate to include these trips in calculating future trip impacts. Therefore, these calculations have removed the trips specific to Battle High School. As previously stated, Battle High School is anticipated to have 1,600 students and 175 faculty/staff when it is open to all grades in 2014 and 1,850 students and 200 staff/faculty by 2034. After deducting the Battle High School trips, the residential trips are associated with 70.3% of the total forecasted trips and the non-residential with 29.7%.

The total 2014 transportation costs from **Table 10** were used to calculate the cost per unit. Three segments were removed from this cost calculation:

- \$9.6 million dollars was removed for the cost of Segment D (the proposed Extension of Battle Avenue south of Clark including the Olivet/Battle Avenue Overpass) since Boone County or the City of Columbia would likely look for other sources to fund this improvement.
- \$1.9 million dollars was removed for the cost of Segment G. This will be a privately funded road built as a condition of the development of the land adjacent to the roadway.
- \$1.1 million dollars was removed for the cost of Segment H. This will be a privately funded road built as a condition of the development of the land adjacent to the roadway

The total 2012 roadway improvement costs ranges were averaged to \$24.7 million for this study area. **Table 11** shows the estimated transportation improvements associated for the different land uses based on the percentage of total trips from the CATSO model.

Table 11: Estimated Cost of New Roadways per Land Use (2014 Dollars)

	Total Cost per Land Use
Residential (Single Family Unit)	\$13,950,000
Residential (Multi-Family Unit)	\$3,400,000
Retail	\$2,050,000
Non-Retail	\$2,875,000
Office	\$1,150,000
Industrial-Manufacturing	\$325,000
Warehouse-Storage	\$205,000
Institutional-Elementary School	\$715,000
Total Cost	\$24,670,000

Residential Land Uses

The residential units consisted of 70.3% of the total trips in the CATSO model (56.5% from the single family units and 13.8% from the multi-family units). Assuming that the residential units should help pay for 70.3% of the total roadway improvements, the cost for all the residential land uses is \$17,350,000 as shown in **Table 11**. There are anticipated to be 2,800 new residential dwelling units in the study area (2,000 single family units and 800 multi-family units). Dividing the total roadway cost for the residential land uses by the total forecasted dwelling units, the cost per single family dwelling unit is \$6,975 and the cost per multi-family dwelling unit is \$4,250.

Non-Residential Land Uses

The non-residential land uses forecasted for future development in this area include:

- Retail
- Non-Retail
- Office
- Industrial/Manufacturing
- Warehousing/Storage
- Institutional-Elementary School

As shown in **Table 12**, the total non-residential trips were broken down as a percentage of the total trips.

Table 12: Non-Residential Trips

	Future New Trips	Percent of New Non-Residential Trips
Retail	2,500	28.0%
Non-Retail	3,500	39.2%
Office	1,400	15.7%
Industrial-Manufacturing	400	4.5%
Warehouse-Storage	250	2.8%
Institutional-Elementary School	875	9.8%

The total number of employees per non-residential land use was also taken from the CATSO model. Using the total employees per land-use, the traffic was forecasted based upon information provided in the “Trip Generation Manual”, Eighth Edition, published by the Institute of Transportation Engineers (ITE). This manual, which is a standard resource for transportation engineers, is based on a compilation of nationwide studies documenting the characteristics of various land uses. The number of total employees was used to estimate the total trips and then checked using the square footage rates to estimate the total square feet per land use in the study area, as shown in **Table 13**.

Table 13: Trip Generation per ITE Trip Generation Manual

Land Use	CATSO Forecasted Employees /Students	ITE Code	Estimated Square Footage	ITE Trip Rate (Trips per 1000 square feet)	Anticipated Daily Trips
Retail	100	820	58,000	42.94	2,500
Non Retail - Gen Office	1000	710	316,500	11.01	3,500
Office	450	710	126,600	11.01	1,400
Industrial/Manufacturing	150	140	105,000	3.82	400
Warehousing	60	150	70,000	3.56	250
Elementary School	600				875

Total Cost per Unit

The cost per square feet was calculated by dividing the total cost per land use, shown in **Table 11**, by the estimated square footage per land use shown in **Table 13**. **Table 14** shows the square footage cost for the non-residential land uses and the cost per residential dwelling unit.

Table 14: Total Cost per Unit for the Land Uses in the Study Area

Land Use	ITE Code	Cost Per Unit
Residential (Single Family)		\$6,975.00 (per dwelling unit)
Residential (Multi-Family)		\$4,250.00 (per dwelling unit)
Retail	820	\$35.34 / sq ft
Non Retail - Gen Office	710	\$9.08 / sq ft
Office	710	\$9.08 / sq ft
Industrial/Manufacturing	140	\$3.10 / sq ft
Warehousing	150	\$2.93 / sq ft
Elementary School		\$1,191.67 /student

The cost schedule shown in **Table 14** assumes 2014 estimated construction costs. It is recommended that the fees be indexed to the cost of living to account for inflation. For any land-uses proposed that do not fall into one of the listed land uses in **Table 14**, a traffic study showing the number of trips associated with the development, roadway improvements needed to accommodate the development, and traffic impacts should be completed to estimate the cost per square foot.

Subdivision Studies

Two specific recently proposed developments, the Somerset Village and North Battleground subdivisions, were evaluated to determine if the proposed site plans provide an appropriate internal roadway network considering future developments. This assessment reviewed the anticipated ADT volumes within the developments and compared these volumes against the County's functional classification thresholds. Additionally, an evaluation of the impact of the stub roads that would connect to adjoining properties was considered. Special attention was given to determine which roads will become collector roadways by volume and function and where classification changes should occur.

According to the County's Roadway Classification Standards, shown in **Table 2**, a Local Road can accommodate up to 750 vpd and a Collector Road can accommodate between 750 and 2,500 vpd. Roadways with an estimated ADT over 2,500 vpd are classified as Arterial Roads.

Somerset Village

Somerset Village Only

The proposed Somerset Village development is located primarily north and west of the St. Charles Road and Battle Avenue intersection. **Exhibit 23** identifies the general location of the proposed development site relative to the surrounding area and proposed site plan. Based on the current site plan, access to the site is proposed via four new streets on Battle Avenue. Several driveways off Battle Avenue are also depicted on the site plan to provide access to the proposed commercial uses on Battle Avenue north of St. Charles Road, in addition to proposed driveways on St. Charles Road both east and west of Battle Avenue. Four stub streets are also depicted on the site plan to provide access to the vacant parcels north and west of the site.

Based on the current site plan at the time of this study, the Somerset Village development would consist of approximately 230 single-family homes, 36 condos, 135 apartments, and a mix of retail uses. Based on data provided in the *ITE Trip Generation Manual*, the average daily traffic generated by the proposed Somerset Village development would be approximately 9,145 trips per day. Although it is acknowledged that some of this traffic would be pass-by in nature and would not add additional traffic to the adjacent roadways, it would create additional turning movements at the access drives and streets. As depicted in **Table 15**, the proposed Somerset Village development would be expected to generate approximately 510 trips during the morning peak hour and 905 trips during the evening peak hour.

Table 15: Somerset Village Development Site Generated Traffic

Land Use	Size/ Qty	ADT	Weekday AM Peak Hour			Weekday PM Peak Hour		
			In	Out	Total	In	Out	Total
Somerset Village								
Single-Family	230 Homes	2,235	45	130	175	140	80	220
Townhome/Condo	36 Units	265	5	20	25	15	10	25
Apartments (3 outlots)	135 Units	940	15	55	70	60	30	90
General Retail	45,000 ft²	1,930	25	20	45	80	90	170
Sit-Down Restaurants (2)	7,500 ft²	955	15	15	30	50	30	80
Drive-In Bank	3,500 ft²	865	25	20	45	80	80	160
Gas Station	2,400 ft²	1,955	60	60	120	80	80	160
Total Trips		9,145	190	320	510	505	400	905

Exhibit 23 depicts the ADT estimates on the subdivision streets for the residential component only of the Somerset Village development, since the retail uses are currently depicted with direct access onto Battle Avenue and St. Charles Road via separate driveways. The segments of roadway that exceed the 750 vpd are highlighted in green in the exhibit and would meet the County's Collector Roadway classification.

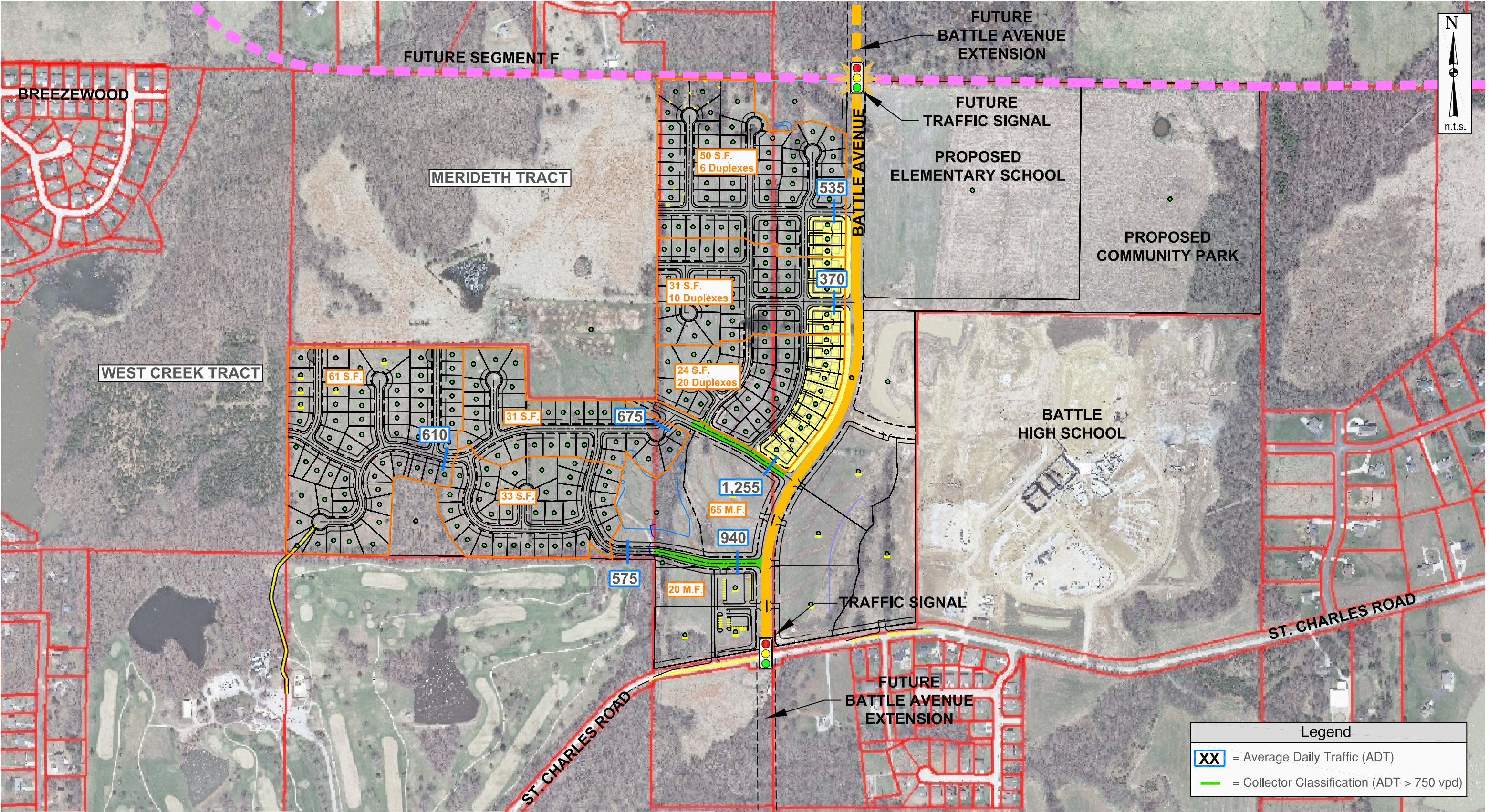


Exhibit 23: Anticipated Traffic Volumes Assuming Somerset Village Only

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Somerset Village and West Creek Tract

A review of the future stub street to the West Creek Tract was also considered to evaluate the impact this connection would have on the estimated ADT's within the Somerset Village development.

Based on discussions with County staff, it is estimated that a subdivision with approximately 100 homes could be developed on the West Creek Tract. The two points of access to the West Creek Tract were assumed to be via the Somerset Village stub street and the existing stub street to Breezewood. As such, it is estimated that approximately 67% of the West Creek Tract trips (670 ADT) would utilize the Somerset Village connection with the remaining 33% of the West Creek Tract trips (330 ADT) utilizing the Breezewood connection. **Exhibit 24** depicts the ADT estimates on the streets within Somerset Village assuming the development of the West Creek Tract. Again, the segments of roadway within Somerset Village that exceed the 750 vpd are highlighted in green in the exhibit and would meet the County's Collector Roadway classification. With both Somerset Village and the West Creek Tract, a Collector Road would be required all the way through the Somerset Village development.

Somerset Village, West Creek Tract and Merideth Tract

A review of the future stub street to the Merideth Tract in addition to the West Creek Tract was also considered to evaluate the impact that both of these connections would have on the estimated ADT's within the Somerset Village development.

Based on discussions with County staff, it is estimated that a subdivision with approximately 180 homes could be developed on the Merideth Tract. The three points of access to the West Creek Tract were assumed to be via the Somerset Village stub streets. As such, it is estimated that approximately 80% of the Merideth Tract trips (1,440 ADT) would utilize the main southern connection with the remaining 20% split (360 ADT) split between the two northern stub streets. Additionally, with the extension of a main roadway through the Merideth Tract to the West Creek Tract, it is estimated that approximately 70% of the West Creek Tract trips (700 ADT) would utilize this new roadway with the remaining 30% (300 ADT) utilizing the southern Somerset Village connection. **Exhibit 25** depicts the ADT estimates on the streets within Somerset Village assuming the development of the West Creek and Merideth Tracts. Again, the segments of roadway within Somerset Village that exceed the 750 vpd are highlighted in green in the exhibit and would meet the County's Collector Roadway classification. The initial entry off Battle Avenue would exceed the 2,500 vpd (highlighted in yellow) and would meet the County's Arterial Roadway classification.

With the development of the West Creek and Merideth Tracts, a collector road would be required all the way through the Somerset Village/Merideth Tract development. The alignment of this collector road is of great importance to the overall transportation plan. As discussed in the Battle Avenue Extension section, it would be desirable to realign this collector road such that it ties into Battle Avenue opposite of Spartan Drive to allow for the future signalization of this intersection. In response to this suggestion, the Somerset Village developers have submitted a revised site plan showing the connection of the proposed collector road to Battle Avenue opposite of Spartan

Drive (**Exhibit 26**). To the west, this collector road should be aligned such that it would connect to a future Segment F running along the north property line of the Merideth Tract between Lake of the Woods Road and Battle Avenue. In the event that a through connection of Segment F is not able to be created along the north property line of the Merideth Tract, this collector roadway could become the future Segment F.

As discussed in the “Segment F” section, the proposed alignment of Segment F, west of Battle Avenue, is located along the north Somerset Village and Merideth Tract property lines. As such, the Somerset Village Subdivision should dedicate one-half of the right-of-way to create a corridor for the future construction of Segment F. Existing county ordinances require that a developer construct a roadway if they are required to dedicate right-of-way for that roadway. Since the developers of Somerset Village would not be able to construct the road as required by county ordinance (because only one-half of the right-of-way would be dedicated) we recommend that an exception should be given to Somerset Subdivision developers such that they would be able to dedicate one-half of the right-of-way for Segment F but would not be required to construct the road. Funds from the proposed trip generation fees could be used to construct Segment F once the full width of right-of-way has been dedicated.

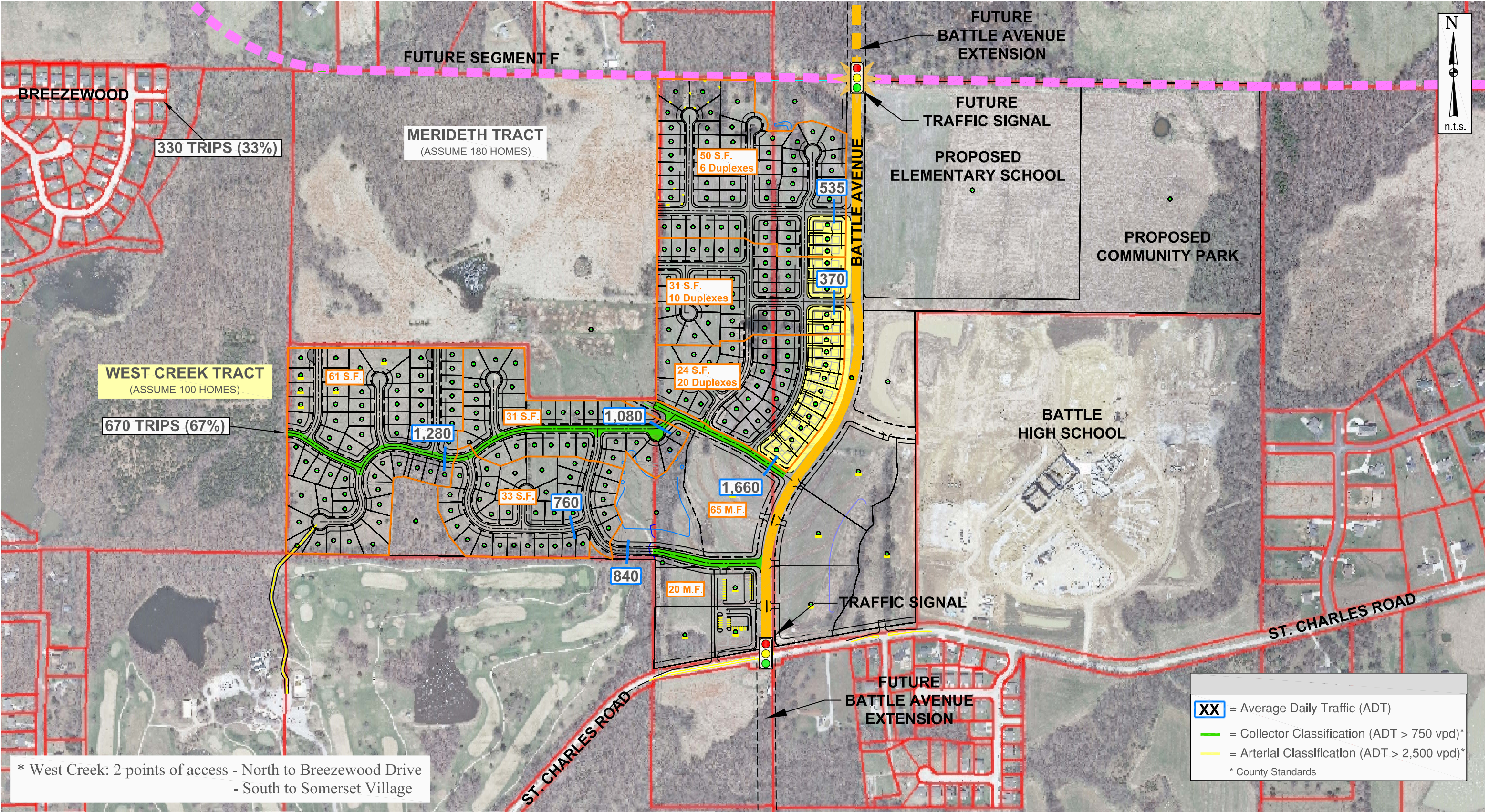


Exhibit 24: Anticipated Traffic Volumes Assuming Somerset Village & West Creek Tract

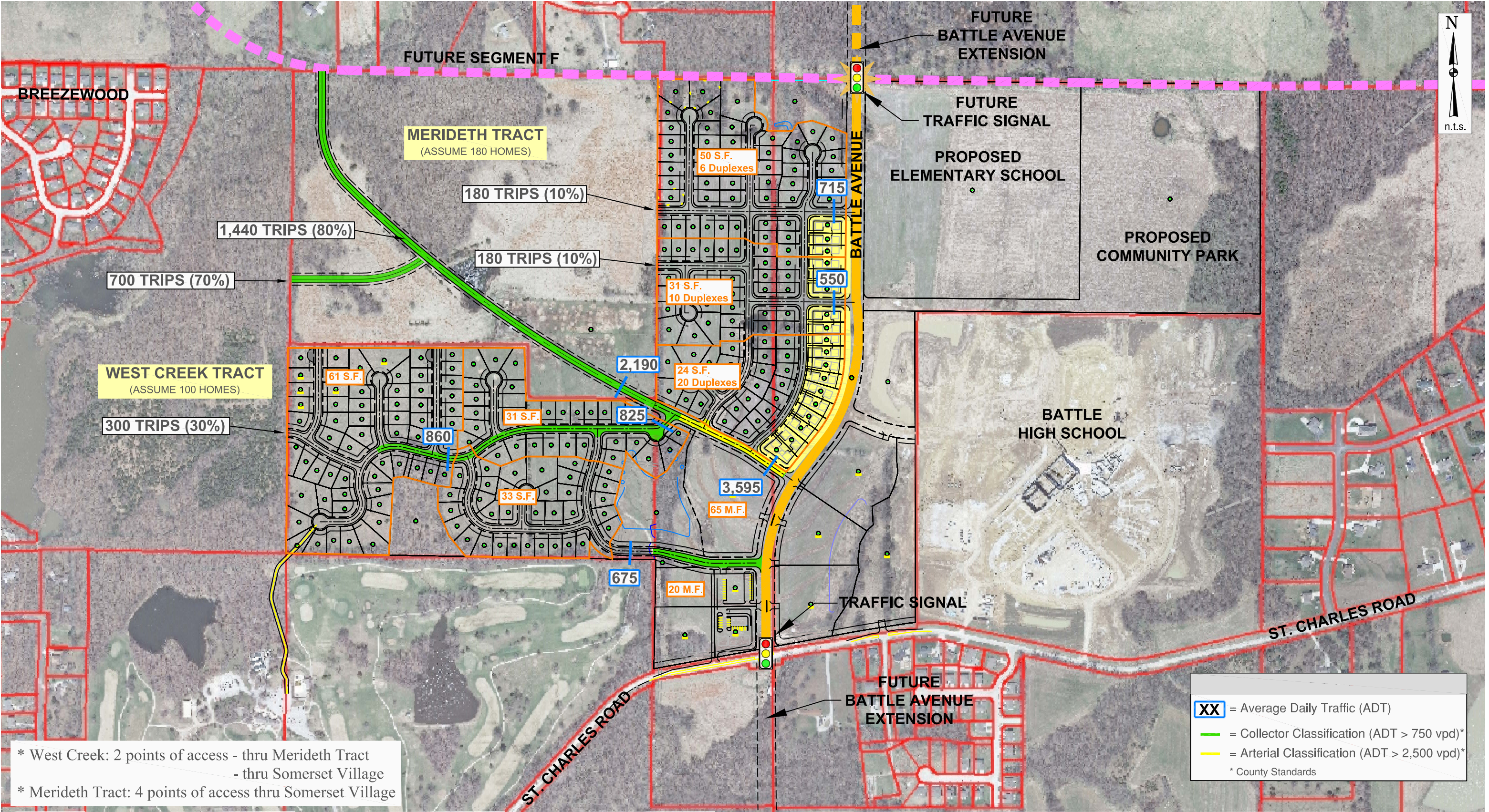


Exhibit 25: Anticipated Traffic Volumes Assuming Somerset Village, West Creek Tract & Merideth Tract

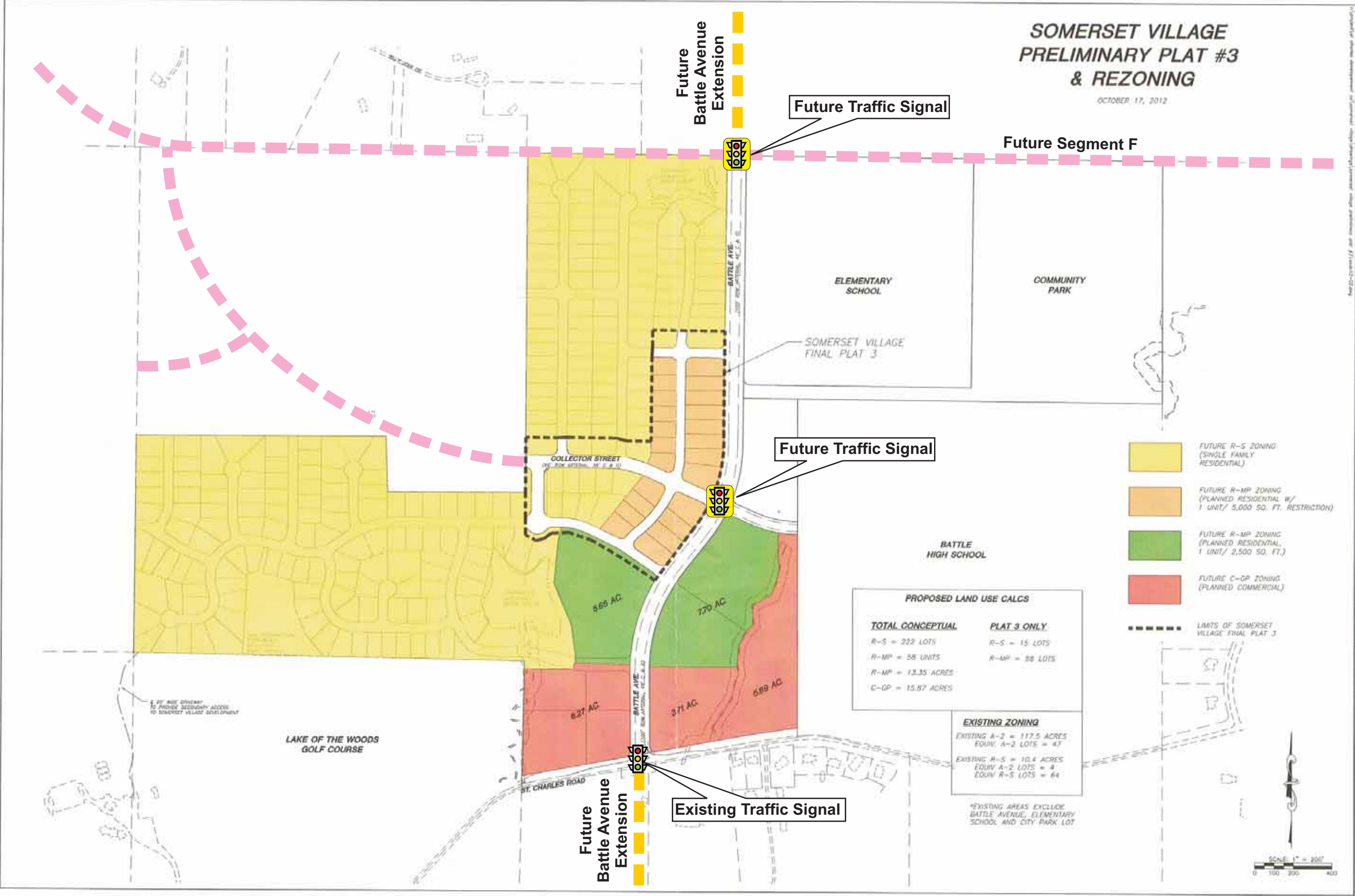


Exhibit 26: Revised Somerset Village Site Plan

Somerset Village – Access Management Considerations

The Somerset Village collector road shown on the revised site plan intersects Battle Avenue at Spartan Drive (Battle High School) will be the primary point of access for the Somerset Village subdivision. This collector road is anticipated to carry approximately 1,255 vehicles per day, only accounting for trips from the Somerset Village subdivision. However, the road should be planned and constructed to provide primary access between Battle Avenue and the Merideth and West Creek Tracts when they develop in the future as well. When all three developments are built out, it is estimated that this road will carry approximately 3,600 vehicles per day. In order to better facilitate future traffic, the Somerset developers have relocated the main access road to tie into Battle Avenue across from Spartan Drive (Battle High School). This realignment will allow for the intersection to be signalized in the future when warranted. Ideally, dedicated left-turn lanes should be provided for all approaches to the Battle Avenue/Spartan Drive/Somerset Collector Road intersection.

The size of this development warrants additional access points, which will also be needed to provide for the two emergency responder access/evacuation routes that are required for all subdivisions. As such, it is desirable to provide additional access to Battle Avenue (via side street stop-controlled intersections) at two locations: 1) between Spartan Drive and Segment F (across from the easement that has been provided for access to the future park and Elementary School), and between Spartan Drive and St. Charles Road (approximately midway between Spartan Drive and St. Charles Road). While the revised site plan shows these additional connections, we recommend that the north connection be moved approximately 100 to 150 feet to the south to connect to Battle Avenue across from the easement that has been provided for access to the future park and Elementary School. A cursory review of the estimated turning movements at these intersections found that auxiliary turn lanes would likely be necessary to accommodate the future traffic volumes. Additionally, it may be desirable to provide access to the Somerset Village subdivision from future segment F. This access could possibly be provided via cross-access to the Merideth Tract or via the extension of one of the cul-de-sacs within the Somerset Village Subdivision to Segment F.

Although not depicted in the revised site pan for the Somerset Village development, additional access would likely be requested for the proposed commercial lots near the intersection of Battle Avenue and St. Charles Road. As discussed in the “Driveway Access Management” section, driveway access control is based upon the type of driveway and functional classification of the roadway on which access is requested. Full access driveways on arterial roadways should be spaced at least 330 feet apart. Right-in right-out driveways on arterial roadways should be spaced at least 165 feet apart. Corner clearance for driveway access should meet or exceed the minimum driveway spacing requirements for that roadway. When minimum spacing requirements cannot be met due to lack of frontage, all means should be undertaken to provide shared access drives or cross access easements

Based on the revised site plan, there is approximately 850 feet between St. Charles Road and the first roadway serving the Somerset Village development shown on the plans. As such, there may be sufficient distance for an additional full access driveway on Battle Avenue between this

southern roadway and St. Charles Drive to serve the retail portion of the development. However, it is likely this access would require separate left-turn lanes on Battle Avenue. As this planning process does not represent a detailed traffic study, it is recommended that a detailed traffic evaluation of the access drives for the Somerset Village be completed to more completely address the development and its specific impact. This traffic study should consider the queues from the adjacent traffic signals at St. Charles Road and at Spartan Drive (in the future) to determine if additional full access on Battle Avenue can be accommodated between St. Charles Road and Spartan Drive.

Likewise, it is anticipated that the developer would request access to the commercial lots directly off St. Charles Road. As discussed previously, it is recommended that any full access drives be a minimum of 330 feet from Battle Avenue and may need to be further away depending on the estimated queues from the signal at St. Charles Road and Battle Avenue. This detailed evaluation would also be part of a future traffic study of the Somerset Village development.

As discussed previously, Somerset Village development will generate approximately 9,145 trips per day. Although it is acknowledged that some of this traffic would be pass-by in nature and would not add additional traffic to the adjacent roadways, it would create additional turning movements at the access drives and streets. As such, this development should be subject to local traffic trip generation fees to mitigate their impact to local roadways.

North Battleground

North Battleground Only

The proposed North Battleground development is located on the north side of St. Charles Road approximately one half mile west of Route Z. **Exhibit 4** identifies the general location of the proposed development site relative to the surrounding area. Initially, access to the site is proposed via two curb cuts on St. Charles Road. One stub street to the vacant parcel west of the site and two stub streets to the vacant parcels east of the site are also planned in order to provide connectivity to the adjoining properties.

The North Battleground development would consist of approximately 92 single-family homes. Based on data provided in the *Trip Generation Manual*, 8th Edition, published by the Institute of Transportation Engineers (ITE), the average daily traffic generated by a single-family home is approximately 10 trips per day per home. As such, the North Battleground development would generate approximately 920 trips per day (460 in and 460 out).

Assuming access is only provided off St. Charles Road, the ADT on Traveller Drive just north of Manassas Drive would be 460 vpd. Assuming approximately 20% of these trips utilize Manassas Drive to access St. Charles Road and the remaining 80% utilize Traveller Drive to access St. Charles Road. The ADT on Traveller Drive at St. Charles Road would be 600 vpd while the ADT on Manassas Drive at St. Charles Road would be 320 vpd. Given that the estimated volumes on the roadways within the North Battleground development are all estimated to be less than 750 vpd, the roadways within the development would all be classified as Local

Roads. The average ADTs estimated within the North Battleground development are shown in **Exhibit 27**.

A cursory review of the estimated turning movements at the intersections of Traveller Drive and Manassas Drive with St. Charles Road, found that auxiliary turn lanes would not be necessary to accommodate the North Battleground development. However, the subdivision will contribute nearly 920 new trips on the local roadway system and should be subject to local trip generation fees to mitigate their impact to local roadways. Additionally, two access routes for all homes within the subdivision will be required to provide for emergency responder access/evacuation. Any of the future stub streets would allow for this second access to the homes in the northern half of the subdivision, north of the Traveller Drive and Manassas Drive intersection at such time as the adjoining properties are developed.

It should be noted that a future Segment H and Segment G would tie into St. Charles Road near the Traveller Drive intersection. It would be appropriate to construct a roundabout to accommodate the intersection of St. Charles Road, Segment H, Segment G, and Traveller Drive.

As discussed in the “Segment F” section, the proposed alignment of Segment F, east of Battle Avenue, is located largely along existing property lines. The north property line of the North Battleground subdivision lies along the proposed Segment F alignment. As such, the North Battleground Subdivision should dedicate one-half of the right-of-way to create a corridor for the future construction of Segment F. Also, as stated in the Segment F section, existing county ordinances require that a developer construct a roadway if they are required to dedicate right-of-way for that roadway. Since the developers of North Battleground Subdivision would not be able to construct the road as required by county ordinance (because only one-half of the right-of-way would be dedicated) we recommend that an exception be given to North Battleground Subdivision developers so they would be able to dedicate one-half of the right-of-way for Segment F but would not be required to construct the road. Funds from the proposed trip generation fees could be used to construct Segment F once the full width of right-of-way has been dedicated.

North Battleground Stub Streets to Adjacent Parcels

A review of the future stub streets was also considered to evaluate whether these connections would change the estimated ADT's within the North Battleground development. If the vacant tract to the west of North Battleground develops, it would be desirable to create a connection to the existing northern stub on North Slick Rock Road so that a majority of these homes could utilize North Slick Rock Road to access St. Charles Road (with the homes within North Battleground continuing to use Traveller Drive and Manassas Drive). However, we understand that it may be difficult to make this connection due to a drainage draw north of the existing development along North Slick Rock Road. Ideally, the development of the vacant tract to the west of North Battleground would not increase the ADT on the roadways within North Battleground. However, it is possible that for a short period some homes from the vacant tract to the west of North Battleground could use Traveller Drive and Manassas Drive to access St. Charles Road. Ultimately, however, this tract would have access via Segment F to access either Battle Avenue or Route Z. Therefore while traffic volumes in the North Battleground

subdivision could be elevated from trips from the vacant tract to the west, in the long term it is unlikely that the roads within the North Battleground development would exceed local road classification. If the vacant tracts to the east of North Battleground develop, a majority of these homes would utilize their internal subdivision streets to access St. Charles Road rather than going through North Battleground. Likewise, the homes within North Battleground are expected to continue to use Traveller Drive and Manassas Drive to access St. Charles Road. As such, the development of the vacant tracts to the east of North Battleground is not expected to increase the ADT on the roadways within North Battleground.

It is anticipated that any vacant tracts north of North Battleground would have access to Route Z or Battle Avenue via “Segment F” and would not utilize the Local Roads within North Battleground. As such, it is unlikely that under any scenario that the roads within the North Battleground development would exceed Local Road status.

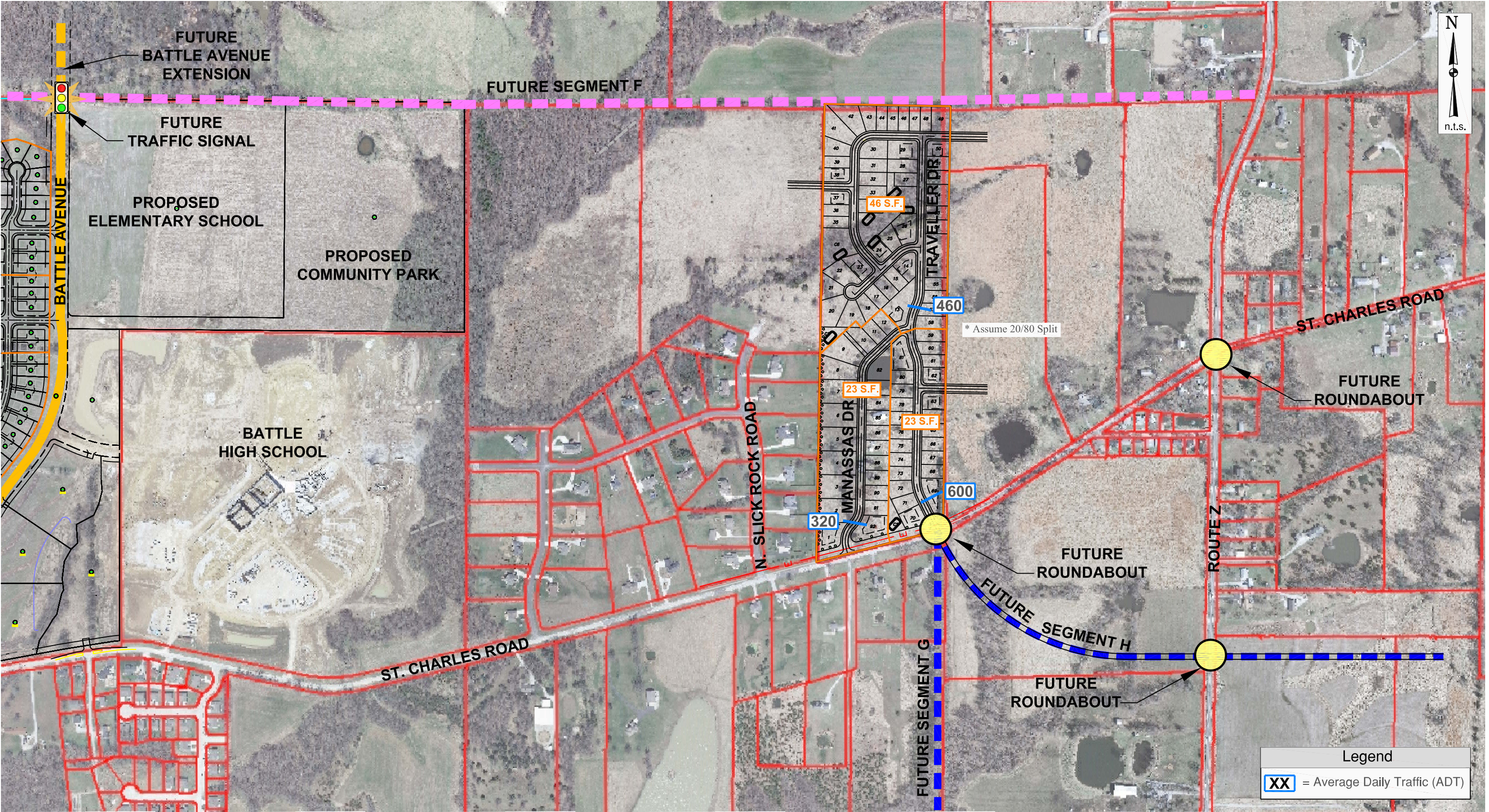


Exhibit 27: Anticipated Traffic Volumes Assuming North Battleground Subdivision

Job# 046-12-1
10/29/12

Summary

Northeast Boone County has come under increased development pressures. As a result Boone County, the City of Columbia, the Columbia Area Transportation Study Organization (CATSO), and Missouri Department of Transportation (MoDOT) partnered together to create a transportation plan for this subarea. This Transportation Plan considers all roadway improvements needed in the subarea or leading to the subarea so that they can be properly planned when developments are brought to the County. The subarea transportation plan ensures that the entire transportation network is cohesive and provides good connectivity. **Exhibit 28** shows the Northeast Boone County Transportation Master Plan as recommended in this report.

Table 14 shows the cost per square foot of non-residential development and cost per residential dwelling unit for future developments. These costs are calculated using the future land uses identified in the comprehensive plan for the area and estimated by the weighted average they have on the roadway network. These unit costs are intended to provide a guideline to Boone County to use for a trip generation fee for future developments in the area. It is not intended that all future development pay for the entirety of the network, but a portion of the cost to ensure that the facilities built don't preclude other future development or land uses.

This Transportation Plan is intended to be used as a guide for transportation improvements and meant to be a living document. It is a document intended to be used as a regulatory tool and periodically reviewed and updated as development occurs and transportation improvements and funding changes. This plan should be reviewed, and amended if necessary, on a cycle of every five years at minimum.

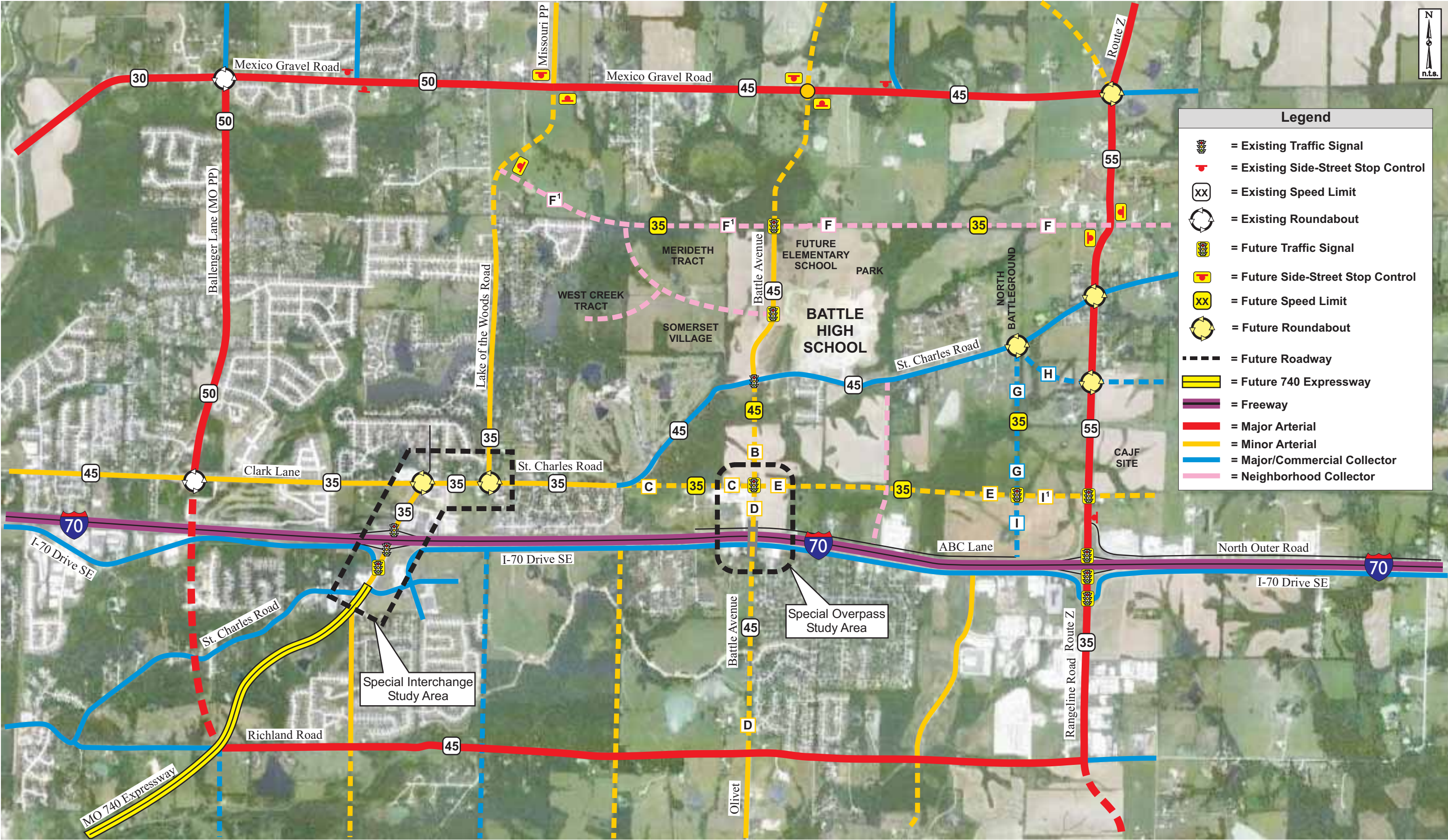


Exhibit 28: Recommended Study Area Roadway Master Plan

Job# 046-12-1
10/29/12

Appendix A:
Excerpt from Boone County
Design Standards

BOONE COUNTY, MISSOURI

ROADWAY REGULATIONS

CHAPTER II

ROAD, BRIDGE & RIGHT OF WAY

REGULATIONS

REVISED – FEBRUARY 24, 2009

(DRAWINGS ONLY)

REVISED – MAY 13, 2004

REVISED – APRIL 22, 2003

REVISED – APRIL 8, 2003

EFFECTIVE – FEBRUARY 21, 2002

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REGULATION OF CONSTRUCTION AND USE OF COUNTY-MAINTAINED PUBLIC ROAD RIGHT OF WAY

- 2.1 **Purpose:** These regulations are enacted for the purpose of regulating all activity that affects publicly dedicated right of way and publicly dedicated easements maintained by Boone County; for the purpose of establishing the construction standards for roadway acceptance for County funded maintenance; and also for the purpose of regulating all activities including but not limited to demolition, construction and repair activities within county-maintained road right of way and utilities within such rights of way; for the purpose of establishing standards for constructing, maintaining or repairing improvements within the rights of way; and also for the purpose of establishing standards for the use, closure and vacation of County-maintained public rights of way and publicly dedicated right of way that is not maintained by the County.
- 2.2 **Authority:** These regulations are enacted under authority vested in Boone County, Missouri by §§ 228.110, 228.190, 229.100, 229.300 to 229.370 RSMo, 67.1830 to 67.1846 RSMo, and Section 49.270 RSMo, as well as applicable judicial interpretations under these sections.
- 2.3 **Definitions:** As used in these regulations, unless the context clearly indicates otherwise or the definition of the term is found in a regulation adopted by reference in this regulation, the following words and terms shall have the following meanings:
- 2.3.1 **Average Daily Traffic (ADT)** - The total volume of traffic during a prescribed time period measured in whole days greater than one day and less than one year, divided by the number of days in that time period which may be further subdivided by specified days of weeks, months, or seasons and may apply to specific geographic areas.
- 2.3.2 **County Commission** - The current elected Boone County Commission.
- 2.3.3 **County Road or County-Maintained Road** - Any public road for which Boone County, Missouri has assumed responsibility for repair, maintenance or improvement.
- 2.3.4 **Construction** - The term construction as used in these regulations shall generally mean all work performed within a right of way or on any other property which will affect a right of way which may involve any form of excavation, whether on the surface or below the surface of any right of way, or which may provide or is intended to provide vehicular access to such right of way or which physically affects or can be reasonably expected to physically affect the condition or character of the right of way or use thereof by motor vehicles regardless of whether the activity involving or causing any of the foregoing is for purposes of maintenance, repair or improvement.

- 2.3.5 **County Engineer** - The Boone County Highway Administrator or a person designated by the Boone County Highway Administrator to perform or cause to be performed professional engineering services for Boone County, Missouri.
- 2.3.6 **County Highway Administrator** - The official appointed by the Commission to be the chief officer of the County in all matters pertaining to highways, roads, bridges, and culverts, under the revised statutes of Missouri and who serves as Director of the Boone County Public Works Department and who is in charge of all operations of that department.
- 2.3.7 **Director** - The Director of the Boone County Public Works Department or his/her designee for the purpose of administering these regulations.
- 2.3.8 **Easement – Temporary** – A grant by a property owner to the public, or other person or entity over specific tract of land for a specific use or purpose for a specific time frame.
- 2.3.9 **Easement – Permanent** – A grant by a property owner to the public, over specific tract of land for a specific use or purpose of indefinite duration.
- 2.3.10 **Inspection** - shall refer to the act of inspection by the Director of the Boone County Public Works Department or his/her designee.
- 2.3.11 **Licensed Professional Engineer** - A person who is professionally licensed to practice engineering in the State of Missouri.
- 2.3.12 **CATSO Major Thoroughfare Plan** – A roadway classification plan prepared by the Columbia Area Transportation Study Organization (CATSO) and passed by the Boone County Commission as of January 27, 1998, which specifies the classification of roadways within the Columbia metropolitan area.
- 2.3.13 **Neighborhood Improvement District** –An area of a city or county with defined limits and boundaries which is created by vote or by petition under sections 67.453 to 67.475 RSMo and which is benefited by an improvement and subject to special assessments against the real property therein for the cost of the improvement.
- 2.3.14 **P & Z Commission** - The current Boone County Planning and Zoning Commission.
- 2.3.15 **Pave in Place** – Boone County projects that allow county maintained roadways to be paved in its existing location with only minimal preparation.

These projects are typical for roadways that only have the 30' Statutory Right of Way.

- 2.3.16 **Person** – Any natural person, business entity of any type, corporation, trust, association of any type, governmental entity of any type, or any agent, officer or employee of any of the foregoing.
 - 2.3.17 **Private Driveway** – A roadway used for ingress and egress typically serving a single tract or parcel; or that provides vehicular circulation within a lot.
 - 2.3.18 **Private Road** – A roadway that is not dedicated to public use serving two or more tracts or lots.
 - 2.3.19 **Public Road** - Any roadway and its associated right of way that is dedicated to public use and used by the public without regard to whether it is a county-maintained road or otherwise maintained at government expense. A public road need not be a county- maintained road as defined in these regulations.
 - 2.3.20 **Right of Way** – All land within a corridor with boundaries defined by use or surveyed description which is established by plat, written deed, easement, instrument of public dedication, or prescriptive use that is used for public roadway purposes and other subordinate permissible uses.
 - 2.3.21 **Road or Roadway** - That portion of any right of way or private road which is paved, graveled or otherwise surfaced by some means to comprise a road or street for use by vehicular traffic and which is typically identified by a road or street name.
 - 2.3.22 **Road and Bridge Advisory Committee** - A committee comprised of ten (10) Boone County citizen representatives, one from each township, the Public Works Director, a County Commissioner and a representative from the Planning and Building Inspection Department.
 - 2.3.23 **Subdivision Regulations** - The currently adopted regulations contained within the document formally titled Boone County, Missouri Land Use Regulations, Chapter I, Subdivision Regulations.
 - 2.3.24 **Urban Service Area** - That area which is defined as the urban service area in the Boone County Subdivision Regulations.
 - 2.3.25 **Zoning Ordinance** - The currently adopted regulations contained within the document formally titled Zoning Ordinance for Boone County, Missouri.
- 2.4 **Applicability:** These regulations shall be applicable to the unincorporated areas of Boone County, Missouri.

2.5 **Roadway Classifications:** All roadways within the unincorporated areas of Boone County, Missouri, shall be classified in one or more of the following categories:

2.5.1 **Arterial Road** - Any planned or existing public road right of way 100 feet or more in width and which serves to collect traffic from collector roads which permits or will permit movement of a large volume of traffic from one geographic area to another. Additionally a public road may be classified as an Arterial Road if it carries an ADT of at least 2,500 vehicles or can be reasonably expected to carry the ADT stated above as a result of a proposed development or is so classified by the Columbia Area Transportation Study Organization Major Thoroughfare Plan.

2.5.2 **Collector Road** - Any planned or existing public road right of way of 66 feet or more in width and which functions or is designed to function to collect traffic from local roads and channel such traffic to an arterial or another collector road. Additionally a public road may be classified as a Collector Road if it carries an ADT of 750 to 2,500 vehicles or can be reasonably expected to carry the ADT stated above as a result of a proposed development or is so classified by the Columbia Area Transportation Study Organization Major Thoroughfare Plan.

2.5.3 **Local Road** - Any planned or existing public road right of way 50 feet or less in width and which serves the primary purpose of permitting ingress and egress from residences or other buildings or structures along such road to circulate to and from collector roads. Additionally a public road must carry an ADT of less than 750 vehicles to be classified as a Local Road or is so classified by the Columbia Area Transportation Study Organization Major Thoroughfare Plan.

2.5.4 **Commercial/ Industrial Road** - Any planned or existing public road right of way 66 feet or more in width and which serves the primary purpose of permitting ingress and egress from a commercial or industrial development or within such a development or is so classified by the Columbia Area Transportation Study Organization Major Thoroughfare Plan.

2.5.5 **Alley** – Roadway bounded by planned or constructed buildings and accessory structures used primarily to access parking for motor vehicles.

2.5.6 **Private or Non-maintained Roads** - All private roads and publicly dedicated roadways which are not governmentally maintained because they do not qualify for governmental maintenance or for which the County is not required to provide maintenance by law.

2.6 **Public Road Acceptance, Maintenance and Improvement:** Public road rights of way may be accepted for county maintenance in accordance with the following:

2.6.1 **Right of Way Acceptance Procedure** - Roadway rights of way that qualify for County maintenance shall be accepted for maintenance by the County under the following procedure:

2.6.1.1 **New Roadway Right of Way** - New roadway right of way shall be dedicated to public use on a subdivision plat. All new roadways to be maintained by the County shall be constructed under permit issued by the County and inspected for compliance with the provisions of these regulations during construction in order to be accepted for maintenance. Roadways constructed without such permit shall not be accepted for maintenance unless it is proven at owner or contractor expense that the road was in fact constructed in accordance with these regulations to the satisfaction of the Director. "If new roadway construction for which a permit is required has not commenced within one year of department approval of roadway plans, the department may require the developer to re-submit plans and construct such roadway in compliance with current regulations in effect if different from those which were effective at the time the department approved original plans"

2.6.1.2 **New Roadway Acceptance** - When all roadways have been built according to the approved plans and specifications submitted, the Boone County Public Works Department will prepare an order for the County Commission recommending acceptance of the roadways. As a condition to acceptance, the County may require the applicant for acceptance to guarantee maintenance of seeding, mulching and other storm water drainage improvements for a period of one year after acceptance and for that purpose may require the applicant to make a cash deposit posting of a performance bond to secure performance of these obligations under such terms as may be deemed reasonable by the Director and approved by the County Commission.

2.6.1.3 **Existing Public Roadways** - Public roadways existing as of July 16th, 1998, which have no instrument recorded in the public records showing conveyance or dedication to public use for roadway purposes but which have been used by the public for roadway purposes for a period of 10 continuous years or more may be accepted for maintenance by County Commission order, filed of record, so long as such roadways meet current County construction standards or have had a variance, as defined in **Section 2.8.4** of these regulations, granted from the strict requirements of the standards provided in these regulations. Other existing public roadways established in accordance with the provisions of Chapter 228 RSMo. or otherwise accepted for county maintenance shall be conveyed to the County for public use forever by means of deed of dedication, quitclaim deed, warranty deed, or easement for all roadway right of way.

2.6.1.4 **Order of Acceptance** - No roadway shall be accepted for maintenance at the expense of Boone County unless the County Commission enters a formal order accepting dedication or other instrument of conveyance and/or enters an order accepting such roadway as a County road for maintenance at County expense. All such orders shall be filed of record with the County Clerk and in the public land records of the County. No such roadways shall be accepted for maintenance except upon application of a party or parties authorized to dedicate or convey such roadway to the public use, or in the case of existing roadways, upon application of an interested party or by the County at its own initiative; applications shall be on forms provided by the Director. Any person applying for public roadway acceptance and maintenance shall be responsible for the necessary expenses in processing such application including land survey and land record recording expenses.

2.6.2 **Roadway Maintenance** – County-maintained road rights of way and roadway structures within them shall be maintained to the extent that funding is available at Boone County expense only if constructed by Boone County, or if currently maintained at the effective date of these regulations, or if constructed privately in accordance with the standards prescribed by these regulations and transferred to Boone County in accordance with these regulations, or if privately constructed prior to the effective date of these regulations but do not conform with current requirements, then only if a variance is granted from the particular requirements of these regulations and transferred to Boone County in accordance with the requirements of these regulations. Notwithstanding County maintenance and control of county road right of way, persons who lawfully own or possess private roads, streets, or driveway ingress and egress which connect to county maintained roads shall be solely responsible for the maintenance and repair of such private roads, streets and driveway ingress and egress to a point which intersects the publicly used and county maintained driving surface of county road and any such work may be performed without a work permit as otherwise required for work within the county maintained road right of way. Except as otherwise authorized in these regulations, no person shall perform any maintenance, repair, or other work within the county maintained road right of way, including work on driveway culverts, ditches, signs, or other structures within the right of way, which are otherwise maintained by and subject to control by the county except pursuant to a duly issued work permit authorized herein.

2.6.2.1 **Drainage Easements and Structures** – Drainage ways within county maintained rights of way and drainage easements and structures accepted by the County for maintenance shall be maintained by the County to the extent funding is available in accordance with County

maintenance standards. The County shall not be responsible for repair or maintenance of publicly dedicated or private drainage easements or structures located outside of County maintained road right of way which have not been formally accepted for repair or maintenance by the County. No drainage structure shall be connected to or adversely impact a County maintained drainage easement or structure without County approval under a work permit issued for that purpose.

2.6.2.2 School Bus Turn-Around – School Districts may make special requests for County assistance in creating school bus turn-around. At the request of a school district the County may deliver surfacing material to a specific location and supply grading services, but the County will not pay for surfacing material and if the work involved is adjacent to but not located within publicly maintained right-of-way, a signed Maintenance Work Authorization form will be required from each property owner in which the work will take place.

2.6.3 Roadway Improvements - County-maintained road rights of way and roadway structures within them shall be improved by Boone County or under its direction and control as deemed necessary by the County to preserve, protect or enhance the public safety and convenience subject to funding made available for this purpose and under such policies as may be adopted from time-to-time by the Director. In order to facilitate repairs and improvements to county-maintained road rights of way and roadway structures within them, persons using such rights of way and areas adjacent to them shall abide by the following regulations:

2.6.3.1 Vehicular Traffic - The Boone County Public Works Department may temporarily close, reroute, detour, or otherwise control vehicular traffic and roadway use in and around construction areas for purposes of promoting safety and efficient delivery of services in connection with road repair and improvement projects consistent with any applicable law and traffic regulations enacted by Boone County, Missouri.

2.6.3.2 Utility Use of Rights of Way; Relocation, Repair and Improvement
From and after the date of these regulations, all new and existing utility usage of county-maintained road right of way shall be by general licensed right of use under the authority of the County Commission and subject to the terms and conditions of these regulations. All utility service providers having utilities located in private easements within county-maintained road right of way shall comply with the requirements of these regulations, subject to the provisions for reimbursement for construction and relocation expense provided for herein. The Director may require public and private utilities located within county-maintained road rights of way to

relocate and/or perform planned repairs or improvements to utilities located within the roadway right of way when necessary for completion of a road repair or improvement project. In such cases, the Director shall provide public and private utility service providers affected by any planned road repair or improvement project with engineering plans and a planned schedule for work to be performed within the roadway right of way within a reasonable time prior to commencement in order to allow all such utility service providers the opportunity to plan for relocating, repairing, or upgrading facilities as a part of, or in coordination with the project, and to obtain necessary permits as required by law or these regulations. Repairs and improvements shall be performed by utility service providers in coordination with the Public Works Department in order to assure that road repair or improvement work is performed in a timely and efficient manner. When relocation is necessary, utilities shall be relocated within or outside the roadway right of way as required under the circumstances as determined by the Director of Public Works in order to complete the project for which the relocation is necessary.

2.6.3.2.1 Utility Relocation Expense - The actual expense of relocating public or private utilities in connection with a county-maintained road repair or improvement project, which are located in private utility easement within and predating the county-maintained road right of way, shall be paid by the County. The actual expense of relocating public or private utilities in connection with a county-maintained road repair or improvement project physically located within the county-maintained road right of way without a private utility easement which predates the county-maintained road right of way shall be paid by the utility service provider. When necessary to preserve or promote public safety or convenience, or for reasons of engineering necessity, the Director may require a public or private utility service provider to relocate utilities within the county-maintained road right of way onto private easement outside of the county-maintained road right of way, thereby requiring acquisition of new private utility easement; in such cases, the County upon order of the County Commission, shall pay such public or private utility the fair and reasonable value of new equivalent easement outside of the public right of way and the fair and reasonable expenses associated with such acquisition. When a utility service provider determines it is necessary to relocate outside of the county-maintained road right of way in connection with a county-maintained road repair or improvement project without requirement by the Director, it may do so at its own expense so long as relocation is accomplished within such time and in a manner which will not hinder or delay completion of the project. The cost of repairing, improving or replacing utilities within a county-maintained road right of way shall be paid by the utility service provider except that the county shall pay the actual expense of repair or replacement of equivalent existing facilities in cases where repair or replacement is necessitated by a county-maintained road repair or improvement project and the utility facilities are located within private easement located within and predating the county-maintained road right of way.

2.6.3.2.2 Utility Repair and Improvement - Utilities shall be repaired, improved or upgraded as a part of a roadway repair or improvement project whenever practicable, and utility service providers having utilities located within the county-maintained road right of way shall promptly notify the Director of needed or planned additions, changes, or improvements to utilities within the area subject to construction, after being given notice of the need for road repairs or improvements scheduled for construction in accordance with Subsection 2.6.3.2.3 below. Whenever utility repairs, improvements, or installations can be performed as a part of a road improvement project, utility service providers shall nonetheless perform such preliminary work as may be appropriate to eliminate future excavation of and damage to newly paved road surfaces, curbs, gutters, drainage structures and related facilities by installation of conduits, sleeves, manholes and other facilities; failure of a utility service provider to perform preliminary work as a part of or in coordination with county-maintained road repair or improvement project shall be grounds for the denial of a construction permit required by these regulations to perform excavation work at a later date.

2.6.3.2.3 Mandatory Utility Work – Utility work such as removal, relocation, or repair of facilities necessary for timely completion of a county-maintained road right of way repair or improvement project shall be performed by utilities in a timely manner so as not to unreasonably delay completion of any such project, provided that the Director provides reasonable advance notice of the need for such work which shall in no event be less than five (5) days as prescribed by law. In the event a utility service provider fails to perform work reasonably necessary for the timely completion of a road repair or improvement project or unreasonably delays performance of such work after reasonable notice of the need for such work as provided for herein, then the Director of the Public Works Department may perform or contract for the performance of such work with the expense thereof chargeable to such utility service provider, or in cases where it is impracticable for the Director to perform or cause the performance of such work, then the Director may seek an order to compel performance of such work from a court of competent jurisdiction with the expense thereof chargeable to such utility provider.

2.7 Closure and Vacation of County-maintained Roads: County maintained roads may be closed or vacated in accordance with the following procedures:

2.7.1 Roadway Closure - County-maintained roads and/or the access points to them may be closed in whole or part in accordance with the traffic regulations of Boone County, Missouri. County-maintained roads which in the judgment of the Director are no longer used by the traveling public or which were at one time county-maintained roads but are currently used only as a means for private ingress and egress may be closed to public use, except for authorized persons, for the purpose of effecting statutory vacation by means of abandonment. The closure of a county-maintained road shall not affect the title to real estate unless and until such road is vacated.

2.7.2 Vacation of Public Roads - Public roads shall be vacated as authorized by law and applicable regulations of the county. The county shall notify all

public and private utility service providers known or discovered to use the right of way proposed for vacation prior to final action thereon. Public roads may be vacated with title thereto reverting to abutting property owners in accordance with the following procedures:

2.7.2.1 **Subdivision Roadways** - Roadways and rights of way located in platted subdivisions may be vacated in accordance with the requirements of the subdivision regulations of Boone County, Missouri or Revised Statutes of Missouri.

2.7.2.2 **Other Public Roads** - Other public roads located in the unincorporated areas of Boone County, Missouri, which are not located within platted subdivisions shall be vacated in accordance with the provisions of § 228.110 RSMo. upon petition or by means of abandonment due to non-use by the public under § 228.190 RSMo.

2.8 **Construction Standards:** All construction work performed within rights of way shall conform to the following standards applicable to the type of work performed:

2.8.1 **New Construction** - All new public roads, existing roadways and storm water projects that are to be maintained by the County shall be constructed or improved under permit issued by the Department of Public Works in accordance with the standards and specifications set forth in **Appendix A** of these regulations and **Appendix D** for plan submittal requirements. No roadway shall be accepted as a public road to be maintained at county expense unless it meets or exceeds the requirements set forth in **Appendix A** or unless specific variances are granted to the requirements set forth in **Appendix A** of these regulations. In either case, all utilities to be located within the rights of way shall be installed before County acceptance unless otherwise authorized by the Director.

2.8.2 **Driveway Locations and Culverts** - All driveway accesses and culverts shall be installed in accordance with the procedures and standards set forth in **Appendix B** of these regulations.

2.8.3 **Utility Pavement Cuts** - All non-emergency cuts within pavement, curbs, gutters, shoulder or drainage areas shall be made in accordance with plans and specifications approved by the Director as set forth in **Appendix C** of these regulations.

2.8.4 **Variances** - A variance from the strict application of the requirements set forth in the Appendices of these regulations may be granted upon a written application to the Director setting forth the specific variance(s) desired, planned substitutes and the reasons and justifications for the variance(s). Written applications for variances must be submitted by the holder of or applicant for a construction permit to the Director and scheduled for

consideration by the Road and Bridge Advisory Committee in accordance with the provisions of 2.16 of these regulations. Any variances tabled and/or not acted upon within 60 days shall be deemed denied. Variances shall be tabled for no more than 60 days from the initial review. Any variance denied by the Road and Bridge Advisory Committee may be appealed to the County Commission, provided the appeal is submitted within 10 working days of the denial date, or resubmitted for review by the Road and Bridge Advisory Committee. Resubmission shall follow the same procedures as submission for a new variance. The Road and Bridge Advisory Committee shall forward its written recommendation to the County Commission. Thereafter the County Commission shall act upon all such applications for variances as soon as practicable after receiving report and recommendation from the Committee and shall grant or deny all such requests.

2.9 Construction Permits: All construction activity shall be carried out pursuant to work permit under Boone County Right of Way Permits Policy dated September 10, 2002 and any amendments to such policy in force as of the effective date of these regulations. No person shall perform any construction within a right of way for any purpose except upon issuance of and in conformity with a permit issued by the Director pursuant to the provisions of these regulations: provided, however that construction work within private easements located within or adjacent to county maintained road right of way which does not alter or damage road surface, road drainage ditches or structures, signage or other road improvements and which will not interfere with road traffic shall not be subject to the permit requirements contained herein. The issuance of a permit in accordance with these regulations does not relieve the permittee of the responsibility to properly plan, design, construct, install, modify, or maintain the construction or the area in which construction is authorized pursuant to the permit. Issuance of the permit shall not relieve the permittee from compliance with any other applicable laws, rules or regulations, including but not limited to identification or location of underground utilities, compliance with erosion control standards, pollution control standards or Floodplain Management Ordinance.

2.9.1 Permit Requirements - Any person seeking a permit for construction within a right of way shall submit a written application on forms provided by the Director. The Director in his discretion may issue general or blanket permits for specific recurring categories of construction activities under such terms and conditions and for such duration as the Director deems appropriate under the terms and conditions of these regulations. **(In the case of new road construction, see 2.8.1 New Construction)**

The Director may require plans and specifications in support of an application for permit to be prepared or approved by a qualified and registered engineer if recommended by the Department's Division of Design and Construction to preserve and promote the public health and safety. All permit applications, including plans and specifications submitted in support thereof, shall demonstrate in writing and graphically, as appropriate, that the

proposed construction activity is or will be in compliance with the requirements of these regulations. All permit applications other than for private driveway culverts, blanket permits, and permits issued under special cooperative agreement, shall be submitted to the Director at least thirty (30) in advance of the proposed date of construction except in cases of emergency as provided in **Section 2.9.3.4**.

The Department shall review and respond to all permit applications for construction activity other than the installation of driveways, blanket permits, or permits issued under special cooperative agreements, within twenty-one (21) days of receipt of the application and supporting materials: provided, however, the Director may extend the time for response to a permit application in extraordinary circumstances in order to address engineering or public safety issues arising from a permit application.

For driveway permits, see **Appendix B**.

A permit may be issued with modifications accompanied by written reasons for such modifications. A permit may be denied if the Director finds that the construction as proposed will endanger the public safety or will result in permanent degradation of the right of way, or if the permittee on one or more occasions has failed to engage in or complete construction activities in accordance with the requirements of these regulations or has failed to properly maintain the right of way subject to the permittee's construction permit within the time provided for by these regulations.

Any permit which is issued with modifications or which is denied shall be subject to review by the County Commission provided the applicant files a written appeal to the County Commission on forms provided by the Department within ten (10) business days of a permit issuance with modifications or permit denial.

The County Commission shall upon timely and proper appeal determine the facts and issues pertaining to the appeal and render its decision thereon in writing. Any further appeal shall be in accordance with the provisions of Chapter 536 RSMo.

- 2.9.2 **Construction Inspection** - All construction activity under authorized permit shall be inspected during construction and upon completion of construction activity by the Boone County Public Works Department. No portion of the right of way subject to construction shall be used by the public or be open to public vehicular traffic until approved after final inspection. No excavation or boring shall be covered or filled in unless authorized by the Director or his designee upon inspection. Inspections hereunder may be waived by the Director in cases where the permittee provides adequate assurances that all construction activity has been performed in accordance with approved plans

and specifications under the construction permit or the work performed under construction permit is otherwise subject to review for conformity with the requirements of these regulations and is found to be in compliance herewith.

2.9.3 General Permit Conditions - Construction permits shall be issued upon submission and approval of a permit application and payment permit fees and charges for recoupment of right of way management costs as authorized by section 67.1832 RSMo and established from time-to-time by County Commission order as otherwise provided in these regulations. In addition, the following general conditions shall be applicable to all permits.

2.9.3.1 Expiration of Permit - Any permit issued hereunder shall expire on the date specified by the Director in the permit or as specified in the application for permit if not specified by the Director, or in the absence of specification, within thirty (30) days after issuance unless the Director has extended the permit in writing. Permits may be extended for good cause for a period not to exceed ninety (90) days after the initial period of validity provided there have been no changes in plans for construction and construction occurs within the time period authorized by the permitted extension. No permit shall be renewed except by written endorsement of renewal of the permit by the Director prior to expiration. Failure to request or obtain renewal prior to expiration shall require the permittee to submit an application for a new permit.

2.9.3.2 Transfer of Permit - Permits may be transferred only with approval of the Director for good cause and proof that transferee is capable of performing all work under the permit in compliance with these regulations. All terms and conditions of permits shall be automatically applicable to any successor permittee.

2.9.3.3 Permit Suspension and Revocation - The Director may deny, suspend or revoke a permit for construction reasonable written notice to the permittee stating the reasons for denial, suspension or revocation and stating what corrective actions and time frames, if any, are necessary to obtain approval or avoid suspension or revocation when practicable under the circumstances. A construction permit may be denied, suspended or revoked due to material non-compliance with the terms of the permit or these regulations, unapproved modifications in design or construction, false or inaccurate information submitted with the application for permit, change in site conditions which will result in violation of one or more provisions of the permit, permittee failure to complete work within the time or under standards authorized or required by the permit, permittee failure to maintain construction after completion when required to do so, permit misrepresentation concerning compliance with these regulations, or any other reasons necessary for the protection

of the public safety or preservation of public property. A permit may be suspended summarily with notice to the permittee when necessary to preserve the public safety. Permit suspension or revocation shall be subject to written appeal to the County Commission if the appeal is filed within 5 business days of denial, suspension or revocation and shall be heard and determined by the County Commission at their next regularly scheduled session or special session called by the County Commission. An appeal shall not stay suspension or revocation of a permit unless so ordered by the County Commission upon a showing of good cause or with the consent of the Director. The County Commission shall determine the appeal of any suspension or revocation as soon as reasonably practicable and shall issue written findings of fact and conclusions of law in support of the decision; the decision of the County Commission shall be final and any further appeal or review shall be as prescribed by Chapter 536 RSMo.

2.9.3.4 Emergency Repair Exemption - Utility service providers may perform unplanned work within county-maintained road rights of way without issuance of construction permit or prior notification or approval of the Director of Public Works in cases of emergency or other exigent circumstance; provided, however, that the utility service provider shall report the occurrence, location, date and scope of emergency work as soon as reasonably practicable but not less than two business days following such work. All exempt emergency repair work shall be performed in accordance with the requirements of **Appendix C** of these regulations.

2.10 Road Name and Regulatory Signs: Roads shall be signed along private and publicly maintained roads under the following provisions:

Road Name Signs - In order to promote and protect the safety of the public at large the County through the County Commission may assign names to all county-maintained roads pursuant to these regulations and all private roads under the zoning regulations of the county, and may place uniform road name signs at the intersections of all such roads in order to facilitate the efficient delivery of emergency public health and safety services except internal roadways in privately maintained subdivisions. Except as authorized by these regulations, no person shall name or change the name of any road, nor install, place or remove or replace any road or street name sign on any such road except duly authorized agents of the County upon order of the County Commission. No new road or street within a subdivision shall be accepted for maintenance by the County unless and until the owner or developer of the roads or streets to be maintained by the County shall purchase and install road or street name signs in conformity with a signage plan submitted by the applicant and approved by the Director consistent with County regulations and standards prior to County acceptance for maintenance. All road names and road name changes shall be established by the County Commission through the

Department of Planning and Building Inspection. The County shall post and maintain Street Name signs on all county maintained roads and at the entrances of privately maintained roads. Street Name signs for newly constructed private roads with official names shall be installed by developers according to county standards. Upon acceptance of this installation, the county will assume on going maintenance responsibility. The Street Name sign posting of the privately maintained roads will be located at the intersection of the county maintained road and the privately maintained road within the county right-of-way, whenever possible. If the privately maintained road intersects with a State right of way, the Street Name sign will be placed in the State right of way as permitted. The County will not provide and maintain Street Name signs for the internal roads of a privately maintained subdivision. The placement or maintenance of any uniform road name sign shall not be construed as creating or establishing any obligation of the County to regulate, control or maintain any private or non-maintained public road not otherwise in compliance with these regulations.

- 2.10.1 **Regulatory Signs and Traffic Control Devices** - The County through the Public Works Department shall have the exclusive authority and control over the placement and maintenance of signs regulating traffic and traffic control devices on county-maintained road right of way consistent with the requirements of the Boone County Traffic Manual adopted July, 2002. No person shall place any sign regulating traffic or other traffic control device, nor any sign or other structure on any county-maintained road right of way without the express written consent of the Director. No road or street within a subdivision shall be accepted for maintenance by the County unless the owner or developer of roads or streets within such subdivision submits a traffic control and signage plan prepared and sealed by a licensed engineer and which is approved by the Director unless submittal of such plan is waived by the Director for good cause shown. All regulatory signs to be installed in accordance with an approved traffic control plan shall be purchased and installed by the owner or developer of roads or streets within a subdivision in accordance with County regulations and standards prior to any such roads or streets being accepted for maintenance by the County. The Public Works Department shall remove any sign, traffic control, or other traffic control device or other structure placed in the right of way without permission from the Director. The County shall not place, install or maintain any sign regulating traffic or other traffic control device upon any private road or any publicly used roadway, which is not maintained by the County except where a privately maintained roadway intersects with a publicly maintained roadway. See Appendix A-1, Section 288, for Sign Specifications.
- 2.11 **Brush and Vegetation Control:** Persons owning real estate adjacent to County publicly maintained road right of way may cut and clear brush and mow grass and other vegetation at their own expense within County maintained roadway right of way adjacent to their property and within 30 feet of their driveways within such

right of way or as determined by **Appendix B, 1.5 Sight Distance for Driveways**. All such work shall be performed without liability for personal injury or property damage on the part of the County to persons performing such work or others who may be affected thereby. All property owners performing such work shall be solely responsible for determining the location of public right of way and for the safe conduct of work and operation of vehicles and equipment and for the removal of trash and debris. No trees over the diameter of six (6) inches measured on the trunk three (3) feet above the ground shall be cut down without the express approval of the Director or his/her designee. All work shall be performed in a manner which prevents natural or man-made obstruction to the visibility of persons using the right of way, prevents erosion to right of way and does not otherwise detrimentally affect the public right of way. Persons desiring to cut or clear trees or brush or mow grass or vegetation within public rights of way which are not adjacent to property owned by them may do so only upon issuance of a written permit authorized by the Director upon such terms and conditions set forth in such permit.

- 2.12 **Bonds:** The Director may require any permit applicant to furnish bond in the form of cash, surety or other approved deposit in such sum sufficient to secure repair and restoration of right of way in the event the applicant for permit fails to perform the obligations under the permit including final maintenance of the construction site after completion as required by these regulations. Such deposit or bond also may be conditioned upon the applicant maintaining a repaired or restored portion of the right of way under construction permit for a period of twelve (12) months from the completion and require the applicant to hold the County harmless from any costs and expense occasioned by or resulting from the use of such right of way during that time period. In addition, the Director may require any utility company or provider to post a general bond in such amount determined by the Director based on any reasonable formula which adequately secures the utility's performance over a time period based on the frequency, nature and extent of excavations made by such utility.
- 2.13 **Penalties and Remedies for Violations:** Any person who violates any requirement or provision of these regulations shall be deemed guilty of a misdemeanor pursuant to § 229.370 RSMo. and punished therefore as prescribed by law. Any person who violates any requirement or provision of these regulations may, in addition to any criminal liability thereof, be civilly liable to the County by way of restitution for such sums and costs the County incurs in repairing or restoring any right of way under construction permit or otherwise if the Director gives notice of violation to the permittee by personal delivery or regular or certified mail and a specified time to cure. Such notice shall advise the permittee of the deficiencies in work and violations of regulations hereunder and advise the permittee that the permittee shall be required to make appropriate restoration or repair within the time stated in the notice and such permittee shall be required to guarantee all such work for twelve (12) months after restoration or repair is made. In the event the permittee fails to perform the work required by the notice within the time specified by the notice, or fails to guarantee the work after it is performed, then the County may perform or cause to be performed all

remedial measures and charge the expense thereof to the permittee which expense shall be chargeable against any bond or cash deposit made by the permittee, or may be recoverable by action filed in the Circuit Court of Boone County, Missouri, for restitution for all such expenses so incurred as well as the cost of enforcement.

- 2.14 **Fees:** The County may uniformly impose right of way management fees and charges as authorized by section 67.1840 RSMo and as established and approved by County Commission order. Any person who is aggrieved by the imposition of any right of way management fee or charge and reasonably believes that any such fee or charge is not in conformity with section 67.1840 RSMo may have any such fee or charge reviewed by the County Commission upon application if such application is filed within five (5) business days of the imposition. In the event a timely application is filed with the County Commission, it shall review the matter as soon thereafter as is practicable and issue its decision and findings of fact and conclusions of law in support of its decision, and may further order any change in its fees and charges deemed appropriate. The filing of an application for review of fees and charges imposed under section 67.1840 shall not relieve a person of the obligation to pay fee or charge imposed, but upon review, the County Commission may order a refund of any fees or charges imposed, or portion thereof, if found not to be in conformity with section 67.1840. Any further review of the County Commission decision shall be as provided for in chapter 536 RSMo.
- 2.15 **Cost of Construction:** The cost of all construction activities within County right of way performed under county issued permit shall be incurred and paid by the permittee. In addition, whenever the Director deems it necessary for the public safety, health or welfare, and a part of necessary repair, maintenance or improvement work within County right of way, the Director may give all utility providers notice of the need to remove, change, or alter utilities within the right of way as specified in § 229.350 RSMo. and these regulations. All such notices shall be given as soon as practicable when the need for utility movement, relocation, or change is necessary but in no event shall notice be given in less than five (5) days prior to the date needed for such work.
- 2.16 **Road and Bridge Advisory Committee:** The Road and Bridge Advisory Committee is established and exists to accomplish the following five goals: (1) to establish short-term and long-term plans for the Public Works Department, (2) to address innovations in construction methods that apply to the Public Works Department; (3) to address inconsistencies in Public Works policy or policy interpretation; (4) to evaluate revisions to these regulations, and (5) to hear disputes and make recommendations on variance requests to any of the Appendices within these regulations. The officers of this committee shall consist of Chairperson, Vice-Chairperson, and Secretary, all of whom shall be elected annually from within the existing membership of the committee. The citizen members of the committee shall be appointed by the County Commission to serve terms of four years except that no term shall expire until a replacement member is appointed unless such member resigns or such member's membership is terminated by order of the County Commission. Four year terms of

membership for citizen members may be designated and staggered as directed by order of the County Commission to promote continuity of citizen membership. The

Committee shall meet as often as necessary to properly conduct necessary business with at least one meeting per quarter. Minutes of the meetings shall be kept and an abbreviated text of the minutes shall be forwarded to the County Commission after each meeting. All actions of the Committee shall require a quorum of at least a majority presence of the existing membership. Recommendations and other actions shall require a simple majority vote of the quorum present. The Committee is charged with the duty of hearing and deciding applications for variances from the strict application of any provision within any Appendices of these regulations. The Committee may grant a variance only if it finds after public hearing and upon competent and substantial evidence that the applicant meets the criteria for grant of a variance required by these regulations. No variance from any requirement contained within Appendices of these regulations shall be granted unless the Committee finds: (a) the applicant will incur unreasonable and unnecessary hardship if a variance is not granted and the variance is not sought primarily to avoid financial expense in complying with the requirements of these regulations (b) grant of a variance will not endanger the health, safety or welfare of the public, and (c) grant of a variance will not hinder, thwart or circumvent the general intent or any specific purpose of these regulations. All applications for variances shall be filed with the Director of Public Works and after review thereof the Director shall make a recommendation to the Committee to grant or deny the application and state the reasons for his recommendation. Either the applicant or the Director may appeal any decision of the Committee to the County Commission; any additional appeal or review shall be as provided by law.

2.17 Jurisdiction: These regulations apply to all road Right of Way to be accepted for maintenance by the County and County maintained right of way in all unincorporated areas of Boone County, Missouri except roads in areas within the jurisdiction of any special road district organized and operating under the provisions of chapter 233 RSMo.

2.18 Effective Date: These regulations shall become effective from and after the date Boone County Commission enters an order adopting these regulations.

APPENDIX A

DESIGN SPECIFICATIONS FOR NEW ROAD CONSTRUCTION

1. GENERAL SPECIFICATIONS

- 1.1 **Specifications:** Plans shall be prepared by a professionally registered engineer duly authorized to conduct business in the State of Missouri.
- 1.2 **All Roadway Construction:** All newly constructed roads, sidewalks and storm drainage shall conform to the typical drawings shown in **Appendix B-1**. The geometric requirements for roadway construction can be found in **1.10, Table A** of this section. See **Appendix A-1** for Construction and Materials Specifications and **Appendix D** for Plan Submittal Requirements.

All new road systems shall be constructed with roadways intersecting at no less than 80 degrees and no more than 100 degrees to each other.

All roadways without curb & gutter shall have a 24-inch v-bottom ditch (minimum depth, based on a 15-inch diameter CMP) with 3:1 in slopes (minimum) and 3:1 back slope (minimum). All ditch flow lines with grades of 3% or greater must have erosion control blanket installed. Blanket must be centered on flow line. If ditching is unnecessary on a section of roadway, the slope from the edge of the roadway or shoulder shall be no less than 3:1. This rule shall also apply to the slope beginning at the back of curb on curb and gutter roadways, which do not require sidewalks.

All roadways where the slopes are less than these minimums may require guardrail. The design engineer shall refer to figure 5.1 on page 5-3, Chapter 5 of the 1996 AASHTO Roadside Design Guidelines to determine whether guardrail is necessary based on slope and height of embankment. If guardrail is necessary it shall be placed such that the face of the guardrail is at either the back of curb or the edge of the shoulder and a 2 foot clear zone shall exist with the same slope as the shoulder or curb section behind the guardrail assembly.

All newly constructed roadways with no outlet shall end in a cul-de-sac, either permanent or temporary, unless the road is less than 100 feet long and less than 2 subdivision lots in depth. Roadways that are to be extended may end in temporary cul-de-sacs at the discretion of the Director. See **Drawings 110.08 –110.11** for cul-de-sac information.

- 1.3 **Alleys:** Alleys, where allowed by the Boone County Subdivision Regulations, shall be 22 feet in width with a thirty-foot minimum right-of-way. In all other respects, alleys shall conform to the pavement cross-section and geometric requirements for a local road.

1.4 **Sidewalks:** Sidewalks, where required by the Boone County Subdivision Regulations, shall be built according to **Appendix A-1, Section 234** and **Appendix B, Drawings 420, 430, 431, 432, 433 and 435.**

1.5 **Mailbox/Structures/Obstructions/Objects Within Right-of-Way:** No mailbox or newspaper delivery box (hereafter referred to as mailbox) or structures / objects will be permitted within the Boone County right-of-way which interferes with the safety of the traveling public or the function, maintenance, or operation of the roadway system.

1.5.1 **Mailbox Location:** No mailbox shall be located in a place where vehicular access to it is prohibited by law or regulation. Mailboxes shall be located on the right-hand side of the roadway in the direction of the delivery route. The bottom of the box shall be set at an elevation established by the U.S. Postal Service, usually between 42" and 48" above the roadway surface. The roadside face of the box shall be offset from the edge of the traveled way or face of curb, a minimum distance of 8" and shall not exceed 12". Notwithstanding these requirements the location and construction of mailboxes shall conform to the rules and regulations of the U.S. Postal Service. A mailbox installation that does not conform to the provisions of the regulation is an unauthorized encroachment under section 229.030, RSMo.

Mailbox installation that conforms to the following criteria will be considered acceptable unless in the judgement of the Boone County Director of Public Works the installation interferes with the safety of the traveling public or the function, maintenance, or operation of the roadway system.

1.5.2 **Shoulder and Parking Area Construction:** It will be the responsibility of the postal patron to inform the Boone County Public Works Department of any new or existing mailbox installation where shoulder construction is inadequate to permit all-weather vehicular access to the mailbox.

1.5.3 **Removal of Nonconforming or Unsafe Mailboxes / Structures / Obstructions / Objects Within Right-of-Way:** Upon notification by the Boone County Public Works Department, the owner of property containing a mailbox or other structure, object or vegetation that is found to violate the requirements of these standards or otherwise obstruct the public right of way shall be considered an unlawful encroachment and shall be subject to removal by the Department. At the discretion of the Boone County Public Works Director and based on an assessment of hazard to the public, the Director or his designee shall give the property owner or other person responsible for the unlawful encroachment not less than 24 hours, nor more than 30 days, written notice to remove or eliminate such encroachment from the right of way. If such encroachment

is not removed or eliminated within the time specified in the notice, the Department may remove the encroachment from the right-of-way.

No structure, object or vegetation which impedes sight distance from traffic or regulatory signs shall be permitted in the area between the curb and sidewalk, or edge of a roadway or its shoulder and ditch line, or otherwise placed or planted within the right-of-way.

1.5.4. Maintenance Repairs/Reconstruction: Persons who own or are responsible for the placement of mailboxes or other structures, objects, trees and other landscaping within the right of way shall be obligated to relocate or remove or eliminate any such item if necessary for performance of right of way maintenance or repairs or reconstruction. The Boone County Public Works Department shall give such persons a minimum of 48 hours notice to remove any of the above-mentioned items before work begins unless work is deemed an emergency.

1.6 Unauthorized Use of County Maintained Road Right of Way:

The deposit without prompt clean-up or removal of mud or debris, or the storage of equipment or construction materials on county maintained roads without a right of use permit is prohibited. Any person who engages in this prohibited activity, may be issued a Notice of Violation (NOV) by the Public Works Department and thereafter the responsible party shall remove such mud, debris, equipment, or construction materials specified in the NOV within 24 hours unless violation is deemed an emergency, then removal shall occur immediately. In addition to any other remedy which may be provided by law or regulation, noncompliance with such notice may result with the Boone County Maintenance Division removing or having removed such mud or debris and the cost of such removal shall paid by the responsible party. If the responsible party cannot be identified, the owner of property from which mud or debris originated (if identifiable) will be held responsible and will be issued a NOV. If mud or debris is deposited on street due to erosion, the owner of property, developer, or both, shall be deemed responsible and may be issued a NOV.

If contractor(s) wish to use county right-of-way or roadway as a staging area during construction activities, a Right of Use Permit will be required as per **Appendix C** of this regulation. A Right of Use Permit will be issued if it is determined that the activity will not interfere with the safety of local traffic. A Contractor issued such a permit must comply with directions of permit or permit will be canceled and NOV will be issued.

- 1.7 Minimum Pipe Size:** All storm water culvert pipes shall be a minimum of 15 inches in diameter. All storm water culvert pipes under roadways shall be a minimum of 18 inches in diameter.

- 1.8 **Materials Allowed (Culverts):** Reinforced Concrete Pipe (RCP), Corrugated Metal Pipe (CMP) and High Density Polyethylene (HDPE) .

Roadway Culverts

RCP and CMP. CMP shall be both zinc and polymeric coated.

Storm Sewer Culverts

RCP, CMP and HDPE.

All pipes shall be used and installed in conformance with the manufacturer's specifications and guidelines. All roadway and storm water pipes shall have mitered ends. Erosion control blanket shall be applied at all roadway inflows and outflows of each pipe if rip-rap is not required. The Erosion Control Blanket shall be the width of material and a minimum of 6- feet in length. See **Section 260** of **Appendix A-1** for Culvert Construction and Material Specifications. For driveway procedures, see **Appendix B**.

1.9 **EROSION, SEDIMENT AND STORMWATER CONTROL PLAN**

- 1.9.1 **Introduction** - This section sets forth the requirements of submitting an erosion and sediment control plan in dealing with the control of non-point source (NPS) pollution. All development and road plans submitted for approval to Boone County must be accompanied by an erosion and sediment control plan as set forth in these regulations.

1.9.2 **Definitions**

- 1.9.2.1 **Certified Contractor** - An individual who has received training and is licensed by (State or Local Environmental Agency) to inspect and maintain erosion and sediment control practices.

- 1.9.2.2 **Clearing** - Any activity, which removes the vegetative surface cover.

- 1.9.2.3 **Drainage Way** - Any channel that conveys surface runoff throughout the site.

- 1.9.2.4 **Erosion Control** - Measures that prevent erosion.

- 1.9.2.4 **Erosion and Sediment Plans** - A set of plans prepared by or under the direction of a licensed professional engineer

- 1.9.2.5 **Control Plan** - indicates the specific measures and sequencing to be used controlling sediment and erosion on a development site before, during and after construction.

- 1.9.2.6 **Grading** - Excavation or fill of material, including the resulting conditions thereof.

1.9.2.7 **Perimeter Control** - A barrier that prevents sediment from leaving a site either by filtering sediment-laden runoff, or diverting it to a sediment trap or basin.

1.9.2.8 **Phasing** - Clearing a parcel of land in distinct phases, with the stabilization of each phase before the clearing of the next.

1.9.2.9 **Sediment Control** - Measures that prevent eroded sediment from leaving the site.

1.9.2.10 **Site** - A parcel of land, or a contiguous combination thereof, where grading work is performed as a single unified operation.

1.9.2.11 **Stabilization** - The use of practices that prevent exposed soil from eroding.

1.9.2.11 **Start of Construction** - The first land-disturbing activity associated with a development, including land preparation such as clearing, grading and filling; installation of streets and walkways; excavation for basements, footings, piers or foundations; erection of temporary forms; and installation of accessory buildings such as garages.

1.9.2.12 **Watercourse** - Any body of water, including, but not limited to lakes, ponds, rivers, streams, and bodies of water which delineated by Boone County.

1.9.2.13 **Waterway** - A channel that directs surface runoff to a watercourse, or to the public storm drain.

1.9.3 Requirements of the Erosion and Sediment Control Plan

All persons who disturb land that would result in the requirement to obtain a Land Disturbance Permit per the Missouri Department of Natural Resources (MoDNR)- Water Pollution Control Program, must submit a copy of Form G- Application for Storm Water Permit and Form E- General Permit: Land Disturbance; along with the Storm Water Pollution Prevention Plan (SWPPP) to the Boone County Public Works department for review. If the MoDNR approves the application, a copy of the approval letter must be forwarded to the Boone County Public Works Department.

1.9.3.1 A brief narrative to include:

1.9.3.1.1 Project description (purpose, size of area to be disturbed, and location).

- 1.9.3.1.2 Before and after site description (topography, principal drainage way for the site, land cover condition, percent of impervious area, and the associated increase of runoff volume from a 25-year 24-hour storm event).
- 1.9.3.1.3 Adjacent property. (This should include the identification of land use and cover conditions.)
- 1.9.3.1.4 Soils descriptions.

1.9.3.2 Planned Best Management Practices to include:

- 1.9.3.2.1 Beginning and completion date of construction activities.
- 1.9.3.2.2 A sequence of all construction-related BMP and vegetative activities. Include any winter shutdowns.
- 1.9.3.2.3 A pre-construction conference is recommended and should be scheduled one week prior to land disturbance to orientate contractors to the erosion, sediment, and storm water control plan. Notice of the pre-construction conference date should be provided to Public Works one week prior to the meeting.
- 1.9.3.2.4 A listing of erosion and sediment control BMPs to minimize pollution during construction along with location and installation schedule for each.

1.9.3.3 Operation and Maintenance (O&M) plan for BMPs.

- 1.9.3.3.1 Temporary measures: a plan for the schedule of maintenance during construction along with any operational criteria.
- 1.9.3.3.2 Permanent measures: a plan for the long term maintenance and operation including entities responsible, financial obligations for continued O&M, designated access for maintenance, and schedule of O&M activities.
- 1.9.3.3.3 Maintenance during and after construction may include practice re-establishment, repair, sediment removal, mowing, etc.

1.9.3.4 Detailed drawings and specifications of BMPs with supporting calculations

- 1.9.3.4.1 Detailed drawings can be utilized along with standard engineering drawings of structures and measures so long as site specific elevations, dimensions, etc., are shown on drawings. A recommended resource is the field manual entitled “Protecting Water Quality”, available through the MoDNR Technical Assistance Program.

- 1.9.3.4.2 Support data and calculations should be sufficient to allow reviewers to reproduce design procedure of structures and measures. Sources of information should be cited.
- 1.9.3.4.3 One permanent benchmark should be clearly labeled on drawings. If elevations are tied to a USGS benchmark, description and elevation of benchmark will be provided.
- 1.9.3.5 **Vicinity USGS Quad Map** - This map should identify the location of:
 - 1.9.3.5.1 Land disturbing activity.
 - 1.9.3.5.2 Site storm water discharge.
- 1.9.3.6 **Site Topographic Map** - This will provide pre-construction site topography while locating drains, property lines, construction work limits, and any utilities. Scale will be no less than 1"=60'. Trees to be preserved will be located on this map.
- 1.9.3.7 **Site Development Map**- This map should identify the location of buildings and associated paved areas, raw materials or finish product stock pile areas, equipment storage areas, processing areas, construction entrances, access or haul roads, and finished grades on a duplicate of the site topographic map. See **Appendix E** for sample checklist for site plan map preparation.
- 1.9.3.8 **Site erosion, sediment, and storm water control map** - This map should identify the location of all the BMPs (temporary and permanent) on a duplicate of the site topographic map along with the location of all permanent construction and associated paved areas and finished grades.
- 1.9.3.9 **Name, address, and telephone number** of the contact personnel responsible for developing and implementing the plan.
- 1.9.3.10 **A continuing education plan** for all employees to inform them of plan requirements is recommended.
 - 1.9.3.10.1 As work progresses and various subcontractors and/or new employees are brought into the work site, each should be familiarized with plan. At the beginning of each workweek, scheduled items of the plan to be implemented during that week should be brought to the attention of the impacted work force.

- 1.9.3.10.2 For post construction assurance and responsibility, operation and maintenance training will be provided to personnel responsible for continued operation of the plan after the project is completed. This should include an annual review of schedule for maintenance activities.

1.9.4 Inspection

- 1.9.4.1 Boone County Public Works or designated agent shall make inspections as hereinafter required and shall either approve that portion of the work completed or shall notify the contractor wherein the work fails to comply with the erosion and sediment control plan as approved. The approved Plans for grading, stripping, excavating, and filling work bearing the stamp of approval of the Boone County Public Works Department shall be maintained at the site during the progress of the work. In order to obtain inspections, the contractor shall notify the department at least two (2) working days before the following:

- 1.9.4.1.1 Start of Construction
- 1.9.4.1.2 Erosion and sediment control measures are in place and stabilized.
- 1.9.4.1.3 Site Clearing has been completed
- 1.9.4.1.4 Rough Grading has been completed
- 1.9.4.1.5 Final Grading has been completed
- 1.9.4.1.6 Close of the Construction Season
- 1.9.4.1.7 Final Landscaping

- 1.9.4.2 The contractor or his/her agent shall make regular inspections of all control measures in accordance with the inspection schedule outlined on the approved erosion and sediment control plan(s). The purpose of such inspections will be to determine the overall effectiveness of the control plan, and the need for additional control measures. All inspections shall be documented in written form and submitted to Public Works Department at the time interval agreed to at the pre-construction meeting. See **Appendix E** for a sample checklist for site inspection purposes.

- 1.9.4.3 Boone County Public Works or its designated agent shall enter the property of the applicant as deemed necessary to make regular inspections to ensure the validity of the reports filed under Section 1.9.4.2 above.

1.9.5 Enforcement

1.9.5.1 In the event that any person holding a set of approved erosion and sediment control plans pursuant to these regulations, violates the terms of these regulations, or implements site development in such a manner as to materially adversely affect the health, welfare, or safety or persons residing or working in the neighborhood or development site so as to be materially detrimental to the public welfare or injurious to property or improvements in the neighborhood, Boone County Public Works Department or its designee, may suspend or stop the site development work progress.

1.9.5.2 No person shall construct, enlarge, alter, repair, or maintain any grading, excavation, or fill, or cause the same to be done, contrary to or in violation of any terms of these regulations. Any person, partnership, or corporation violating any of the provisions of these regulations, shall be subject to bearing all costs of penalties and damages associated with the applicable provisions prescribed by law.

1.10 **DESIGN CRITERIA FOR STORM WATER DRAINAGE FACILITIES**
See **Appendix F**

1.11 **ROAD CONSTRUCTION STANDARDS** - All new roads constructed within the unincorporated areas of Boone County shall be constructed in accordance with the specifications and standards as shown in **Table A** of this section.

TABLE A

ROAD CONSTRUCTION MINIMUM STANDARDS				
	Arterial	Collector	Local	Commercial / Industrial
ADT	>2500	750-2500	<750	By Land Use
Right of Way Width	100 ft.	66 ft.	50 ft.	66 ft.
Cul-de-sac R.O.W. Radius	N/A		47 ft.	66 ft.
Paving	Yes			
Curb and Gutter	See note #1			Yes
Design Speed	40 mph	30 mph	30 mph	30 mph
Minimum Pavement Radius at Intersecting Streets	30'			
Minimum Curve Radius	730 ft.	575 ft.	100 ft.	250 ft.
Maximum Grade	7%	8%	10%	7%
Minimum Grade	1 %			
Stopping Sight Distance	275-325 ft.	200 ft.		
K Value - Sag Curves	60-70	40		
Clear Zone	10 ft.			
Driveway Locations	See Appendix B-1, Drawings 410.01A & 410.01B			
Bridge Design Loading	HS20-44/3S2			
Roadway Cross-Sections	See Appendix B-1, Drawings 110.01-110.11			

NOTES:

1. **Curb and gutter** requirements for new subdivisions will be stated in the Boone County Land Use Regulations, Chapter I, Subdivision Regulations dated June 17, 1995 as amended.
2. **All Corner Lots** – Driveway approaches and sidewalks shall be placed according to these regulations before roadways will be accepted for maintenance.
3. **All utilities** to be located within Right of Way must be installed before roadways will be accepted for maintenance.
4. **All cul-de-sacs** shall be less than 1000 feet from the nearest street that has 2 outlets within the roadway system. Distance is measured from the centerline of the adjacent street to the center of the cul-de-sac.
5. **In cases** where the Subdivision Regulations and the Roadway Regulations conflict, the most stringent Standard shall apply

Appendix B Driveway Locations and Culverts

1.1 GENERAL INFORMATION - An application for a Right of Way Access Permit (driveway) must be obtained from the Planning and Building Inspection Department (P&B), prior to constructing any driveway entrance (temporary or permanent). Driveway location must be approved by the Public Works Department before P&B will approve foundation. Driveway culverts shall be located as per **Drawing 410.04** or as directed by the Public Works Department. Driveway culvert pipe sizes must be approved by a representative of the Public Works Department prior to installation. The minimum pipe size shall be 15 inches in diameter and the minimum pipe length shall be 24 feet. A 12 inch CMP will be authorized only in situations where it is determined to be appropriate by the Public Works Department. Pipe specifications shall meet **Section 260.3.4 of Appendix A-1, Construction & Materials Specifications**.

Culvert pipes greater than 30 ft. in length shall increase one pipe size in diameter. No pipe longer than 50' shall be installed without prior approval by the Department of Public Works. All driveways shall be constructed in such a manner as to not direct drainage onto the roadway. Culverts not meeting the specifications and/or causing drainage problems will be removed as necessary to correct the drainage problems. Costs of new culvert installations shall be borne entirely by the property owner.

All driveway culverts shall be annular riveted corrugated metal pipes with a minimum of zinc coating.

1.2 DRIVEWAY LOCATIONS – Driveway Locations shall be defined as the distance from the point of curvature or end of triangular driveway flare to either the next driveway's point of curvature or end of triangular driveway flare or the point of curvature of an intersecting roadway. The minimum distances for which accesses will be allowed are shown in Standard **Drawings 410.01A and 410.01B**.

1.3 GEOMETRICS

1.3.1 ENTRANCE ONTO CURB AND GUTTER STREETS -

Driveway locations shall meet the geometric requirements as shown on Standard **Drawings 410.01 A , 410.02, 410.03 and 410.05**.

1.3.2 ENTRANCES ONTO NON-CURB AND GUTTER ROADWAYS –

Driveway locations shall meet the geometric requirements as shown on Standard **Drawings 410.01B and 410.04**.

1.4 INSTALLATION OF DRIVEWAY CULVERTS - It will be the responsibility of the permit holder to purchase all materials and to install the driveway culvert. The Public Works Department shall determine pipe diameter size, final location of pipe

and determine any other special conditions, that exist which may warrant additional work based upon stopping sight distance and drainage requirements.

A representative from the Public Works Department shall inspect the installation within five (5) business days of notification of completion by the permit holder. When major road improvements (not considered normal maintenance by the Public Works Department) are performed and/or contracted by the County, the County shall be responsible for upgrading driveway entrances and drainage improvements to meet these regulations. Any variance from this policy must follow the procedures as established for a variance as stated in this regulation.

1.5 SIGHT DISTANCE FOR DRIVEWAYS

Preparation for issuing a driveway permit must include a prior inspection of the driveway site to insure that vehicles can enter and exit from the proposed driveway with a minimum hazard and disruption of traffic along the roadway. Sight distance for driveway construction should be considered essential in the design of commercial or industrial type driveways and desirable with respect to residential driveways. If there is a request to construct a driveway at a reasonable location, a traffic study must include an on-site inspection to evaluate the sight distance.

There are two basic concerns of responsibility when considering the sight distance requirements for any driveway. The first concern is to provide maximum safety for the motoring public. The second concern is to provide for access to the adjacent property owners. Vertical and horizontal alignments of many existing roadways are based on 30 mph design speed while the posted speed is often higher.

Fortunately, adjacent property owners who are constructing new driveways to an existing route, are usually anxious to consider the safest location for a driveway.

The following criteria based on the American Association of State Highway and Transportation Officials (AASHTO) guidelines and the Design Manual has been developed in order to establish a uniform method of determining the Minimum Entrance Stopping Sight Distance for a driveway constructed by permit. The sight measurement is based on a 3.5-foot height of eye and a 4.25-foot height of object. The use of the 4.25-foot object is based on fact that typically the only change in the roadway is that there is now an additional entrance to the roadway and a vehicle is the expected object using the driveway and the existing route.

If the Minimum Entrance Stopping Sight Distance is not met, the permit will not be approved. An appeal may be made to the Road and Bridge Advisory Committee

Both vertical and horizontal alignment can limit sight distance. In order to measure actual sight distance limited by vertical alignment (**See Appendix B-1, Drawing 410.01C**), place a sighting target 4.25 feet above the edge of pavement at a point 12 feet from the edge of pavement (approximate location of a driver approaching the

roadway) at the proposed driveway location. Sighting from a height of 3.5 feet, move along the roadway away from the proposed driveway site to a point beyond where the target disappears. Now move toward the target until it can first be seen and place a mark on the pavement. Measure the distance along the roadway between the mark and the target. Measurement may be made with an accurate measuring device mounted on an automobile. This measured distance is the sight distance.

Horizontal Sight Distance (**See Appendix B-1, Drawing 410.01C**) is determined by placing a target 4.25 feet above the edge of pavement and 12 feet from the edge of pavement at the proposed driveway location. Move away from the target along the roadway and around the horizontal curve until the target is out of sight or the line of sight is beyond the right of way limits. The line of sight must stay within the limits of the right of way. Consideration may also be given to vegetation both on the right of way and adjacent to the right of way as it may impede vision more at one time of the year than another. Sighting from a height of 3.5 feet, move along the roadway toward the target until it can first be seen and place a mark on the pavement. Measure the distance to the driveway target along the roadway. This measured distance is the sight distance.

Posted speed at horizontal curves may be used to determine required sight distance for driveways within the limits of a horizontal curve.

Even when the applicant is present, sight distance measurements in terms of feet may be difficult for an applicant to understand when it comes to getting on and off the roadway. A measurement of time lapse may help the applicant get a better understanding of critical nature of the situation.

A sight distance visibility time for the driver exiting a driveway to see an approaching vehicle can be used. A value of 7 seconds enables a stopped passenger car to cross a 2-lane highway. A value of 10 seconds allows vehicles exiting the driveway to turn left or right onto 2-lane roads without interference (slowing down) of through traffic at speeds up to 30 mph. At speeds greater than 30 mph, the value of 10 seconds will require some slowing of through traffic.

Trucks require greater sight distance than needed for passenger cars, however, the greater driver eye height, typically over 6 feet, provides an allowance for vertical curve conditions. If the obstruction to a sight is a horizontal curve or other lateral blockage, a 50% increase in visibility is recommended.

Grading of the right of way to improve sight distance should be considered by the applicant.

SIGHT DISTANCE REQUIREMENTS

Posted Speed (MPH)	Minimum Entrance Stopping Sight Distance
30	200
35	225
40	275
45	325
50	375
55	425
60	525
65	600
70	700

The above distances are based on Table III-1 and Figure IX-41 of the AASHTO Green Book 1994 edition.

1.6 CULVERT POLICY PROCEDURE

- A. An application for a driveway permit shall be applied for at the Boone County Planning and Building Inspections Department.
- B. A copy of the application will be forwarded to the Public Works Department for processing.
- C. The applicant shall contact the Public Works Department at 573-449-8515 to schedule an appointment for review of the proposed installation site.
- D. A Boone County Public Works representative shall, upon meeting with the applicant and reviewing the location, issue a permit with written requirements for culvert installation. The requirements shall include pipe diameter, length of pipe, flow line direction, minimum depth of cover and any other special circumstances that may need to be addressed.
- E. The permit holder shall install the culvert pipe as per **Appendix B-1, Drawing 410.04**. Upon completion, the permit holder shall notify the Public Works Department for a final inspection.
- F. Within five (5) Business days after notification of completion, a representative shall inspect the installation and record his/her findings on the permit. If the installation is found to be deficient, the representative shall supply the permit holder with a list of the deficiencies. When corrected, the permit holder will notify the Public Works Department to prompt a re-inspection. If the installation is found to be satisfactory, the representative shall forward a copy of the closed permit to the Planning and Building Inspections Department.
- G. The Planning and Building Inspections Department will note that the driveway permit requirements have been satisfied.
- H. Driveway location must be approved by Boone County Public Works before Planning and Building Inspections will allow footings to be poured.

Appendix B-1

Standard Construction Drawings

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TYPICAL STREET SECTIONS

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110.02	Local Road with Curb and Gutter
110.03	Collector Road with Shoulders
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110.05	Arterial Road with Shoulders
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	400.02	Curb Details – Residential Driveways
	400.03	Curb Details – Commercial Driveway
Driveways	410.01A	Driveway Locations with Curb and Gutter

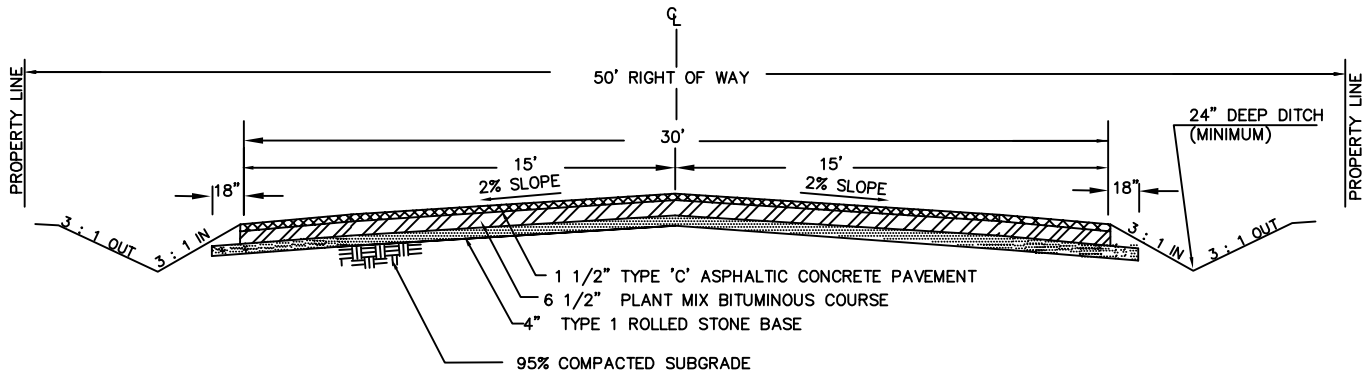
Standard Construction Drawings (Continued)

	410.01B	Driveway Locations without Curb and Gutter
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Standard Construction Drawings (Continued)

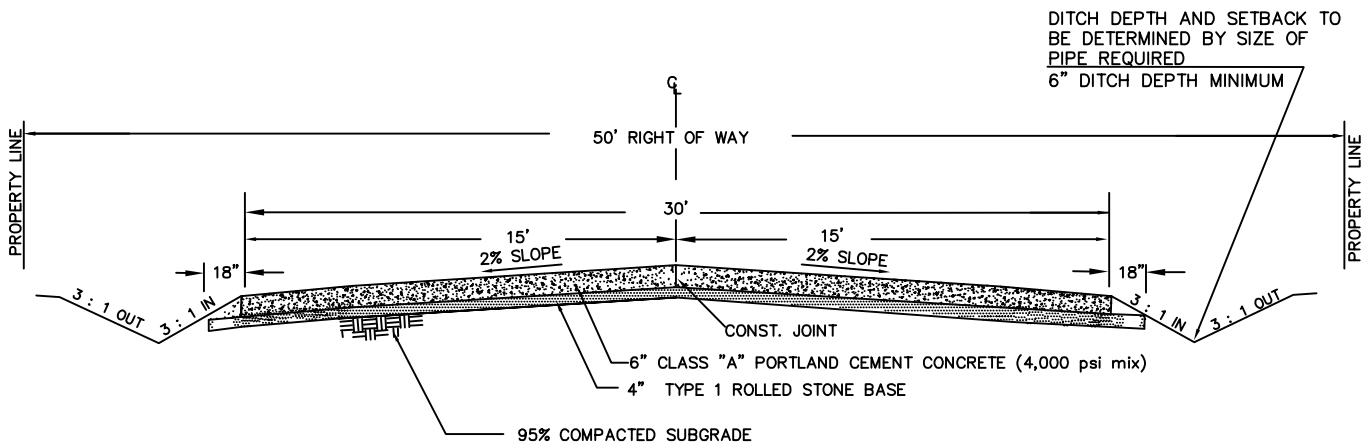
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	500.02	Drainage Structure Invert
	500.03	Inlet Opening Trash Rack
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ASPHALT PAVEMENT WITH SHOULDERS

NTS



CONCRETE PAVEMENT WITH SHOULDERS

NTS

JPW-II

Approved

1/29/09

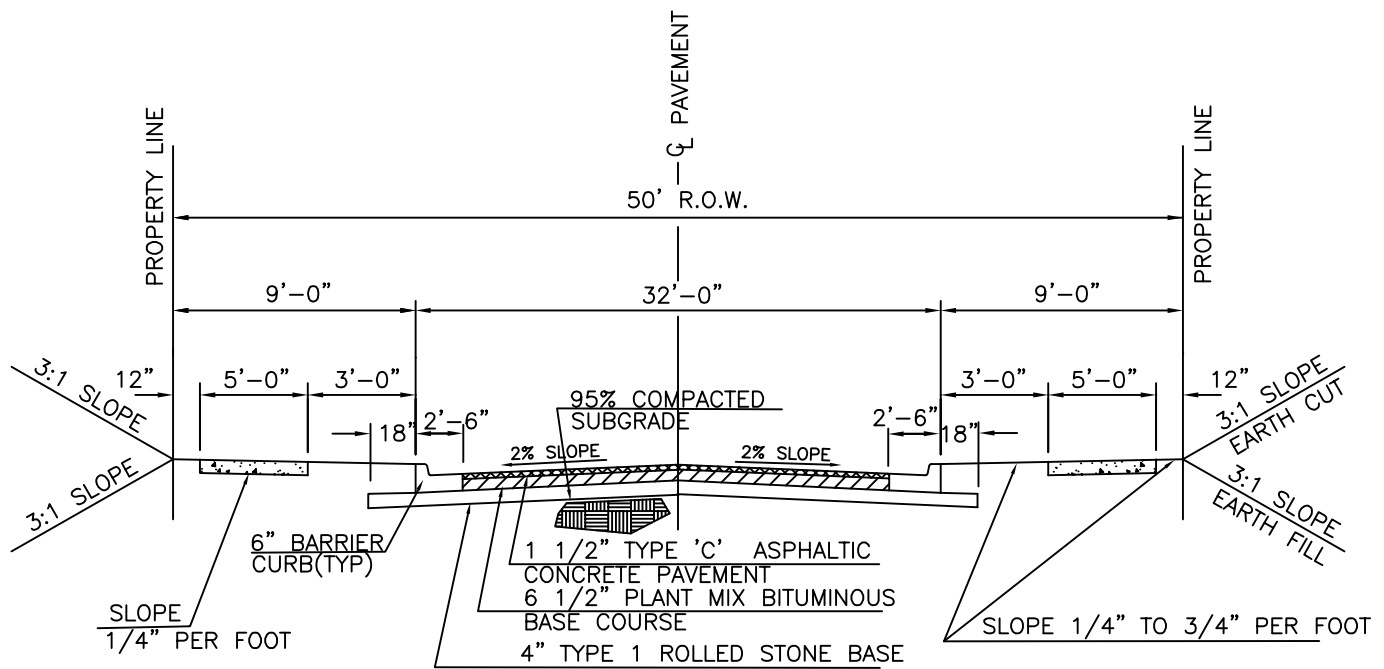
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Revisions

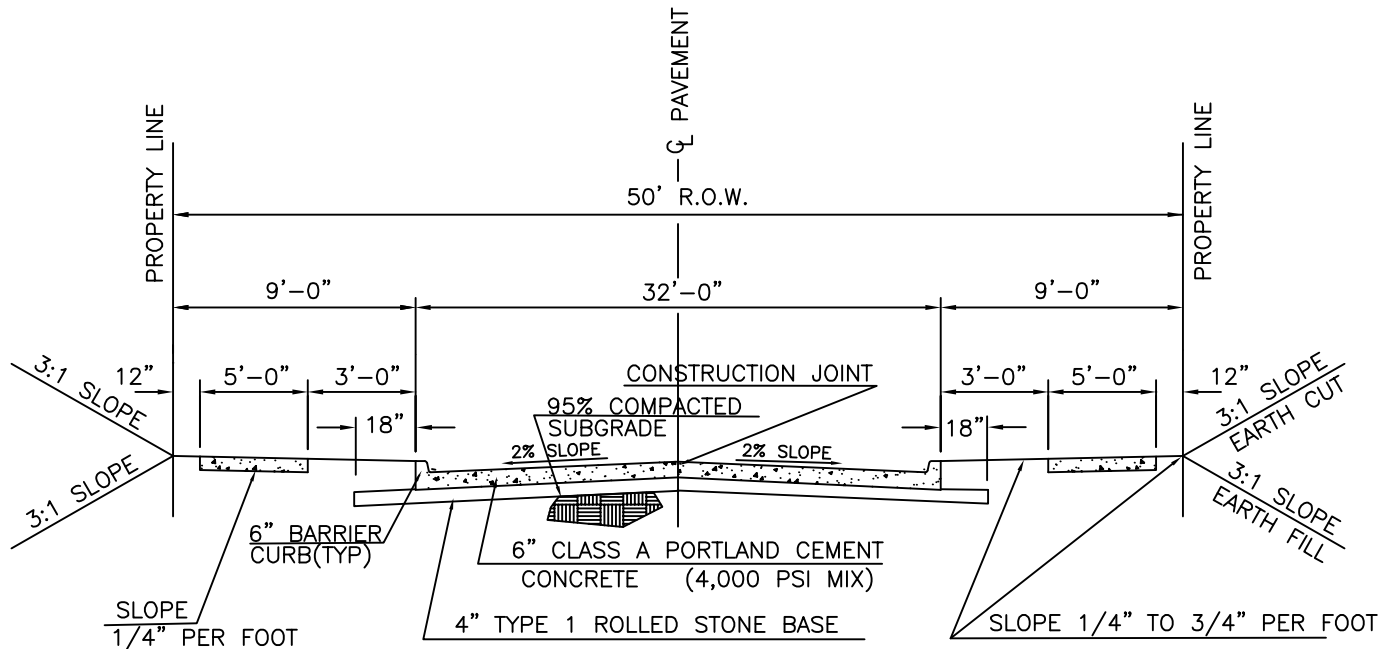


LOCAL ROAD
WITH SHOULDERS
TYPICAL CROSS SECTIONS

110.01



32 FT. ASPHALT PAVEMENT
(Standard)



32 FT. P.C.C. PAVEMENT
(Standard)

JPW-II

Approved

1/29/09

Date

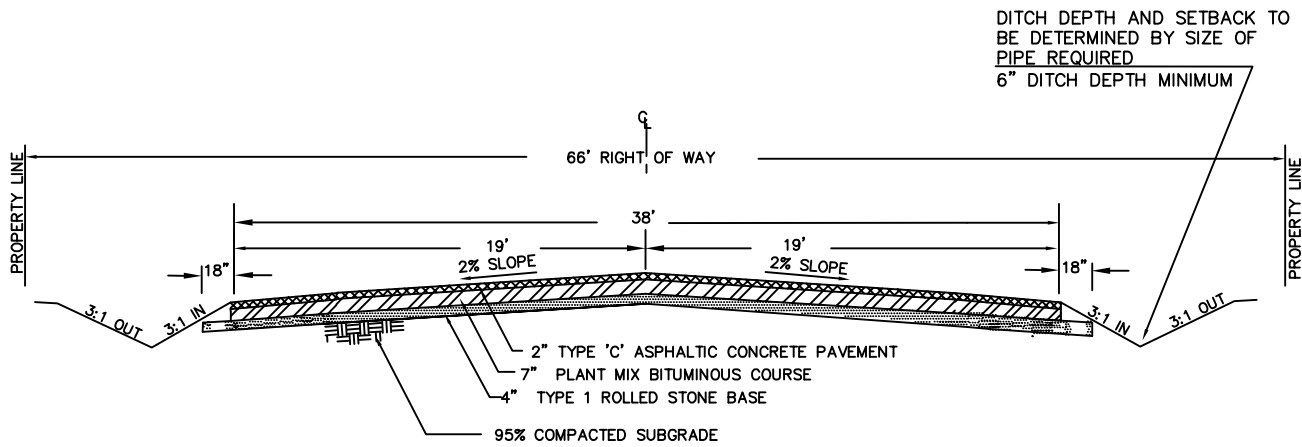
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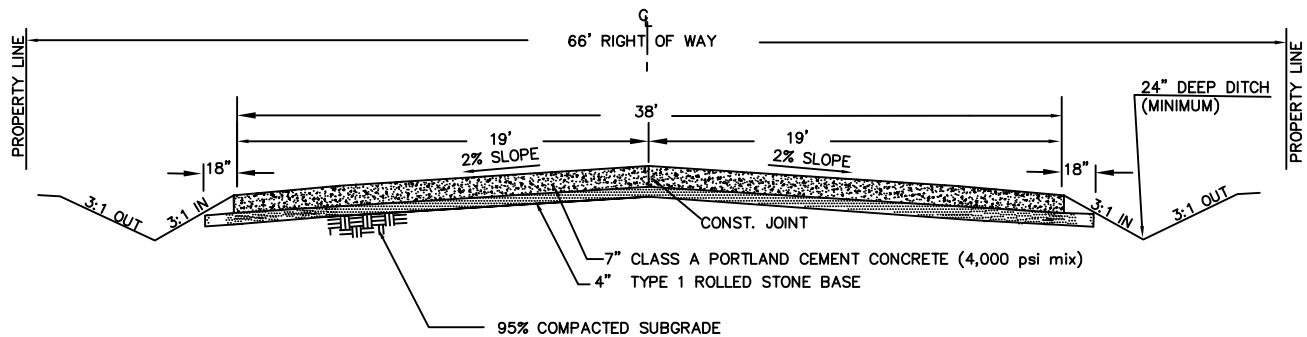
LOCAL ROAD WITH CURB AND GUTTER TYPICAL CROSS SECTIONS

110.02



ASPHALT PAVEMENT WITH SHOULDERS

NTS



CONCRETE PAVEMENT WITH SHOULDERS

NTS

JPW-II

Approved

1/29/09

Date

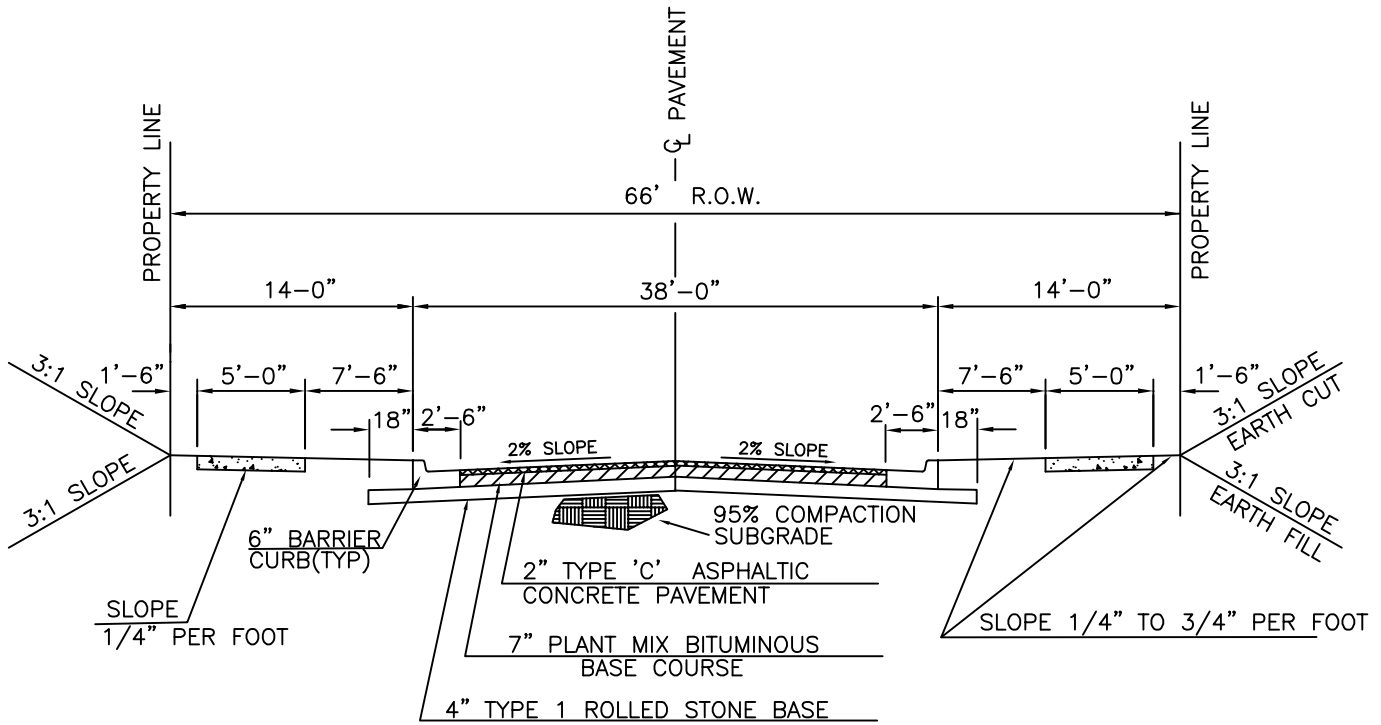
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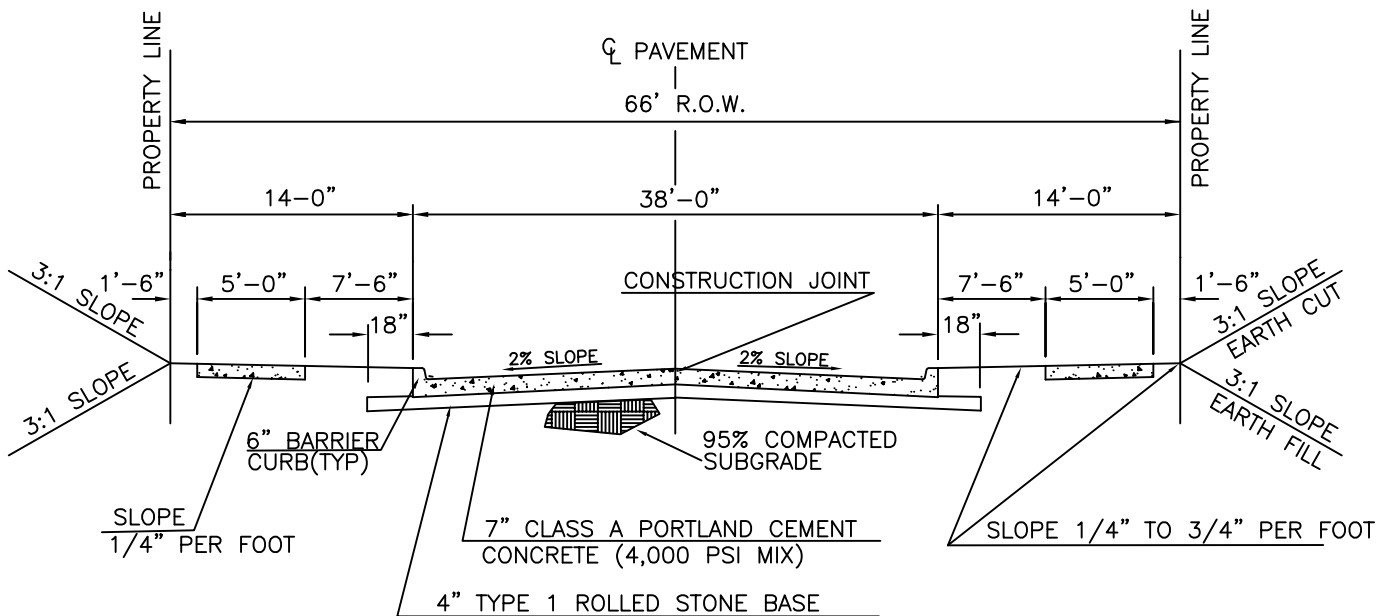
PUBLIC WORKS

COLLECTOR ROAD WITH SHOULDERS TYPICAL CROSS SECTIONS

110.03



38 FT. ASPHALT PAVEMENT
(Standard)



38 FT. P.C.C. PAVEMENT
(Standard)

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Approved

1/29/09

Date

Revisions

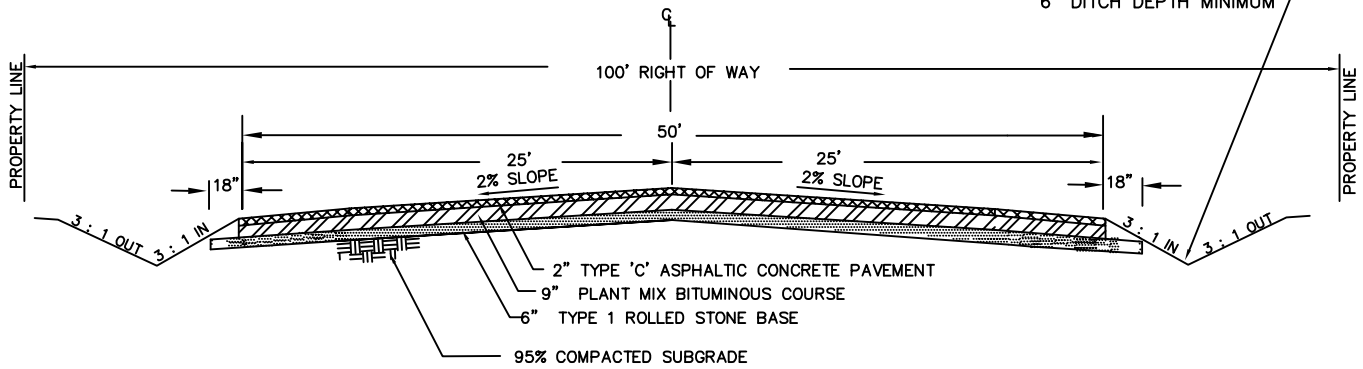


COLLECTOR ROAD WITH
CURB AND GUTTER
TYPICAL CROSS SECTIONS

110.04

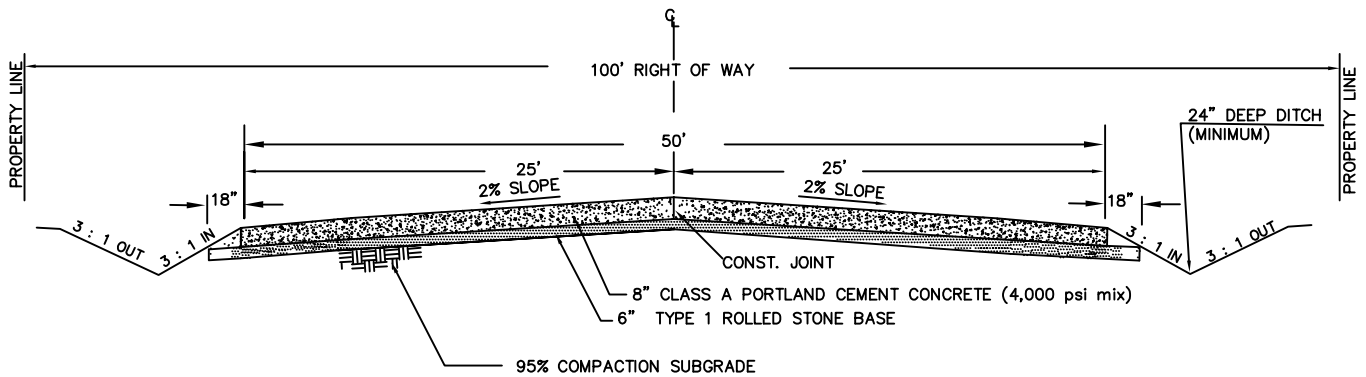
APPENDIX B-1

DITCH DEPTH AND SETBACK TO
BE DETERMINED BY SIZE OF
PIPE REQUIRED
6" DITCH DEPTH MINIMUM



ASPHALT PAVEMENT WITH SHOULDERS

NTS



CONCRETE PAVEMENT WITH SHOULDERS

NTS

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Approved

1/29/09

Date

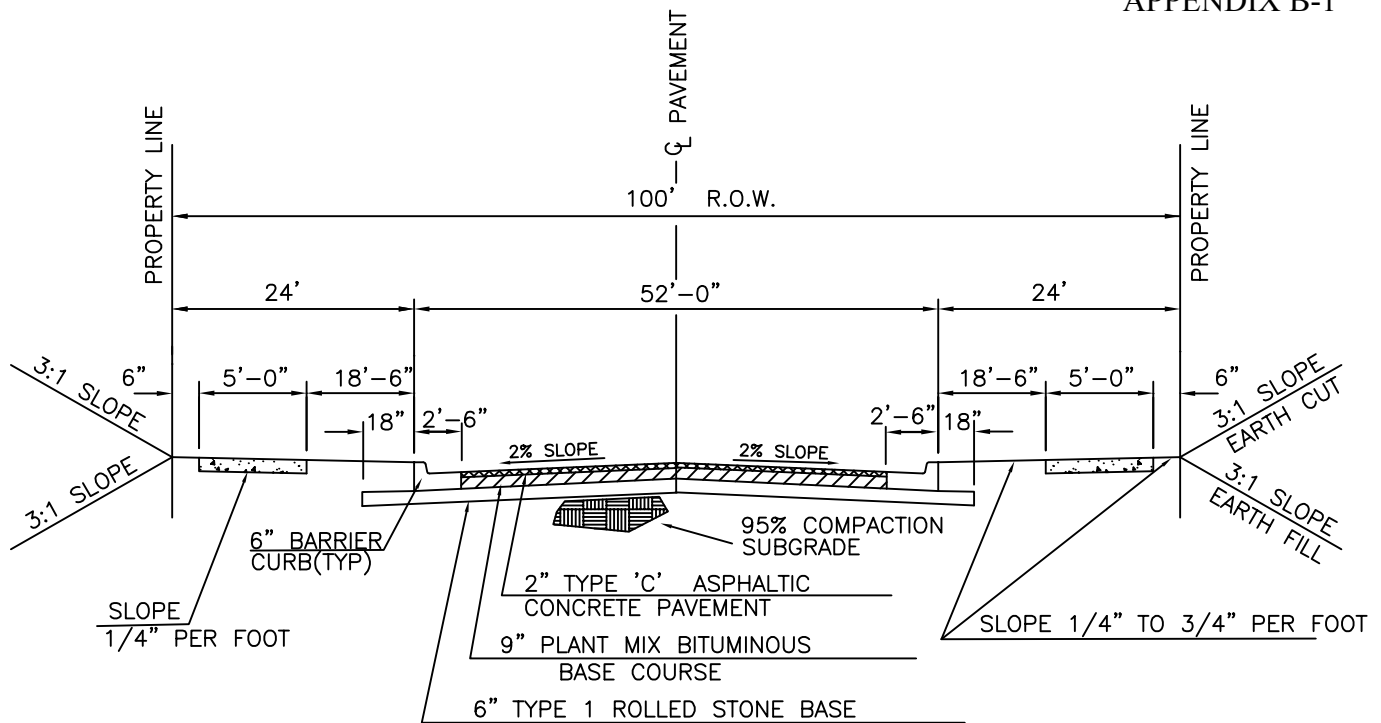
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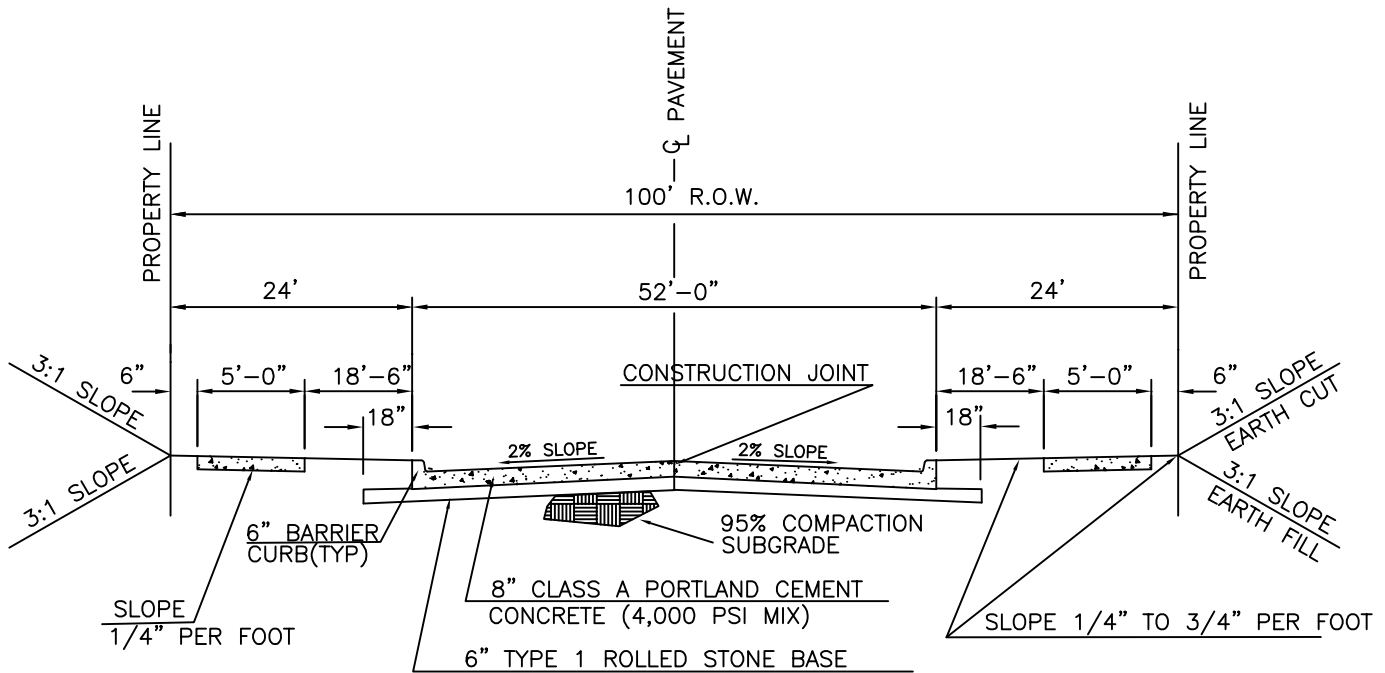
PUBLIC WORKS

ARTERIAL ROAD WITH SHOULDERS TYPICAL CROSS SECTIONS

110.05



52 FT. ASPHALT PAVEMENT
(Standard)



52 FT. P.C.C. PAVEMENT
(Standard)

JPW-II

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1/29/09

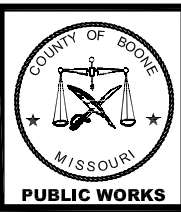
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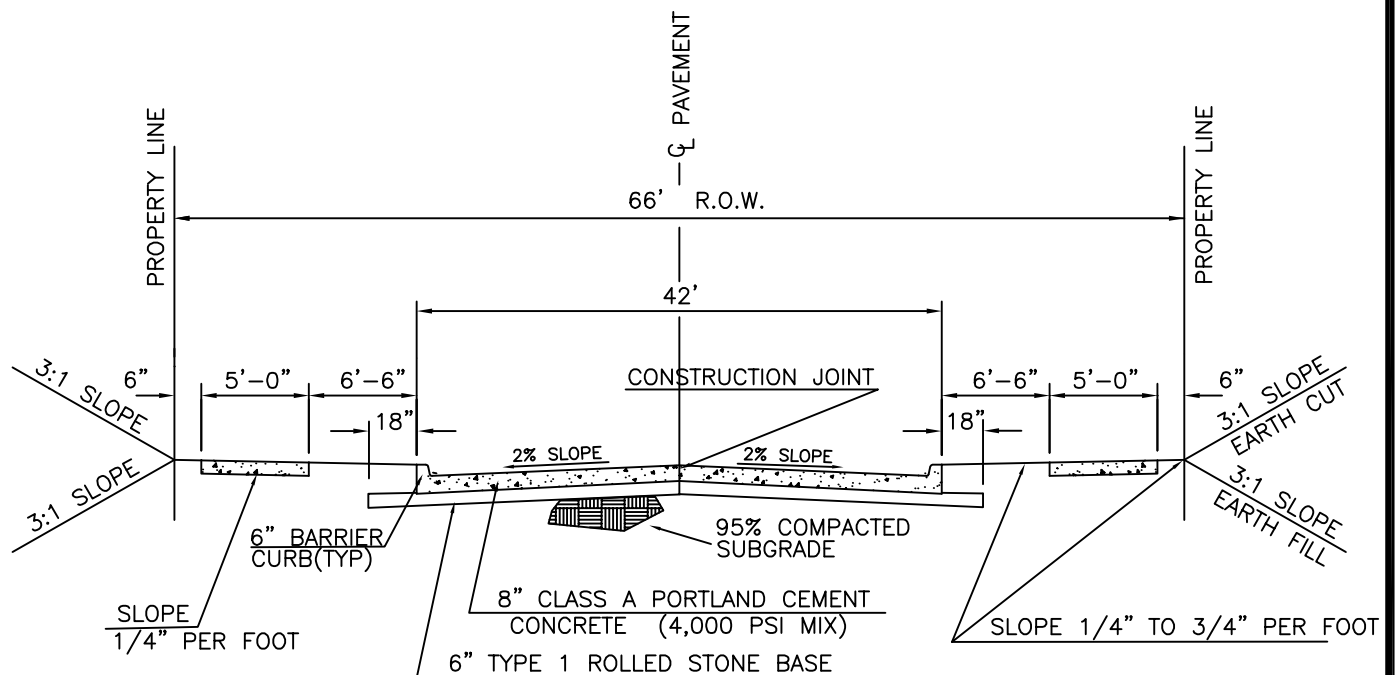


ARTERIAL ROAD
WITH CURB AND GUTTER
TYPICAL CROSS SECTIONS

110.06



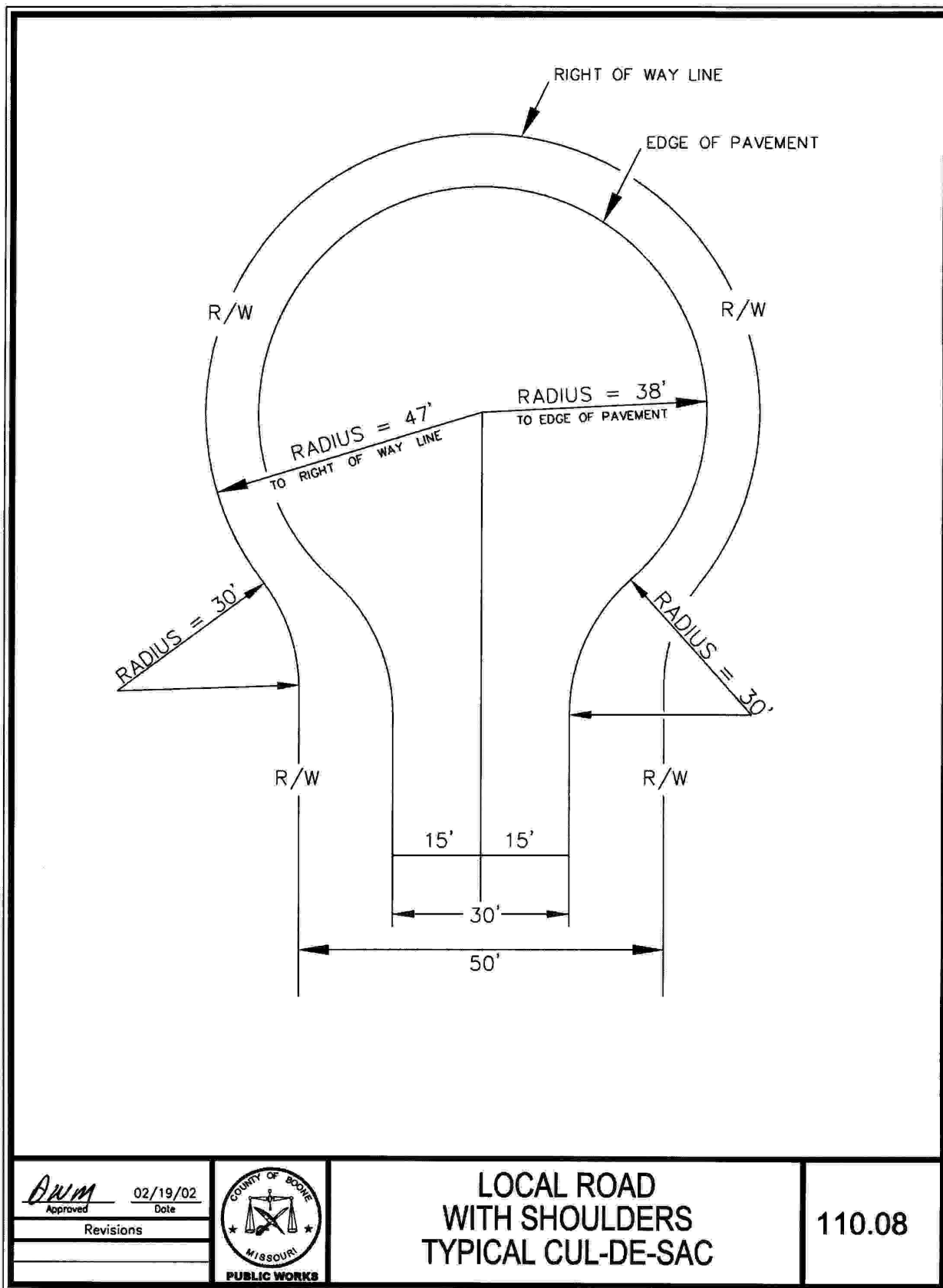
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(Standard)

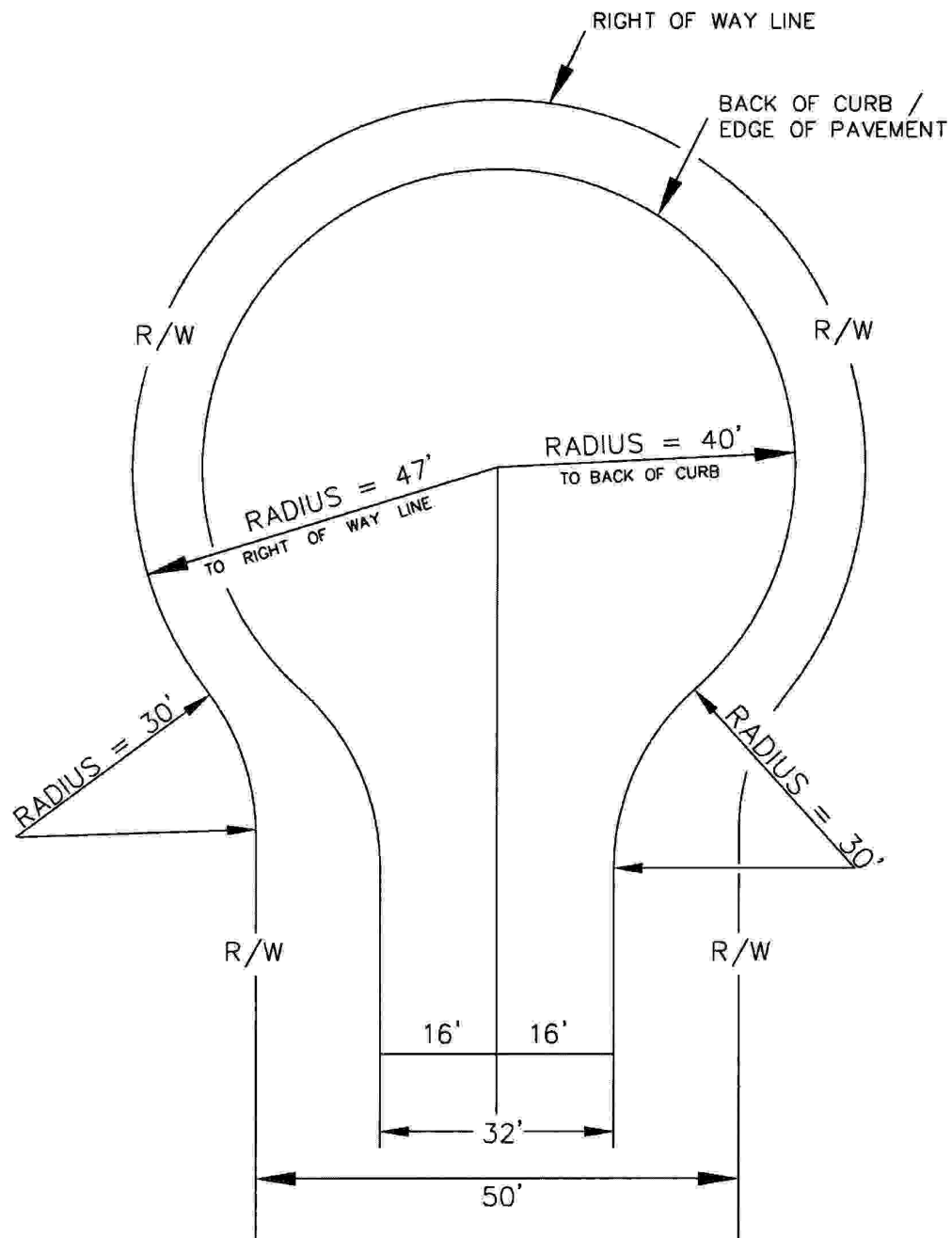


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(Standard)

COMMERCIAL / INDUSTRIAL CURB AND GUTTER TYPICAL CROSS SECTIONS

110.07





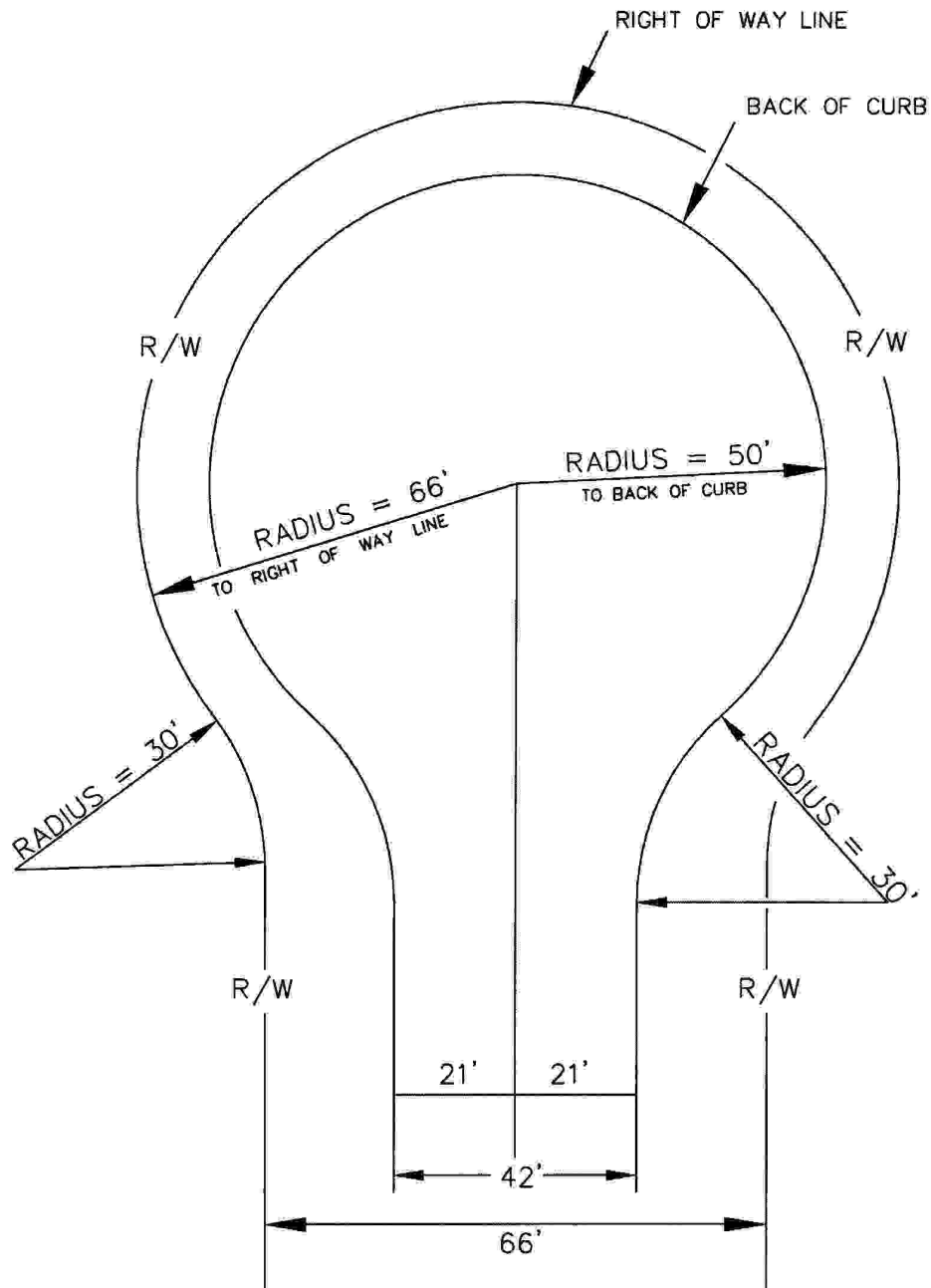
DWM 02/19/02
Approved Date

Revisions



LOCAL ROAD WITH CURB AND GUTTER TYPICAL CUL-DE-SAC

110.09

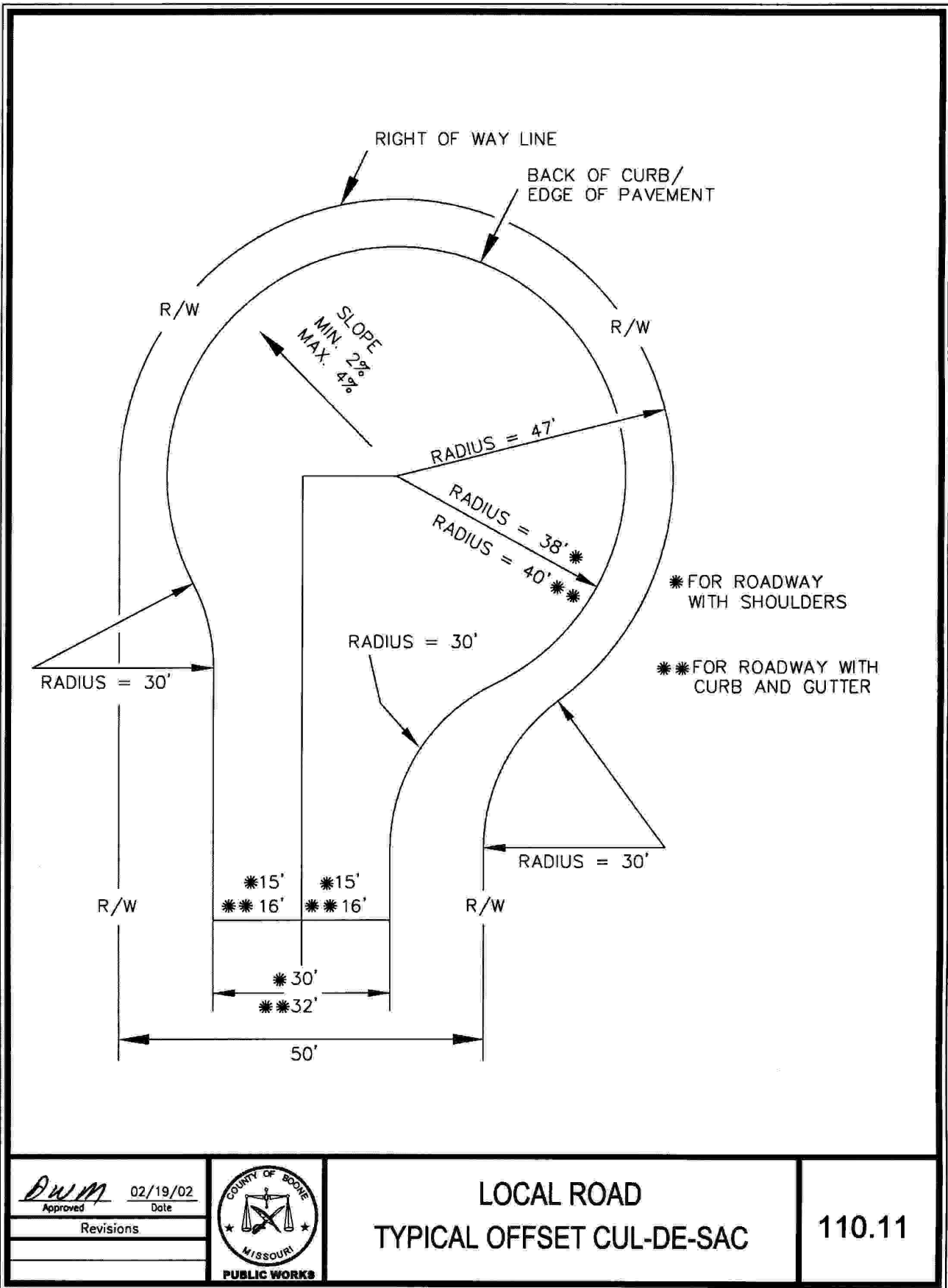


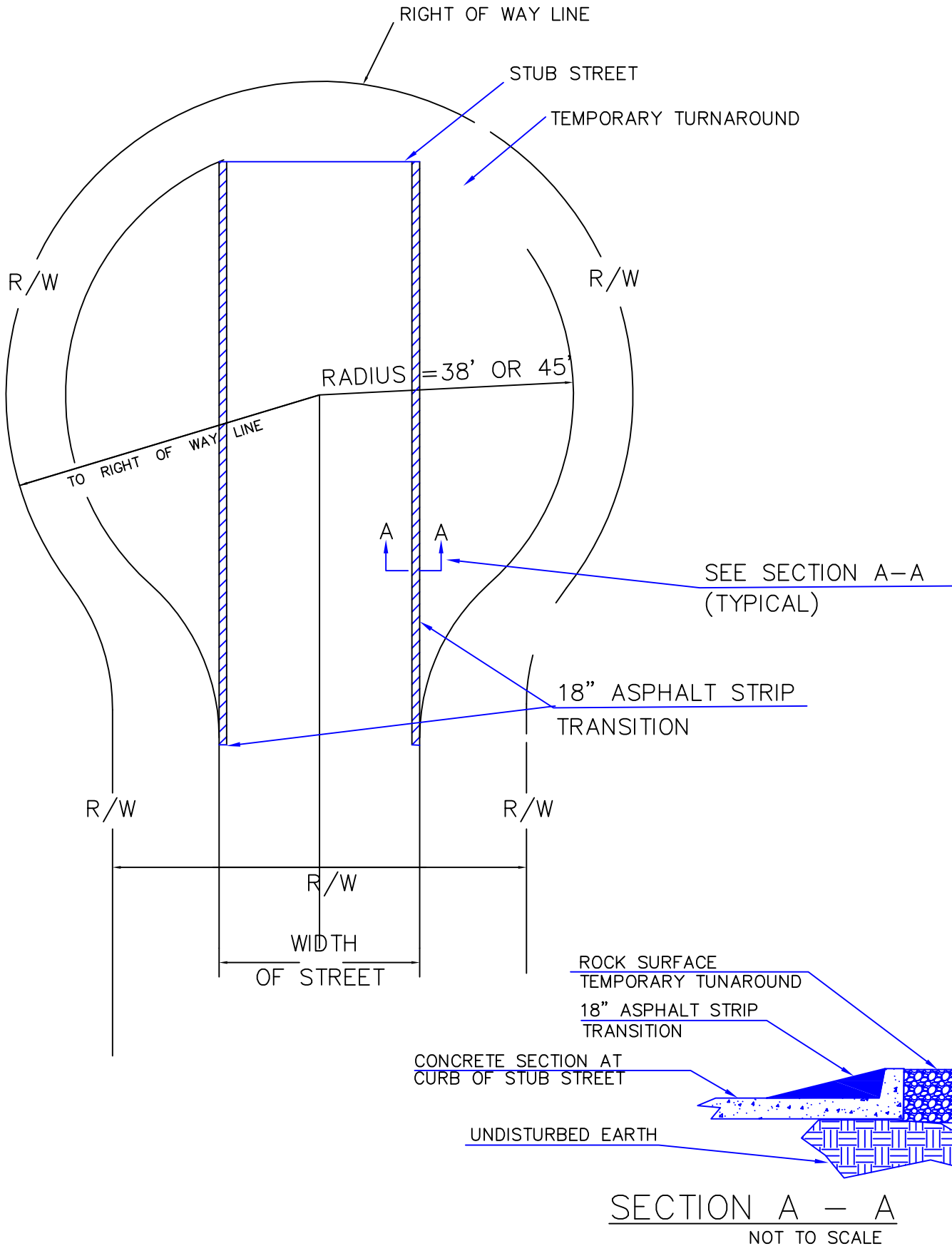
BWM 02/19/02
 Approved Date
 Revisions



**COMMERCIAL / INDUSTRIAL ROAD
 WITH CURB AND GUTTER
 TYPICAL CUL-DE-SAC**

110.10





JPW-II

Approved

1/29/09

Date

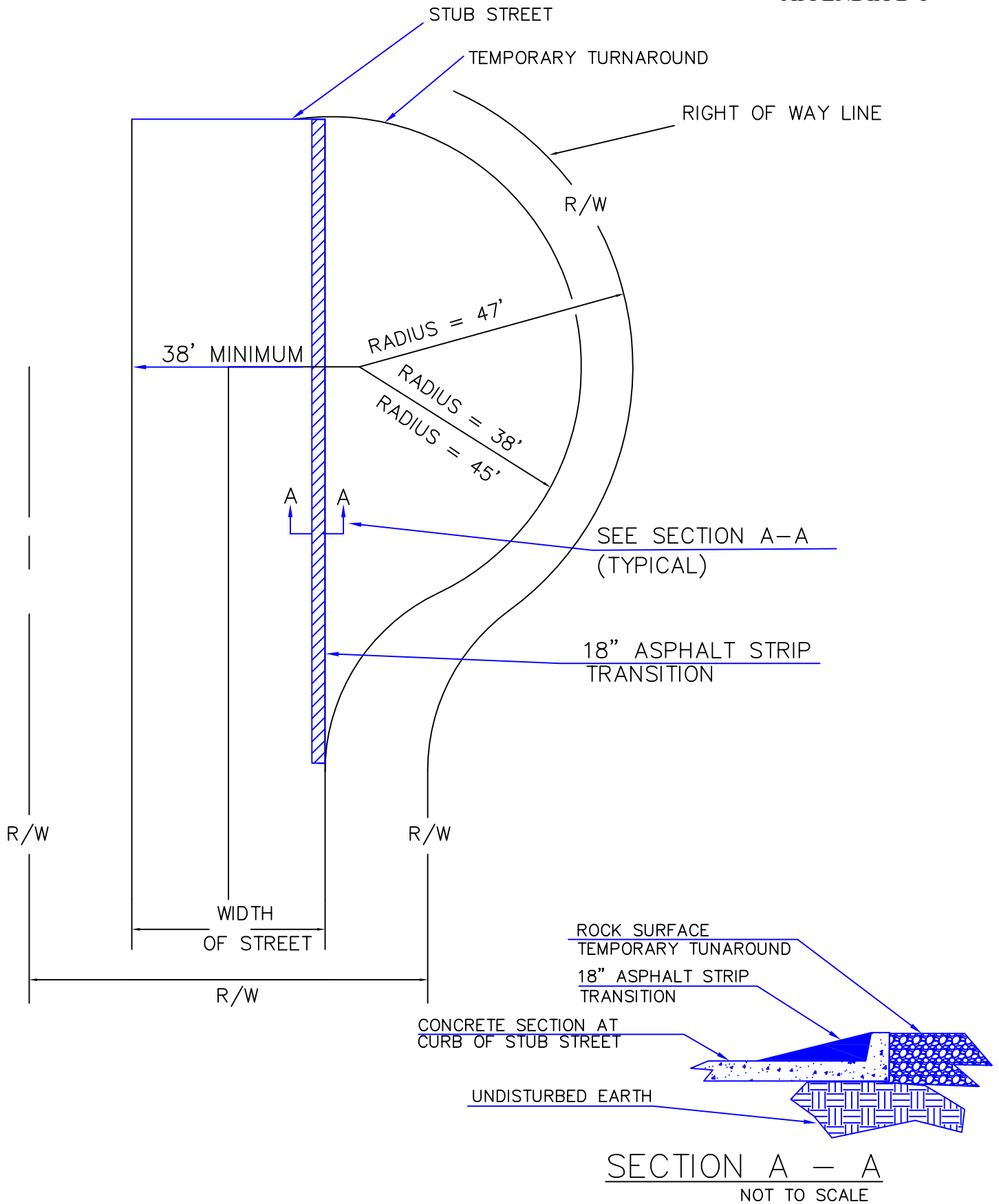
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PUBLIC WORKS

TEMPORARY CUL-DE-SAC

110.12



JPW-II

Approved

1/29/09

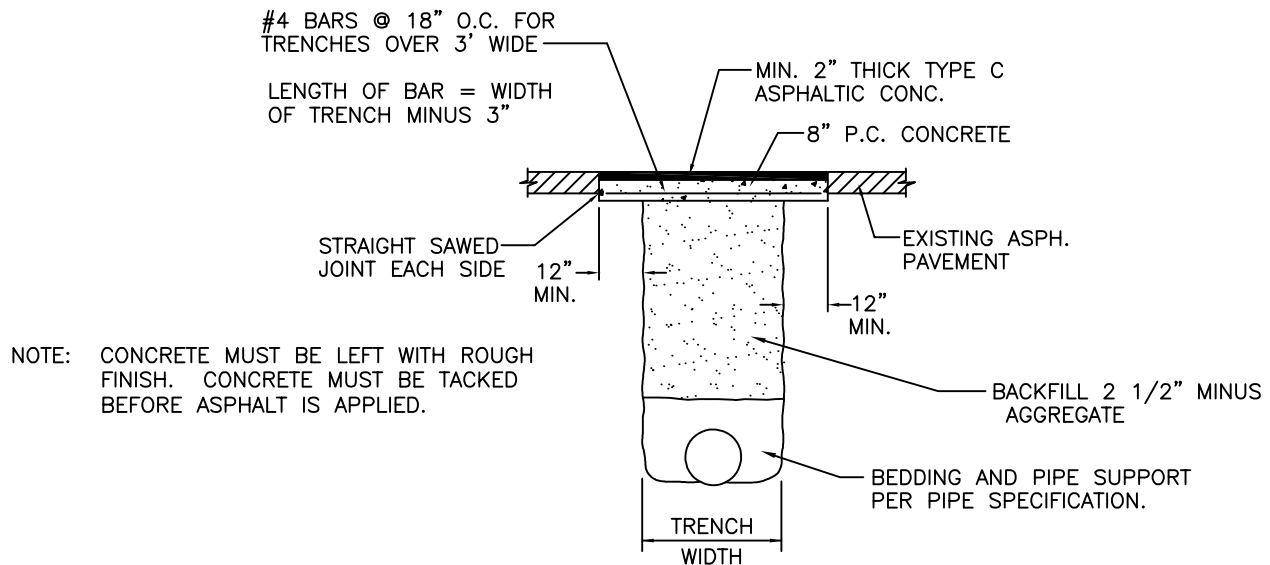
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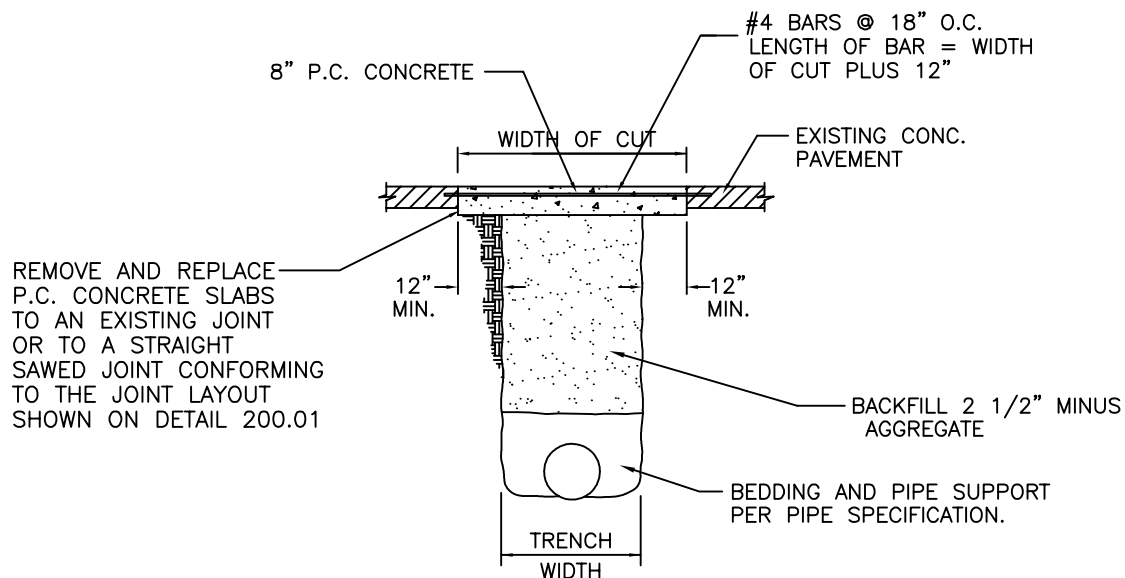


TYPICAL OFFSET CUL-DE-SAC

110.13



EXISTING ASPHALTIC PAVEMENT



EXISTING CONCRETE PAVEMENT

- NOTES: 1) IF THE DISTANCE FROM SAW-CUT TO ANY LONGITUDINAL OR TRANSVERSE JOINT OR CRACK IS LESS THAN 4', THE PAVEMENT SHALL BE REMOVED TO THAT TRANSVERSE JOINT OR CRACK.
- 2) CONCRETE SHALL BE CLASS AA.
- 3) HIGH/EARLY CONCRETE IS PERMITTED WITH AUTHORIZATION.

DWM

Approved

04/08/03

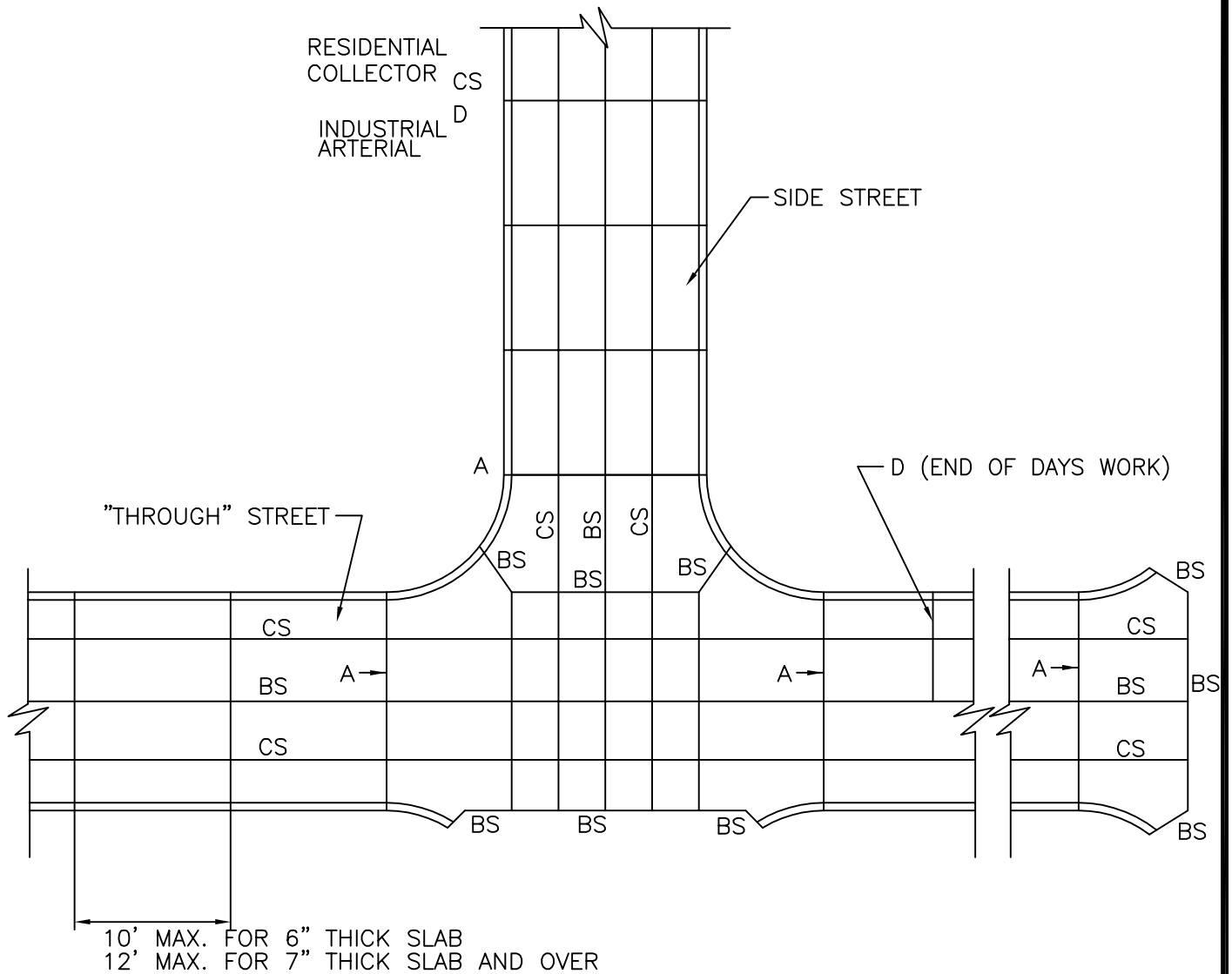
Date

Revisions



PATCHING PAVED STREETS

120.01



JOINT LOCATION PLAN

NOTE:

1. TRANSVERSE TYPE C JOINTS SHALL BE SAWED AS SOON AS CONCRETE CAN WITHSTAND RAVELING, JOINTS SHALL BE CLEANED AND FILLED WITH BITUMINOUS COMPOUND IMMEDIATELY FOLLOWING SAWING.
NO TRAFFIC SHALL BE ALLOWED ON ROADWAY UNTIL JOINTS ARE SEALED.
2. INSTALL TYPE A EXPANSION JOINTS AT INTERSECTIONS, AND AT STRUCTURES.
3. INSTALL TYPE A EXPANSION JOINTS AT PC & PT OF CURVES. WITH DEFLECTION ANGLE OF GREATER THAN 30°.
4. INSTALL TYPE A EXPANSION JOINT AT BULB OF CUL-DE-SAC.
5. USE TYPE D JOINT AT END OF DAYS WORK.
6. ALL JOINTS TO BE FILLED PER SECTION A-1, 231.6.8

JPW-II

Approved

1/29/09

Date

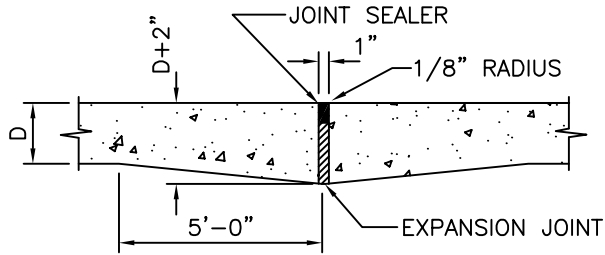
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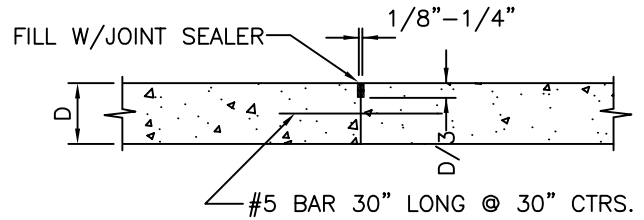
PUBLIC WORKS

JOINT DETAILS (P.C. Concrete Pavement)

200.01A

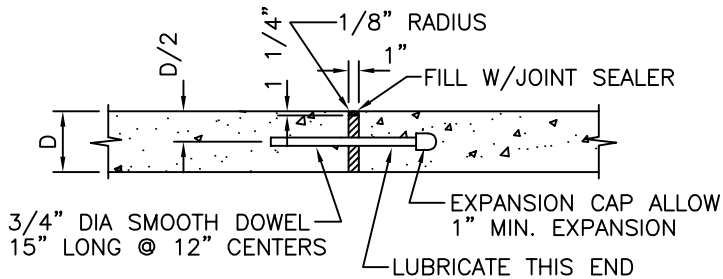


TYPE A
EXPANSION JOINT

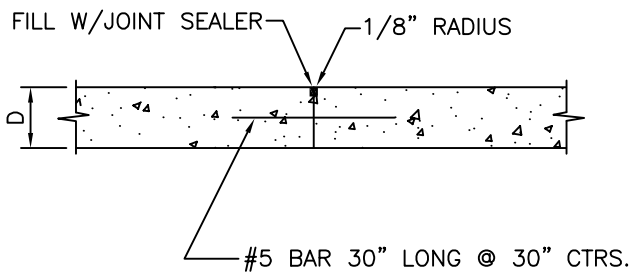


TYPE © - CONSTRUCTED WITHOUT TIE BAR
TYPE ©S - REQUIRES TIE BAR

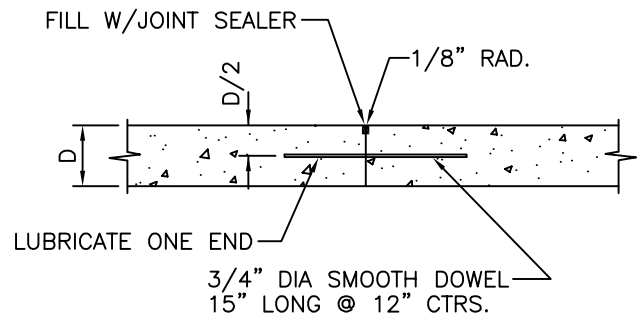
TYPE C & CS
SAWED OR PREMOLDED STRIP



TYPE A - ALTERNATE
EXPANSION JOINT



TYPE BS
KEYED CONSTRUCTION JOINT
(With Steel)



TYPE D
TRANSVERSE CONSTRUCTION JOINT

NOTE: JOINT SEALER - SEE SECTION 1-A, 231.6.8.

JPW-II

Approved

1/29/09

Date

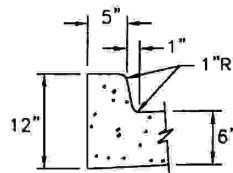
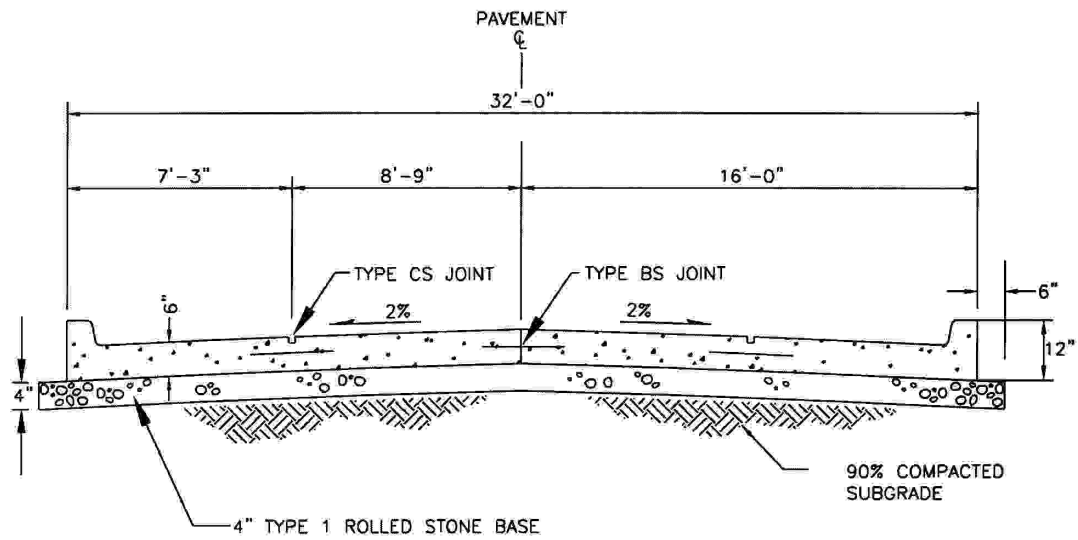
Revisions



PUBLIC WORKS

JOINT DETAILS (P.C. Concrete Pavement)

200.01B



INTEGRAL CURB SECTION

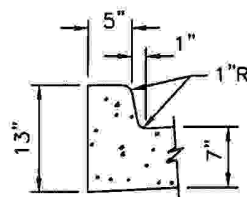
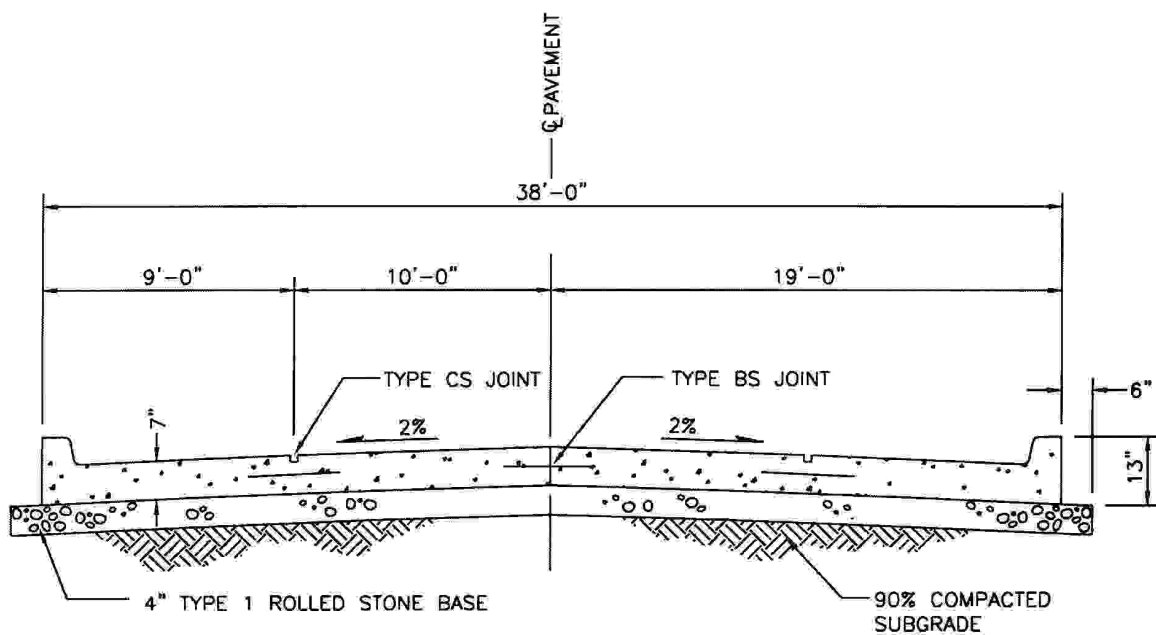
ALTERNATE: SEE DRAWING 400.02

ROLLBACK CURB MAY BE USED. DESIGN ENGINEER SHALL PROVIDE CURB SECTION AND DESIGN STORMWATER IMPROVEMENTS TO MEET B.C.P.W. APPENDIX A. DESIGN ENGINEER MUST ALSO PROVIDE DESIGN FOR SIDEWALK RAMP CONNECTIONS WITH DETAILS.

NOTES:

1. ALL P.C. CONCRETE SHALL BE CLASS A.
2. SEE DETAIL 200.01A AND 200.01B FOR JOINT DETAILS.

<p><i>Dam</i> 02/19/02 Approved Date</p> <p>Revisions</p>	<p>COUNTY OF BOONE MISSOURI PUBLIC WORKS</p>	<p>LOCAL STREET (Concrete Pavement)</p>	<p>210.01</p>
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INTEGRAL CURB SECTION

NOTES:

1. ALL P.C. CONCRETE SHALL BE CLASS A.
2. SEE DETAIL 200.01A AND 200.01B FOR JOINT DETAILS.

DWM 02/19/02
Approved Date

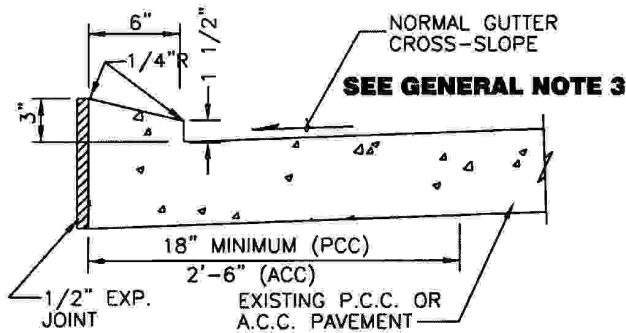
Revisions



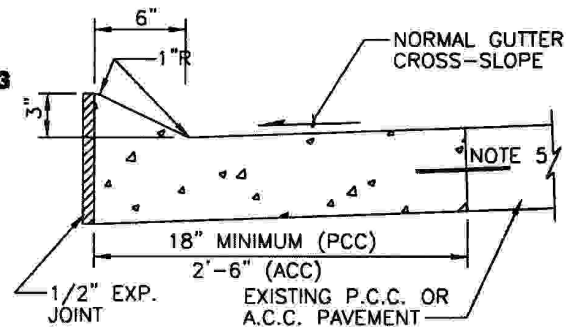
PUBLIC WORKS

COLLECTOR STREET
(Concrete Pavement)

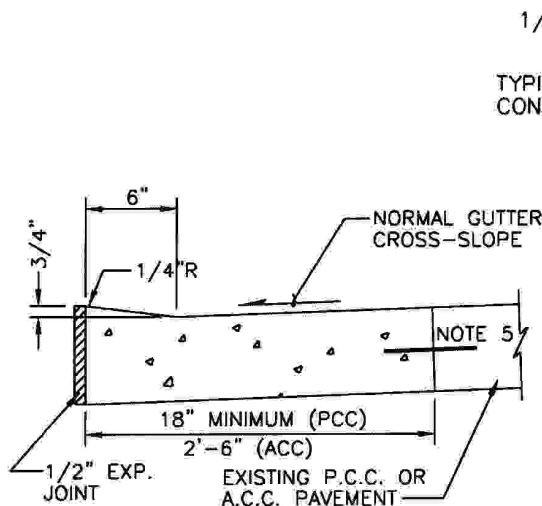
220.01



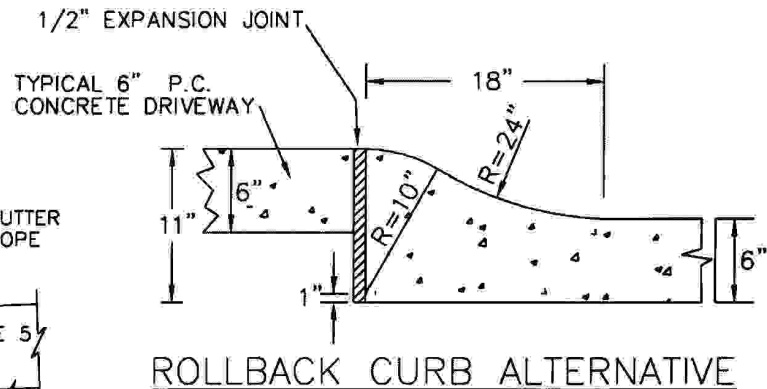
RESIDENTIAL DRIVEWAY CURB
MAXIMUM RISE (PREFERRED)



RESIDENTIAL DRIVEWAY CURB
MAXIMUM RISE (ALTERNATE)



RESIDENTIAL DRIVEWAY CURB
MINIMUM RISE



ROLLBACK CURB ALTERNATIVE

GENERAL NOTES:

1. ELEVATION OF DRIVEWAY AT R.O.W. LINE REQUIRED TO BE A MINIMUM OF 8 1/4" ABOVE GUTTER ELEVATION. VERIFY R.O.W. WIDTH AND ALLOWABLE DRIVEWAY SLOPES PRIOR TO CONSTRUCTING MINIMUM RISE DRIVEWAY CURB.
2. ALTERNATE CURB PROFILES WHICH FALL WITHIN THE MINIMUM RISE AND MAXIMUM RISE CURBS SHOWN WILL BE APPROVED. SLOPE ACROSS RESIDENTIAL DRIVEWAY CURB TOP MUST BE AT LEAST 1/2" IN 6" TOWARD THE STREET.
3. FOR RESIDENTIAL DRIVEWAYS, HORIZONTAL SAWING OF CURB IS REQUIRED. HORIZONTAL SAWING NOT ALLOWED ON NEW CONSTRUCTION WHERE DRIVEWAYS ARE IDENTIFIED. HORIZONTAL SAWING MACHINES AND METHOD REQUIRES PRIOR APPROVAL.

PCC / ACC PAVEMENT NOTES:

1. CONCRETE SHALL BE CLASS A.
2. PAVEMENT THICKNESS SHALL MATCH EXISTING. BASE SHALL MATCH EXISTING.
3. EXPANSION JOINTS AND CONTRACTION JOINTS SHALL BE PLACED AT LOCATIONS SIMILAR TO THE PAVEMENT WHICH WAS REMOVED.
4. CURB EDGE SHALL BE TOOLED WITH 1/4" RADIUS
5. WHERE EXISTING PAVEMENT IS P.C.C., LOW CURB REPLACEMENT SHALL BE DOWELLED INTO EXISTING. 12" LONG #4 BARS AT 24" CTR.

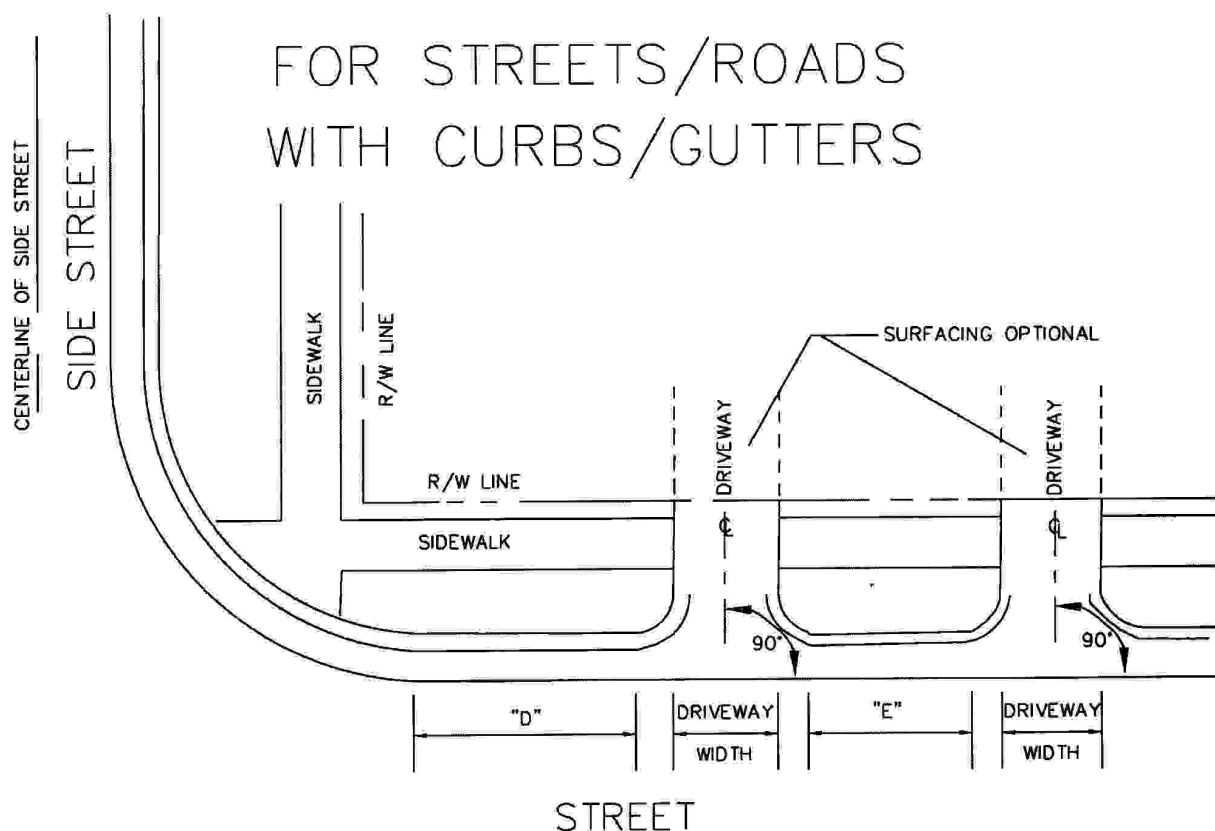
BWM
Approved Date
02/19/02

Revisions



CURB DETAILS
(Residential Driveway)

400.02



TYPE OF STREET	MINIMUM DISTANCES *		DRIVEWAY WIDTH	
	"D"	"E"	MIN.	MAX.
LOCAL	30'	10'	30'	10'
COLLECTOR	150'	50'	30'	10'
ARTERIAL	400'	150'	30'	10'
COMMERCIAL/INDUSTRIAL	150'	150'	20'	40'

* MINIMUM DISTANCES MEASURED FROM POINT OF CURVATURE TO POINT OF CURVATURE

DRIVEWAY LOCATIONS & DIMENSIONS

NTS

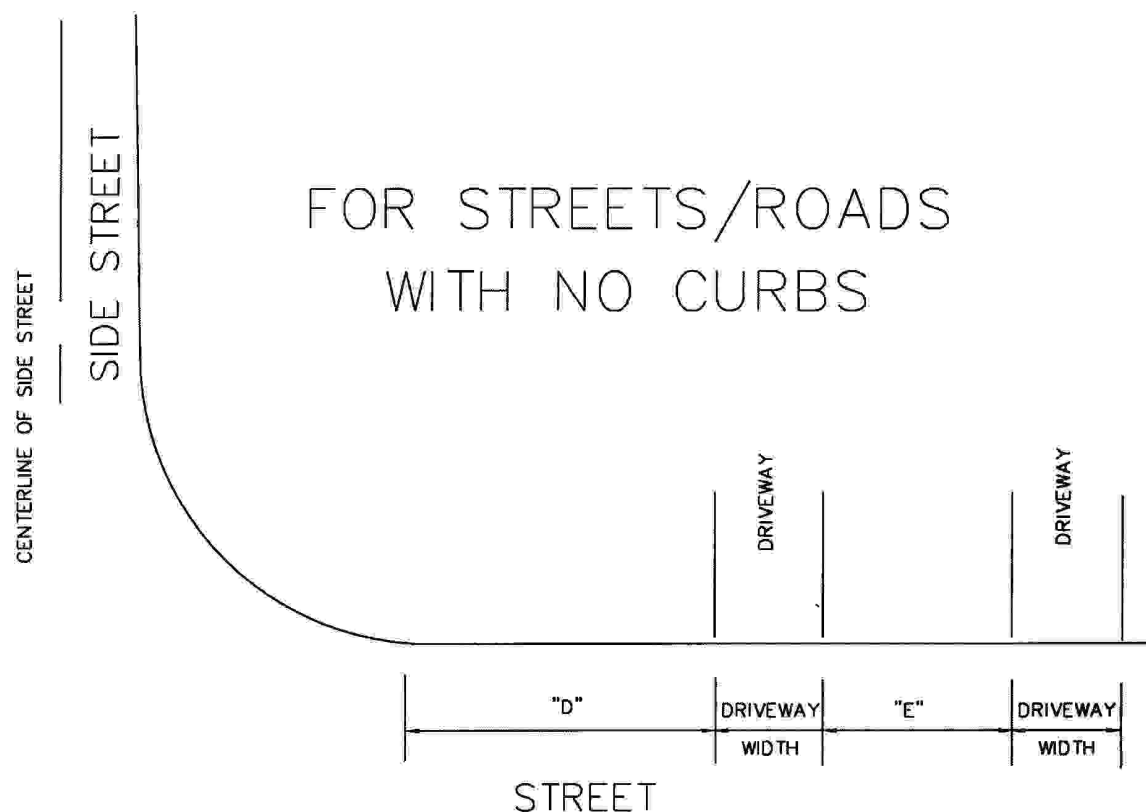
DWM
Approved
02/19/02
Date

Revisions



FOR STREETS W/CURBS
Driveway Location and Dimensions

410.01A



TYPE OF STREET	MINIMUM DISTANCES *		DRIVEWAY WIDTH	
	"D"	"E"	MIN.	MAX.
LOCAL	30'	10'	30'	10'
COLLECTOR	150'	50'	30'	10'
ARTERIAL	400'	150'	30'	10'
COMMERCIAL/INDUSTRIAL	150'	150'	20'	40'

* MINIMUM DISTANCES MEASURED FROM POINT OF CURVATURE TO POINT OF CURVATURE

DRIVEWAY LOCATIONS & DIMENSIONS

NTS

DWM
Approved

02/19/02
Date

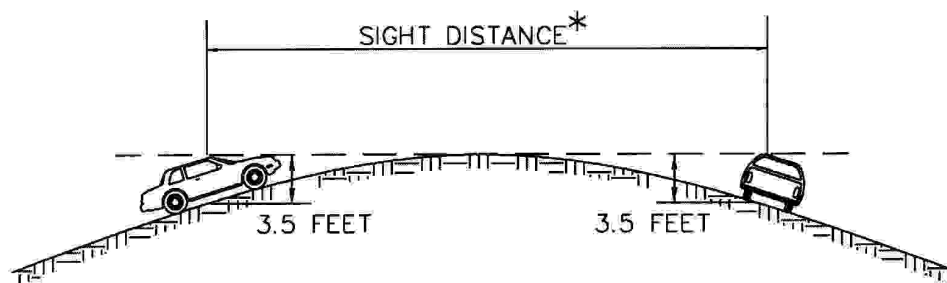
Revisions



PUBLIC WORKS

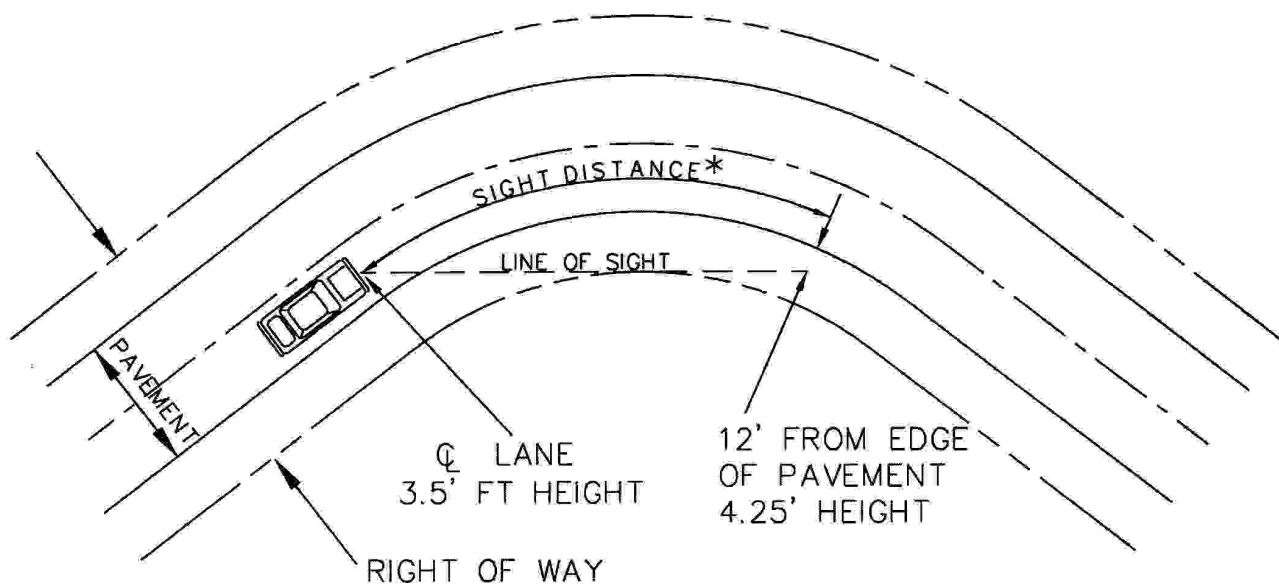
FOR STREETS W/O CURBS
Driveway Location and Dimensions

410.01B



VERTICAL STOPPING DISTANCE

* NOTE: SEE APPENDIX B, 1.5 FOR SIGHT DISTANCE REQUIREMENTS



HORIZONTAL STOPPING DISTANCE

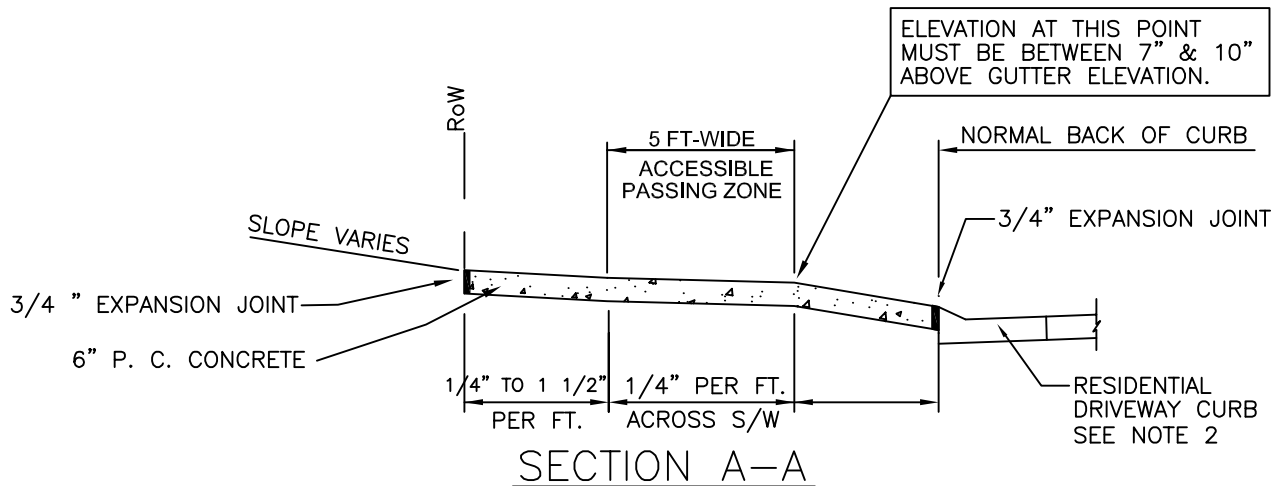
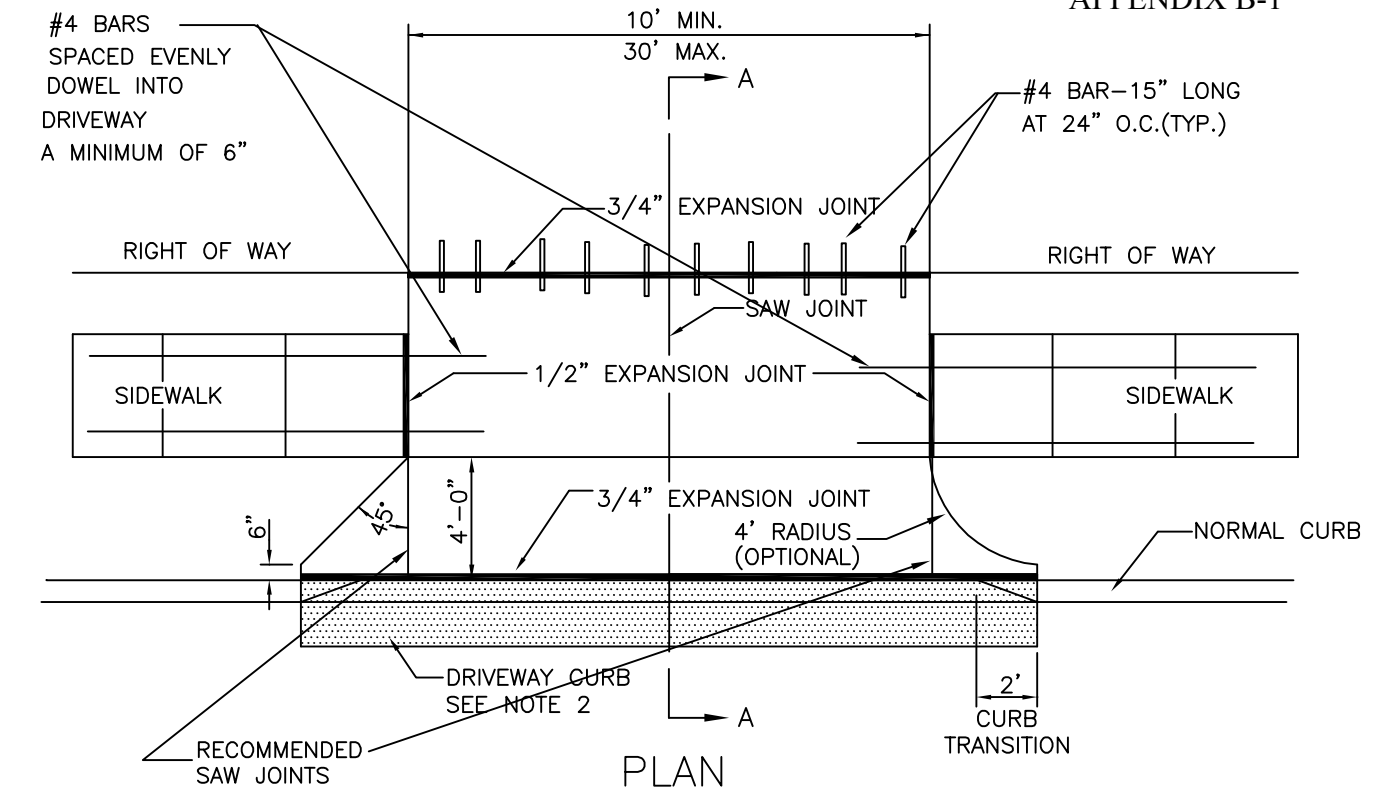
DWM
Approved
02/19/02
Date

Revisions



SIGHT DISTANCE DIAGRAM

410.01C



NOTES:

1. DRIVEWAY APPROACH SHALL BE 6" CLASS A CONCRETE ON 4" OF AGGREGATE BASE.
2. RECOMMEND CURB CUT OR REPLACE STANDARD CURB & GUTTER SECTION WITH DRIVEWAY CURB SECTION. SEE DETAIL 400.02. IF ROLLBACK CURB OPTION IS USED, CURB DOES NOT HAVE TO BE REMOVED. PLACE 3/4" EXPANSION JOINT BETWEEN CURB AND DRIVEWAY APPROACH.
3. EXPANSION JOINT SHALL BE 3/4" RUBBERIZED EXPANSION JOINT MATERIAL.
4. ALL DRIVEWAY APPROACHES SHALL SLOPE TOWARD THE STREET.
5. ALL DRIVEWAY APPROACHES SHALL BE CONSTRUCTED TO ACCOMMODATE SIDEWALKS. (EXISTING AND FUTURE) STANDARD SIDEWALK LOCATION IS 1 FT INSIDE RIGHT OF WAY LINE.
6. DRIVEWAY APPROACH SHALL PROVIDE A MINIMUM 5' WIDE ACCESSIBLE SIDEWALK PASSING ZONE.
7. DRIVEWAY SLOPE ACROSS ACCESSIBLE SIDEWALK PASSING ZONE IS 1/4" PER FT.
8. MINIMIZE SIDEWALK WARPING ADJACENT TO DRIVEWAY APPROACH.
9. DRIVEWAY SLOPE WITHIN RIGHT OF WAY SHALL NOT EXCEED SLOPES SHOWN ABOVE.

JPW-II

Approved

1/29/09

Date

Revisions

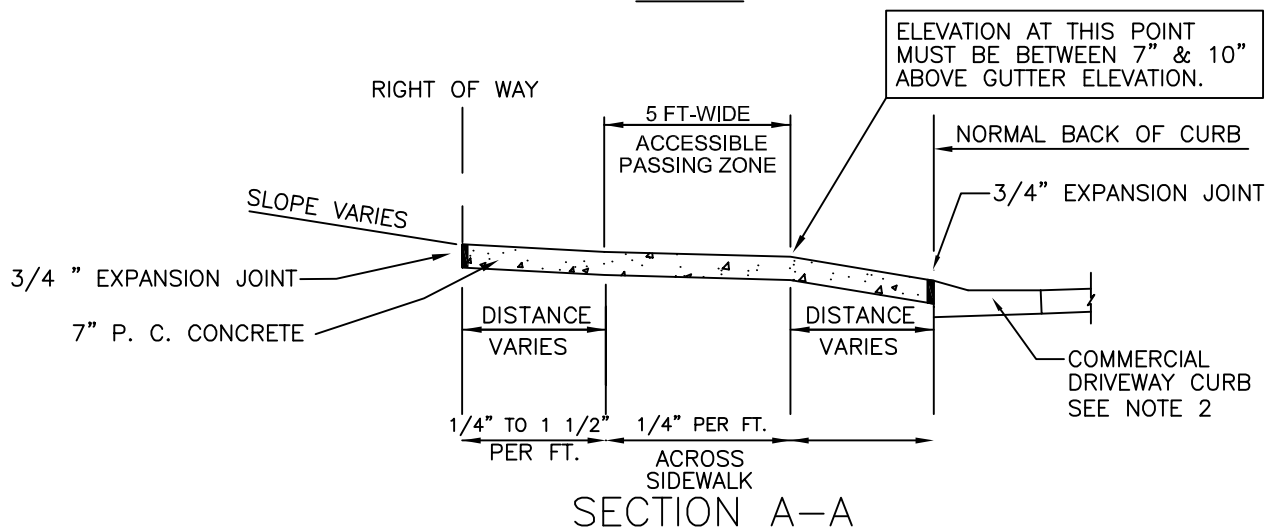
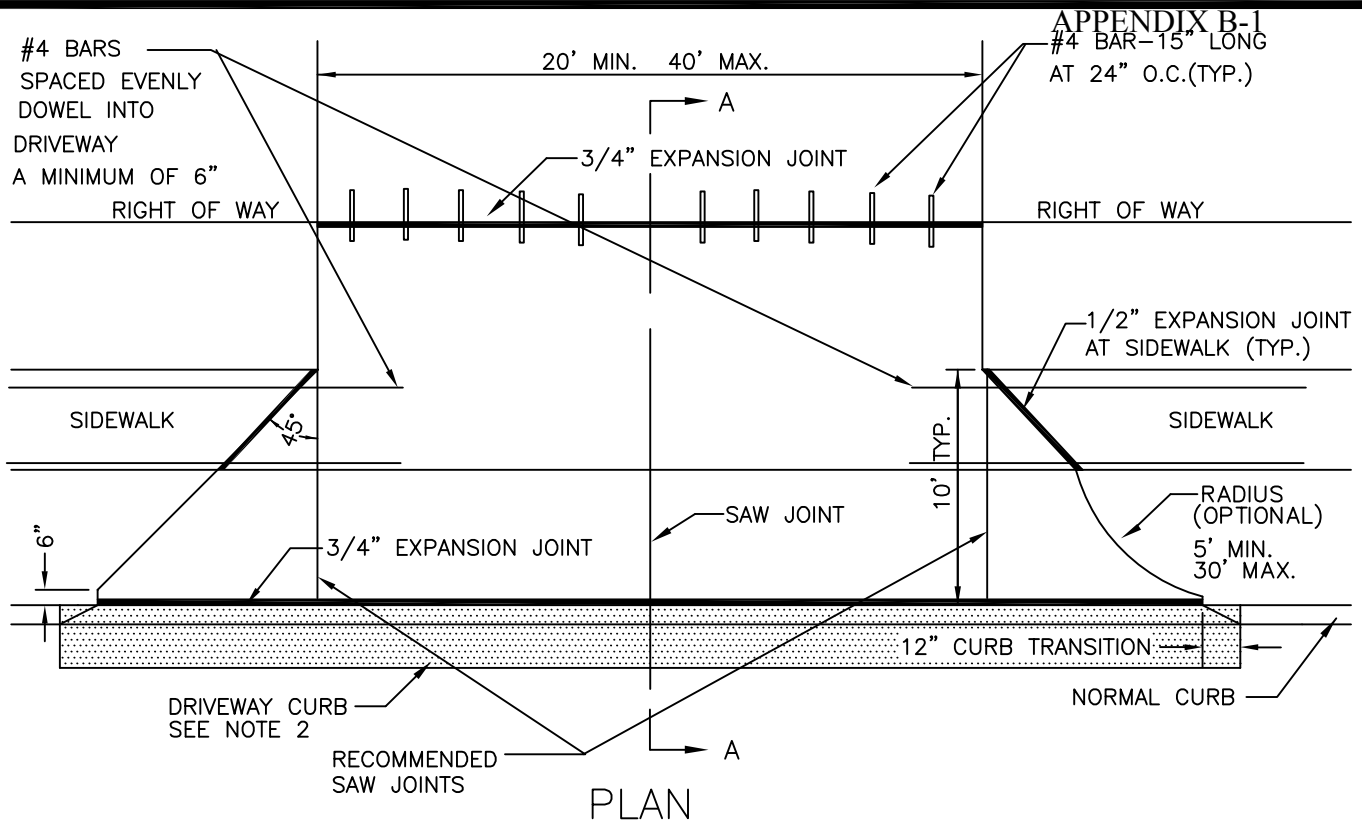


PUBLIC WORKS

DRIVEWAY

(Residential with Curb and Gutter)

410.02



NOTES:

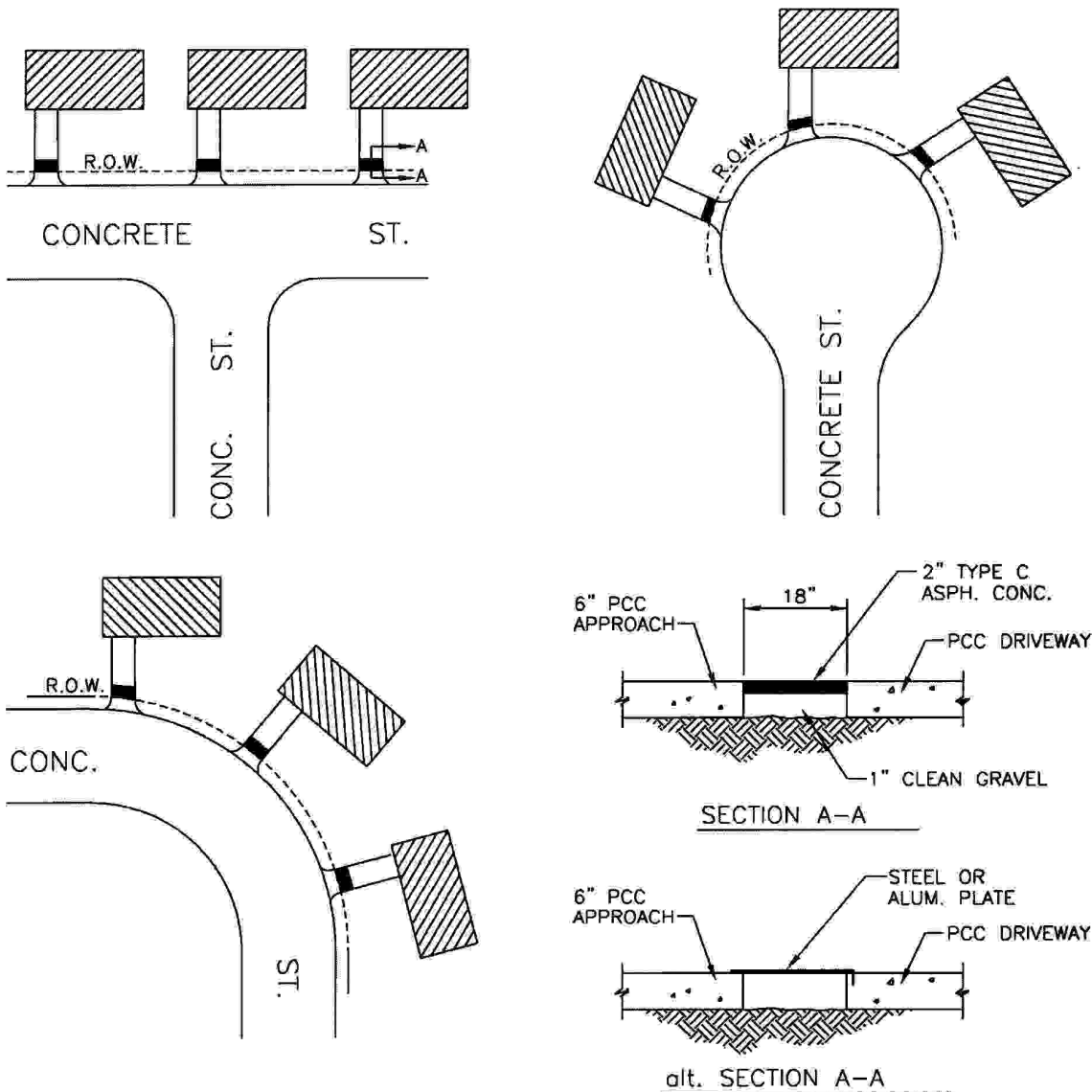
1. DRIVEWAY APPROACH SHALL BE 7" THICK CLASS A CONCRETE ON 4" OF AGGREGATE BASE.
2. RECOMMEND CURB CUT OR REPLACE STANDARD CURB & GUTTER SECTION WITH DRIVEWAY CURB SECTION. SEE DETAIL 400.02. IF ROLLBACK CURB OPTION IS USED, CURB DOES NOT HAVE TO BE REMOVED. PLACE 3/4" EXPANSION JOINT BETWEEN CURB AND DRIVEWAY APPROACH.
3. EXPANSION JOINT SHALL BE 3/4" RUBBERIZED EXPANSION JOINT MATERIAL.
4. ALL DRIVEWAY APPROACHES SHALL SLOPE TOWARD THE STREET.
5. ALL DRIVEWAY APPROACHES SHALL BE CONSTRUCTED TO ACCOMMODATE SIDEWALKS. (EXISTING AND FUTURE) STANDARD SIDEWALK LOCATION IS 1 FOOT OFF OF RIGHT OF WAY LINE.
6. DRIVEWAY APPROACH SHALL PROVIDE A MINIMUM 5' WIDE ACCESSIBLE SIDEWALK PASSING ZONE.
7. DRIVEWAY SLOPE ACROSS ACCESSIBLE SIDEWALK PASSING ZONE IS 1/4" PER FT.
8. MINIMIZE SIDEWALK WARPING ADJACENT TO DRIVEWAY APPROACH.
9. DRIVEWAY SLOPE WITHIN RIGHT OF WAY SHALL NOT EXCEED SLOPES SHOWN ABOVE.

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**DRIVEWAY
(Commercial)**

410.03



THE MOVEMENT OVER TIME OF CONCRETE STREETS DUE PRIMARILY TO THE THERMAL EXPANSION AND CONTRACTION PROPERTIES OF CONCRETE HAS CAUSED DAMAGE TO PRIVATE RESIDENCES IN SOME NEW SUB-DIVISIONS IN BOONE COUNTY WHERE CONCRETE STREETS ARE USED.

IN ORDER TO CONTROL SUCH DAMAGE, THE COUNTY IS RECOMMENDING THE USE OF ONE OF THE JOINT DETAILS ABOVE WHEN THE DRIVEWAY IS LOCATED AS DEPICTED ON THIS DRAWING.

BOONE COUNTY SHALL NOT BE LIABLE FOR ANY DAMAGE THAT MAY OCCUR TO ANY STRUCTURE DUE TO NON-COMPLIANCE WITH THIS RECOMENDATION. A WAIVER MUST BE SIGNED BY OWNER BEFORE DRIVEWAY WILL BE APPROVED. A FEE IN THE AMOUNT TO RECORD A 1 (ONE) PAGE DOCUMENT PAYABLE TO THE RECORDER OF DEEDS WILL BE REQUIRED.

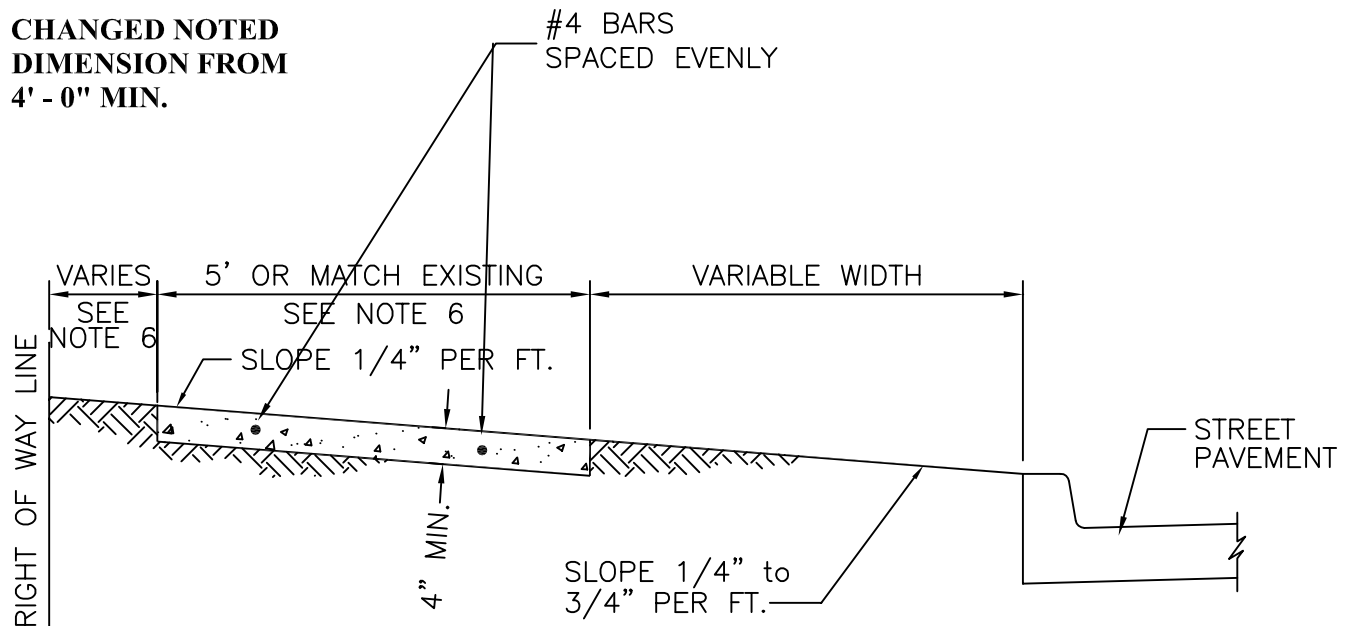
<i>DM</i>	02/19/02
Approved	Date
Revisions	



**ALTERNATE EXPANSION JOINTS FOR
DRIVEWAYS ON P.C.C. STREETS**

410.05

**CHANGED NOTED
DIMENSION FROM
4' - 0" MIN.**



SIDEWALK WITH GRASS PARKWAY

NOTE:

1. SIDEWALK SHALL BE 4" THICK CLASS A CONCRETE.
2. INSTALL 1/2" EXPANSION JOINTS AT INTERSECTIONS, RAMPS, STRUCTURES, AND DRIVEWAY APPROACHES.
3. INSTALL TRANSVERSE SAW JOINTS AT SPACING = SIDEWALK WIDTH.
4. FOR SIDEWALKS WIDER THAN 6 FT, INSTALL LONGITUDINAL SAW JOINT AT \mathcal{Q} , TRANSVERSE SAW JOINT SPACING = 1/2 SIDEWALK WIDTH.
5. FOR SIDEWALKS LESS THAN 5'-0" WIDE, INSTALL A 60" BY 60" PASSING SPACE AT 200 FT MAXIMUM INTERVALS. DRIVEWAYS, RAMP LANDINGS AND INTERSECTING SIDEWALKS WHICH PROVIDE THE REQUIRED AREA QUALIFY AS PASSING SPACE. CROSS SLOPE OF PASSING SPACE CAN NOT EXCEED 1/4" PER FT.
6. STANDARD SIDEWALK PLACEMENT IS 12" FROM RIGHT OF WAY LINE.

NOTE 7
REMOVED



JPW-II

Approved

1/29/09

Date

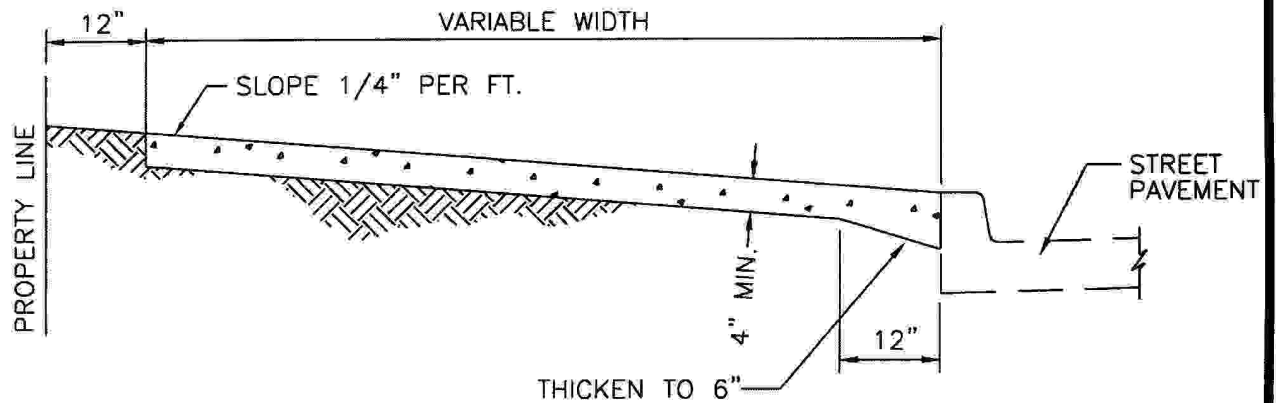
Revisions



PUBLIC WORKS

SIDEWALK

420.01



NOTE:

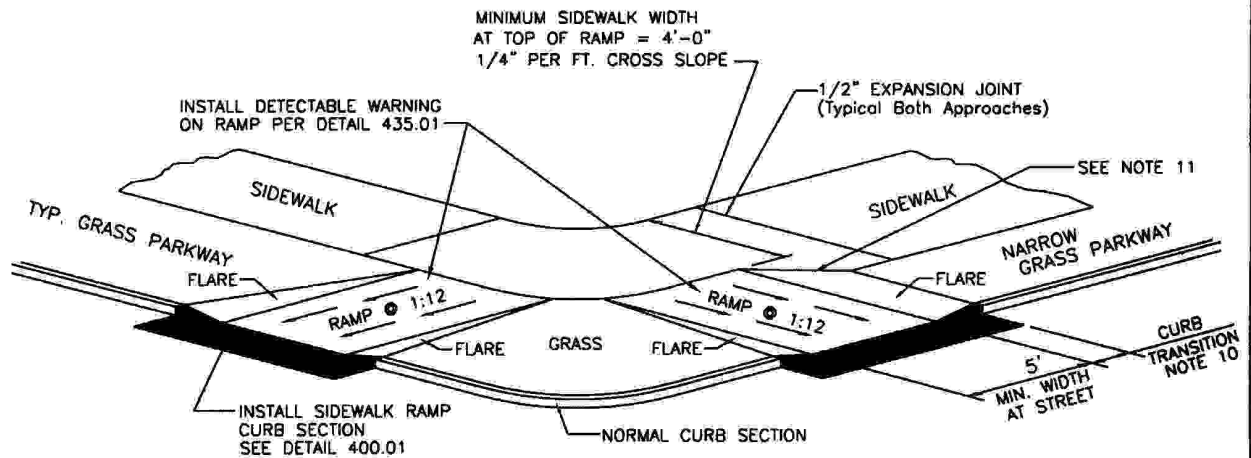
1. SIDEWALK SHALL BE 4" THICK CLASS A CONCRETE.
2. INSTALL 1/2" TRANSVERSE EXPANSION JOINTS TO MATCH STREET OR CURB AND GUTTER EXPANSION JOINTS AND AT ALL DRIVEWAY APPROACHES, AND SIDEWALK RAMPS.
3. INSTALL TRANSVERSE SAW JOINTS AT SPACING = SIDEWALK WIDTH.
4. FOR SIDEWALKS WIDER THAN 6 FT., INSTALL LONGITUDINAL SAW JOINT AT ϕ , TRANSVERSE SAW JOINT SPACING = SIDEWALK WIDTH.
5. FOR SIDEWALKS LESS THAN 5'-0" WIDE, INSTALL A 60" BY 60" PASSING SPACE AT 200 FT MAXIMUM INTERVALS. DRIVEWAYS, RAMP LANDINGS AND INTERSECTING SIDEWALKS WHICH PROVIDE THE REQUIRED AREA QUALIFY AS PASSING SPACE. CROSS SLOPE OF PASSING SPACE CAN NOT EXCEED 1/4" PER FT.

<i>AWM</i>	02/19/02
Approved	Date
Revisions	



SIDEWALK AT BACK OF CURB

420.02



NOTE:

1. RAMP SHALL BE 4" THICK CLASS A CONCRETE.
2. EXPANSION JOINT SHALL BE 1/2" PREFORMED CORK OR BITUMINOUS EXPANSION JOINT MATERIAL.
3. MAXIMUM RAMP CROSS SLOPE IS 1/4" PER FT.
4. ALL SLOPES ARE MEASURED FROM THE HORIZONTAL.
5. REPLACE STANDARD CURB SECTION WITH SIDEWALK RAMP CURB SECTION - DETAIL 400.01
6. RAMP LENGTH IS DEPENDENT ON 1:12 MAX. SLOPE. USE FLATTER WHEN POSSIBLE.
7. LANDING AREA AT TOP OF RAMP SHALL BE 4'-0" MIN WIDTH, CROSS SLOPE OF LANDING SHALL NOT EXCEED 1/4" PER FT., INCREASE SIDEWALK RADIUS TO OBTAIN MINIMUM 4'-0" LANDING.
8. TYPE "A" RAMP NOT APPLICABLE IF SIDEWALK AND PARKWAY WIDTH DOES NOT PROVIDE 4'-0" LANDING AT TOP OF RAMP.
9. FLARES ARE REQUIRED AT RAMPS TO KEEP GRASS PARKWAY SLOPES IN CONFORMANCE WITH THE TYPICAL CROSS SECTION.
10. CURB TRANSITION LENGTH IS DEPENDENT ON FLARE SLOPE
11. IF RAMP EXTENDS INTO NORMAL SIDEWALK, FLARE SLOPE MUST NOT EXCEED 1:10. A LANDING IS REQUIRED, SEE NOTE 7.

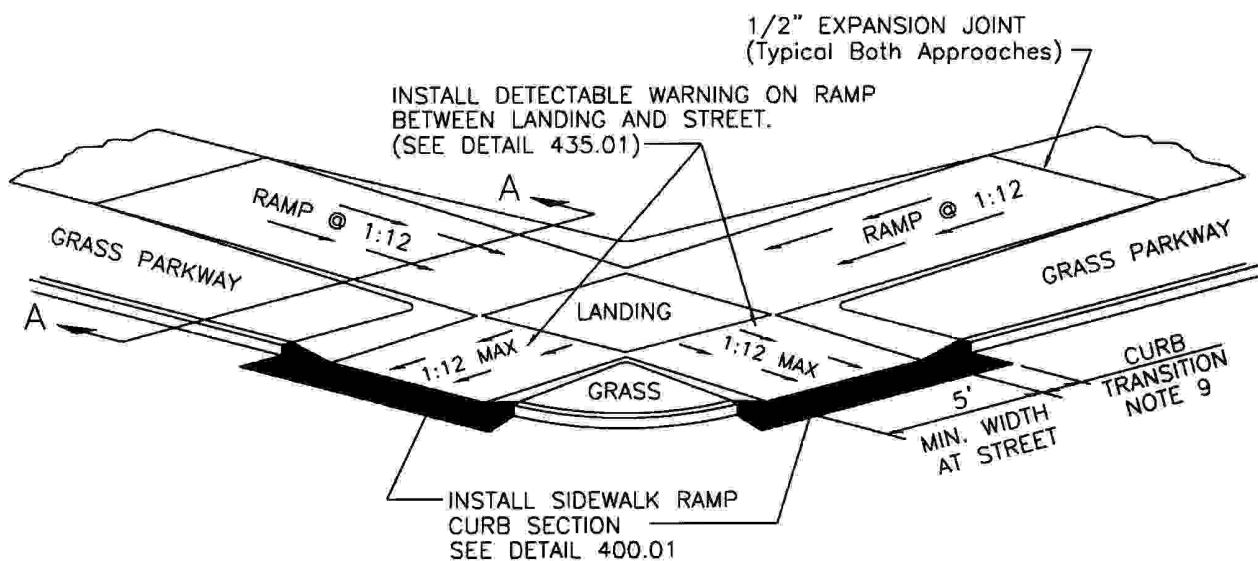
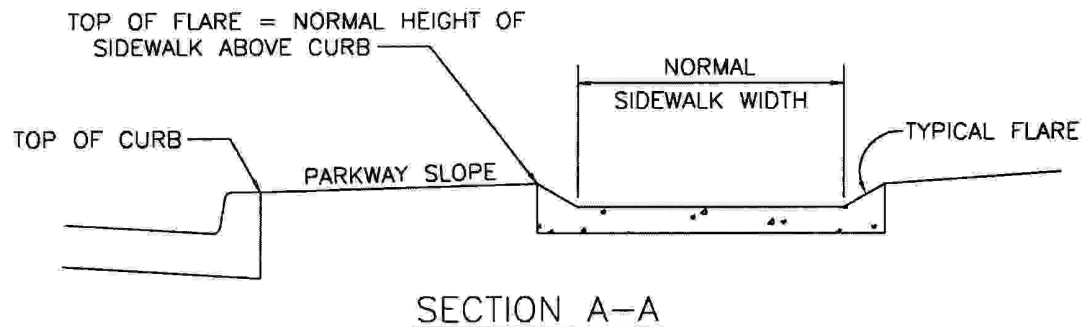
Sum
Approved Date
02/19/02

Revisions



SIDEWALK RAMP Sidewalk with Grass Parkway (Type A)

430.01



NOTE:

1. RAMP SHALL BE 4" THICK CLASS A CONCRETE.
2. EXPANSION JOINT SHALL BE 1/2" PREFORMED CORK OR BITUMINOUS EXPANSION JOINT MATERIAL.
3. MAXIMUM RAMP CROSS SLOPE IS 1/4" PER FT.
4. ALL SLOPES ARE MEASURED FROM THE HORIZONTAL.
5. REPLACE STANDARD CURB SECTION WITH SIDEWALK RAMP CURB SECTION - DETAIL 400.01
6. RAMP 1:12 MAX. USE FLATTER WHEN POSSIBLE.
7. LANDING AREA SHALL BE 4'-0" MIN WIDTH, CROSS SLOPE OF LANDING SHALL NOT EXCEED 1/4" PER FT.
8. FLARES ARE REQUIRED AT RAMPS TO KEEP GRASS PARKWAY SLOPES IN CONFORMANCE WITH THE TYPICAL CROSS SECTION. (SEE SECTION A-A)
9. CURB TRANSITION LENGTH IS DEPENDENT ON FLARE SLOPE

AWM 02/19/02
Approved Date

Revisions

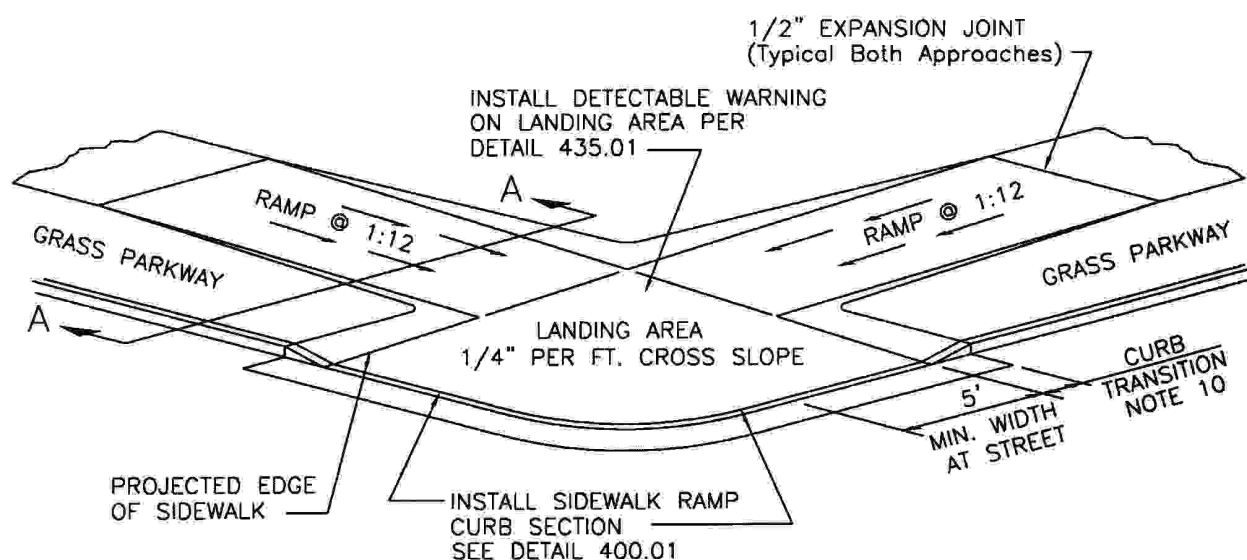
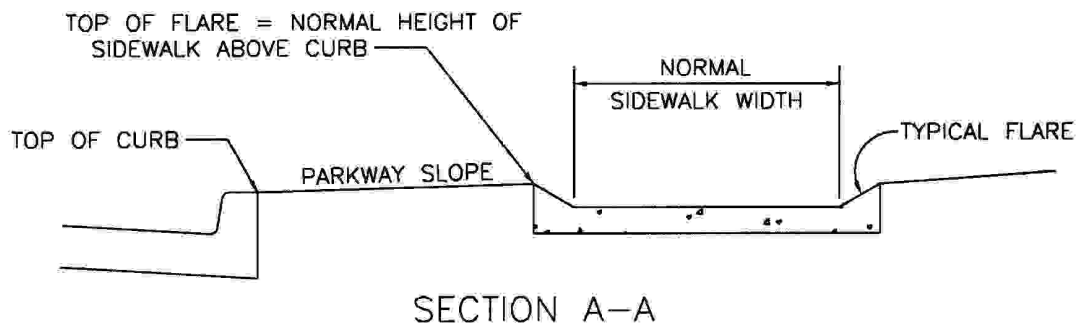


PUBLIC WORKS

SIDEWALK RAMP

Sidewalk with Grass Parkway (Type B)

430.02



NOTE:

1. RAMP SHALL BE 4" THICK CLASS A CONCRETE.
2. EXPANSION JOINT SHALL BE 1/2" PREFORMED CORK OR BITUMINOUS EXPANSION JOINT MATERIAL.
3. MAXIMUM RAMP CROSS SLOPE IS 1/4" PER FT.
4. ALL SLOPES ARE MEASURED FROM THE HORIZONTAL.
5. REPLACE STANDARD CURB SECTION WITH SIDEWALK RAMP CURB SECTION - DETAIL 400.01
6. RAMP LENGTH IS DEPENDENT ON 1:12 MAX. SLOPE. USE FLATTER WHEN POSSIBLE.
7. LANDING AREA SHALL BE 4'-0" MIN WIDTH, CROSS SLOPE OF LANDING SHALL NOT EXCEED 1/4" PER FT.
8. USE TYPE "C" RAMP ONLY IF TYPE "A" & "B" ARE NOT FEASIBLE.
9. FLARES ARE REQUIRED AT RAMPS TO KEEP GRASS PARKWAY SLOPES IN CONFORMANCE WITH THE TYPICAL CROSS SECTION. (SEE SECTION A-A)
10. CURB TRANSITION LENGTH IS DEPENDENT ON FLARE SLOPE

BWM
Approved

02/19/02
Date

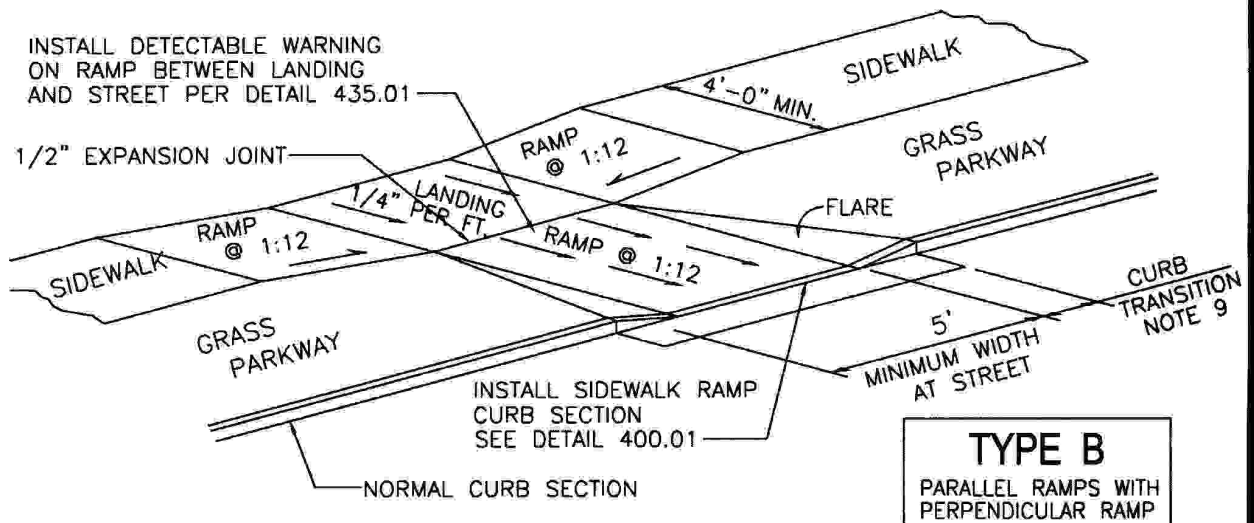
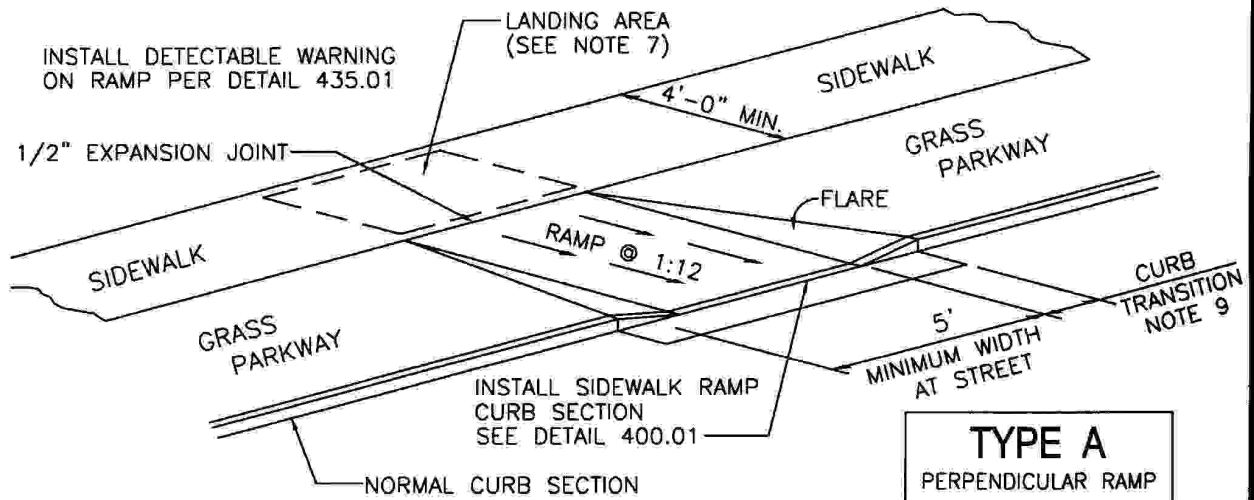
Revisions



SIDEWALK RAMP

Sidewalk with Grass Parkway (Type C)

430.03



NOTE:

1. RAMP SHALL BE 4" THICK CLASS A CONCRETE.
2. EXPANSION JOINT SHALL BE 1/2" PREFORMED CORK OR BITUMINOUS EXPANSION JOINT MATERIAL.
3. ALL SLOPES ARE MEASURED FROM THE HORIZONTAL.
4. REPLACE STANDARD CURB SECTION WITH SIDEWALK RAMP CURB SECTION - DETAIL 400.01
5. RAMP LENGTH IS DEPENDENT ON 1:12 MAX. SLOPE. USE FLATTER WHEN POSSIBLE.
6. LANDING AREA AT TOP OF RAMP SHALL BE 4'-0" MIN WIDTH, CROSS SLOPE OF LANDING SHALL NOT EXCEED 1/4" PER FT.
7. TYPE "A" RAMP NOT APPLICABLE IF PARKWAY WIDTH DOES NOT PROVIDE ENOUGH LENGTH FOR PERPENDICULAR RAMP AT 1:12 SLOPE.
8. FLARES ARE REQUIRED AT RAMPS TO KEEP GRASS PARKWAY SLOPES IN CONFORMANCE WITH THE TYPICAL CROSS SECTION.
9. CURB TRANSITION LENGTH IS DEPENDENT ON FLARE SLOPE.

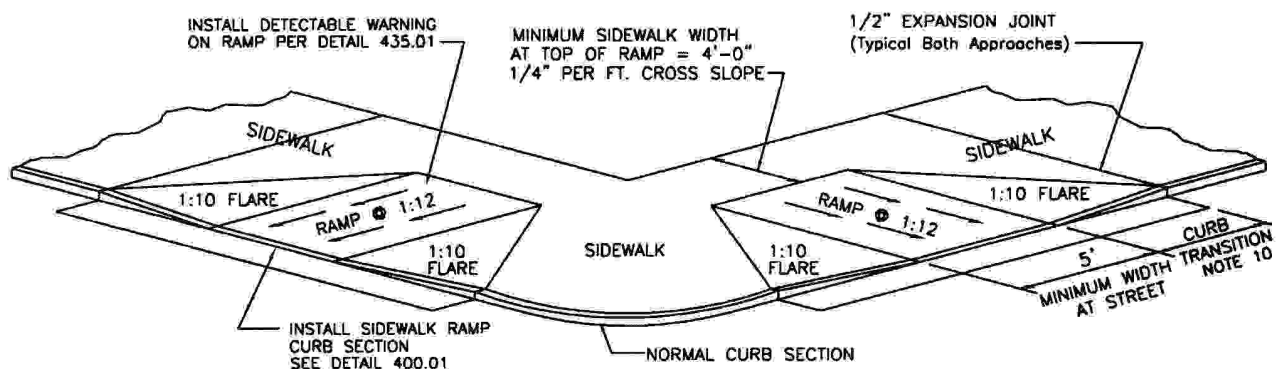
awm 02/19/02
Approved Date

Revisions



MIDBLOCK SIDEWALK RAMP Sidewalk with Grass Parkway

431.01



NOTE:

1. RAMP SHALL BE 4" THICK CLASS A CONCRETE.
2. EXPANSION JOINT SHALL BE 1/2" PREFORMED CORK OR BITUMINOUS EXPANSION JOINT MATERIAL.
3. MAXIMUM RAMP CROSS SLOPE IS 1/4" PER FT.
4. ALL SLOPES ARE MEASURED FROM THE HORIZONTAL.
5. REPLACE STANDARD CURB SECTION WITH SIDEWALK RAMP CURB SECTION - DETAIL 400.01
6. RAMP LENGTH IS DEPENDENT ON 1:12 MAX. SLOPE. USE FLATTER WHEN POSSIBLE.
7. LANDING AREA AT TOP OF RAMP SHALL BE 4'-0" MIN WIDTH, CROSS SLOPE OF LANDING SHALL NOT EXCEED 1/4" PER FT.
8. TYPE "A" RAMP NOT APPLICABLE IF SIDEWALK WIDTH DOES NOT PROVIDE 4'-0" LANDING AT THE TOP OF RAMP. USE TYPE "B" RAMP.
9. RAMP EXTENDS INTO SIDEWALK, FLARE SLOPE MUST NOT EXCEED 1:10.
10. CURB TRANSITION LENGTH IS DEPENDENT ON 1:10 FLARE SLOPE

DWM
Approved

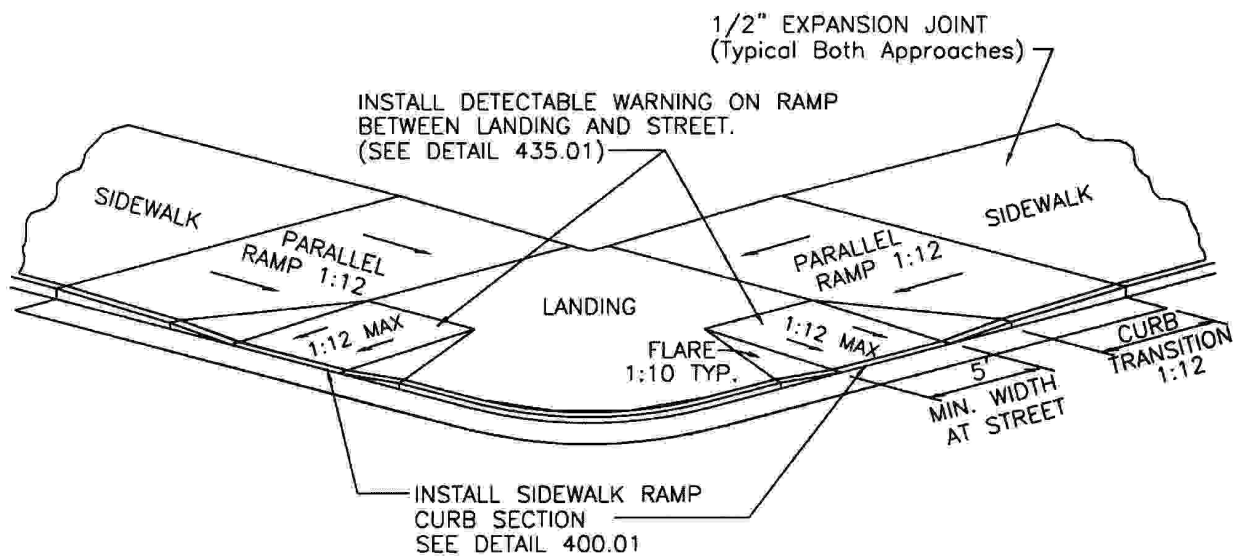
02/19/02
Date

Revisions




SIDEWALK RAMP Sidewalk at Back of Curb (Type A)

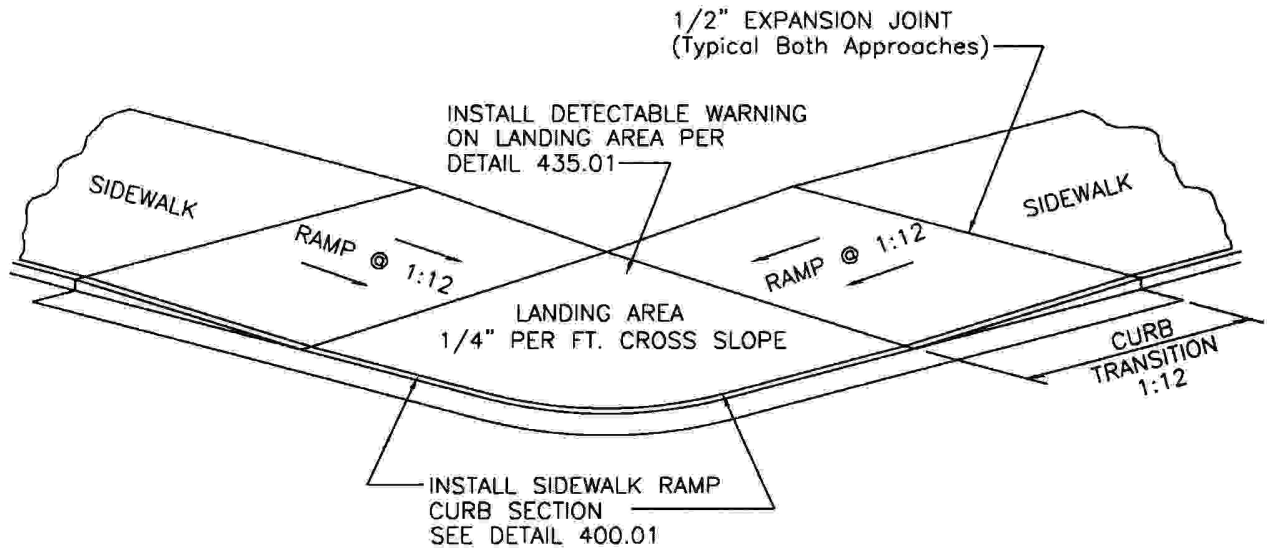
432.01



NOTE:

1. RAMP SHALL BE 4" THICK CLASS A CONCRETE.
2. EXPANSION JOINT SHALL BE 1/2" PREFORMED CORK OR BITUMINOUS EXPANSION JOINT MATERIAL.
3. MAXIMUM RAMP CROSS SLOPE IS 1/4" PER FT.
4. ALL SLOPES ARE MEASURED FROM THE HORIZONTAL.
5. REPLACE STANDARD CURB SECTION WITH SIDEWALK RAMP CURB SECTION - DETAIL 400.01
6. RAMP 1:12 MAX. USE FLATTER WHEN POSSIBLE.
7. LANDING AREA SHALL BE 4'-0" MIN WIDTH, CROSS SLOPE OF LANDING SHALL NOT EXCEED 1/4" PER FT.
8. TYPE "B" RAMP PROVIDES PARALLEL RAMPS TO REDUCE THE PERPENDICULAR RAMP LENGTH AND PROVIDE ADEQUATE LANDING.
9. RAMP EXTENDS INTO SIDEWALK, FLARE SLOPE MUST NOT EXCEED 1:10.

<p><i>Sum</i> Approved _____ Date 02/19/02</p> <p>Revisions _____</p>		<p>SIDEWALK RAMP Sidewalk at Back of Curb (Type B)</p>	<p>432.02</p>
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NOTE:

1. RAMP SHALL BE 4" THICK CLASS A CONCRETE.
2. EXPANSION JOINT SHALL BE 1/2" PREFORMED CORK OR BITUMINOUS EXPANSION JOINT MATERIAL.
3. MAXIMUM RAMP CROSS SLOPE IS 1/4" PER FT.
4. ALL SLOPES ARE MEASURED FROM THE HORIZONTAL.
5. REPLACE STANDARD CURB SECTION WITH SIDEWALK RAMP CURB SECTION - DETAIL 400.01
6. RAMP LENGTH IS DEPENDENT ON 1:12 MAX. SLOPE. USE FLATTER WHEN POSSIBLE.
7. LANDING AREA SHALL BE 4'-0" MIN WIDTH, CROSS SLOPE OF LANDING SHALL NOT EXCEED 1/4" PER FT.
8. USE TYPE "C" RAMP ONLY IF TYPE "A" & "B" ARE NOT FEASIBLE.

DWM
Approved

02/19/02
Date

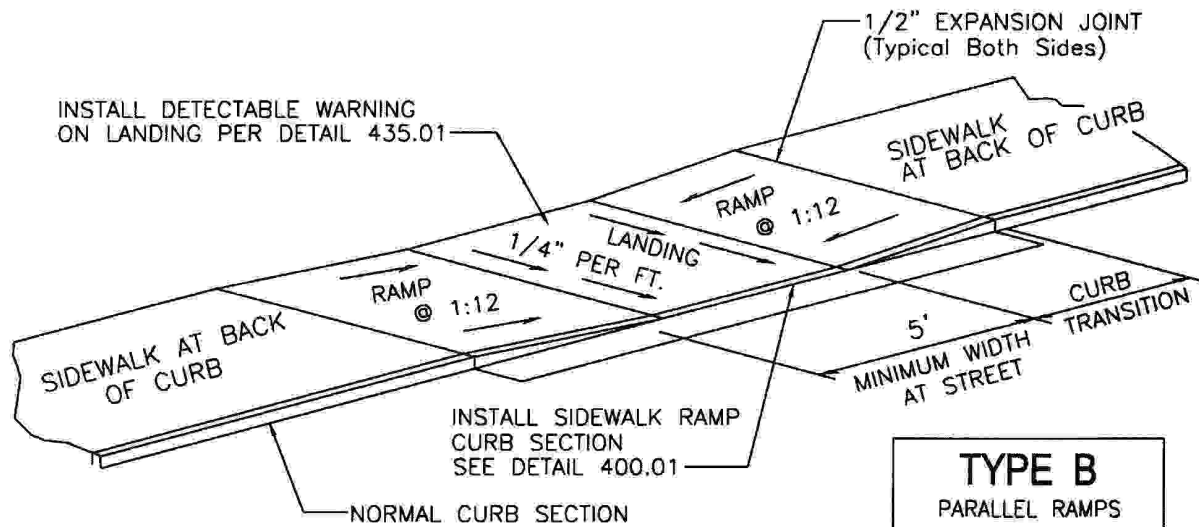
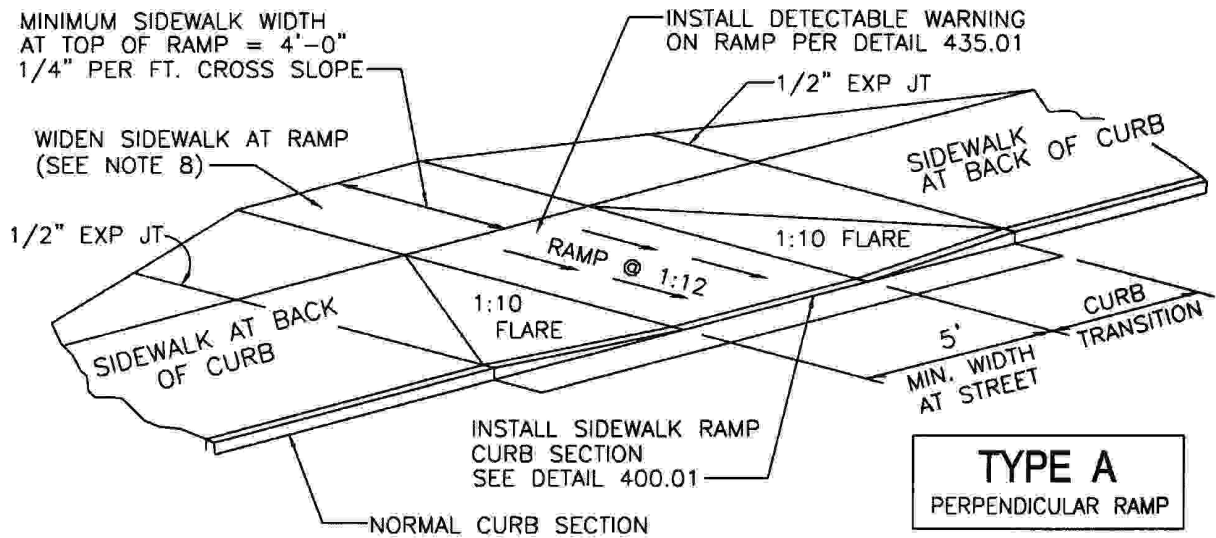
Revisions



PUBLIC WORKS

SIDEWALK RAMP Sidewalk at Back of Curb (Type C)

432.03



NOTE:

1. RAMP SHALL BE 4" THICK CLASS A CONCRETE.
2. EXPANSION JOINT SHALL BE 1/2" PREFORMED CORK OR BITUMINOUS EXPANSION JOINT MATERIAL.
3. MAXIMUM RAMP CROSS SLOPE IS 1/4" PER FT.
4. ALL SLOPES ARE MEASURED FROM THE HORIZONTAL.
5. REPLACE STANDARD CURB SECTION WITH SIDEWALK RAMP CURB SECTION - DETAIL 400.01
6. RAMP LENGTH IS DEPENDENT ON 1:12 MAX. SLOPE. USE FLATTER WHEN POSSIBLE.
7. LANDING AREA SHALL BE 4'-0" MIN WIDTH, CROSS SLOPE OF LANDING SHALL NOT EXCEED 1/4" PER FT.
8. TYPE "A" RAMP NOT APPLICABLE WHEN NORMAL SIDEWALK WIDTH DOES NOT PROVIDE 4'-0" LANDING AT THE TOP OF RAMP, WIDEN SIDEWALK OR USE TYPE "B" RAMP.
9. 10:1 FLARES ARE REQUIRED ON TYPE "A" RAMPS.

DWM
Approved
02/19/02
Date

Revisions



MIDBLOCK SIDEWALK RAMP
Sidewalk at Back of Curb

433.01

Appendix B:
Excerpt from City of Columbia
Design Standards

APPENDIX A

Design Standards for Streets, Sidewalks and Bikeways – 6/07/04

Purpose and Intent

The 2025 Transportation Plan established a functional classification system consisting of Major Arterials, Minor Arterials, Major Collectors and Neighborhood Collectors. In developing new design standards, it was determined that local residential and local non-residential streets should also be included. This provides for an integrated street system.

A roadway system must balance the conflicting goals of traffic movement and access to land. Arterials are primarily for the movement of through traffic; collectors provide equal attention to land access and through traffic; and local streets provide access to individual parcels of land at the expense of through traffic. Selecting the proper roadway design for each functional classification is vital to development of a system of roadways which provides the needed connectivity between all areas of the city as well as the capacity to handle future traffic volume.

Design elements encompassing right of way width, pavement width, number of travel lanes, bike lane width, use of curb and gutter, sidewalk and pedway width, parking, driveways, buffer strip width, and utility easements must be appropriately selected to provide the function, character, traffic volume and speed desired.

Major streets serve a development pattern that ranges from low density residential to intensely developed commercial centers and corridors. To meet such varied conditions and address neighborhood livability factors requires an array of design approaches. A “one standard fits all” is not consistent with traffic needs or the wide variety of situations encountered.

In several of the street types, an alternative design will be considered or may be required when conditions specified in the standards are found to exist. This language was drafted specifically to allow a design appropriate for the land use and traffic conditions being created by a proposed development. The alternative design may be requested by the developer or recommended by city staff or the Planning and Zoning Commission. Criteria are included to provide guidance in selecting the proper street design to match the expected conditions. If the alternative design exceeds the standard design for a particular street type, it shall be presumed to satisfy these requirements. In all other cases, the final decision shall rest with the City Council.

Application of Design Standards

The design standards are intended to result in a more predictable and acceptable outcome for street improvements. Due to the wide range of circumstances, however, the standards need to be applied with a certain amount of flexibility. Street construction activity consists of building completely new streets as well as making minor improvements to existing streets. Many existing streets will not be changed at all in the next several years while others will be candidates for additional lanes, intersection reconfiguration, or major reconstruction. Unlike new streets, existing streets have physical constraints to being retrofitted to meet new standards due to a narrow right of way or the proximity of buildings, utilities or mature trees. Additionally, adjacent property owners often voice concern about more traffic, speeding, noise, storm water runoff, and other issues.

To deal with the application issue, two categories of improvements have been developed. Major projects consist of significant improvements to the street system and the design standards are to be interpreted as requirements. In situations where it is not feasible, practical or desirable for a proposed street improvement to meet the required standards, a design exception may be considered and approved by the City Council as part of the public hearing process. Major projects include:

- Construction of a new street
- Major reconstruction of an existing street (e.g. upgrade to city standards)
- Major widening of an existing street (e.g. addition of one or more lanes)

For minor improvements the design standards are regarded as a guideline rather than an absolute requirement. In such cases, if the standards are not attainable a design exception will not be required. Minor projects include:

- Resurfacing or partial reconstruction of the pavement
- Installation of traffic calming devices
- Intersection improvements (e.g. traffic signals, turn lanes, etc.)
- Reconstruction resulting in incidental widening
- Installing bike lanes or sidewalks on existing streets

Major projects typically entail significant citizen input in evaluating location and design alternatives. Meetings are held with interested parties such as property owners and residents followed by public hearings by the City Council. Citizen input on Minor projects varies. Resurfacing usually involves public notice but little citizen involvement whereas traffic calming measures can entail extensive citizen participation in the location and design process.

In regards to private development, the proposed standards would normally only apply to undeveloped land that is being platted for the first time. The standards could, however, apply to a previously developed area under two circumstances: 1) the area is being replatted to create a different street and lot layout for redevelopment and the construction of new buildings; and 2) the area is being rezoned to allow more intensive development (e.g. changing from residential to commercial and thus from residential to non-residential streets).

Local Residential Street Design Standards

Residential Streets provide direct access to residential dwellings and other allowed uses. They should be designed for this intended function and exhibit characteristics which contribute to a safe and attractive living environment. This can be achieved by providing a diversity of street types, each serving a specific role. Right of way and pavement widths less than the general standard should provide acceptable levels of access, safety and convenience for all users, including emergency service providers, while enabling enhanced site design and creation of attractive streetscapes. Subdivision layouts should avoid the creation of pass through routes for external traffic while allowing local drivers to move easily to and from higher order streets.

The design standard for a **Residential Street** shall be as follows:

1. Right-of-way: 50 feet wide

2. Pavement: 28 feet wide measured from back of curb
3. Turnarounds: Terminal streets shall have a turnaround at the closed end with an outside right-of-way diameter of 94 feet and a roadway pavement diameter of 76 feet.
4. Drainage: Curb and gutter system.
5. Sidewalks: 5 feet wide on both sides constructed 1 foot inside the right-of-way.
6. Parking: Permitted on both sides of the street.
7. Buffer Strip: 5 feet wide with trees permitted in the right-of-way subject to compliance with city policies and regulations.
8. Utility Easements: 10 feet on both sides adjacent to the right-of-way. The city and public utility providers will not be responsible for the restoration of any landscaping placed within utility easements that is removed or damaged as a result of constructing, repairing or maintaining public utilities.

In place of the typical Residential Street, a request may be submitted at the time of preliminary plat review for approval of one or more of the following alternative streets:

A **Residential Feeder** will be considered or may be required when one or more of the following conditions exist: 1) the intended use and adjacent zoning allows duplex or multi-family dwellings; 2) the expected average daily traffic (ADT) exceeds 500; or 3) the street collects localized traffic within a subdivision and leads to a collector or arterial street. A Residential Feeder shall conform to the following design standards:

1. Right-of-way: 50 feet wide
2. Pavement: 32 feet wide measured from back of curb
3. Sidewalks: 5 feet wide on both sides constructed 1 foot inside the right-of-way.
4. Buffer Strip: 3 feet wide with only ornamental trees permitted.
5. Other Features: Same as a Residential Street

An **Access Street** will be considered when all of the following conditions exist: 1) the intended use and adjacent zoning is single-family detached dwellings; 2) the street is not longer than 750 feet, and 3) the expected average daily traffic (ADT) is less than 250. An Access Street shall conform to the following design standards:

1. Right-of-way: 44 feet wide
2. Pavement: 24 feet wide measured from back of curb
3. Turnarounds: Terminal streets shall have a turnaround at the closed end with an outside right-of-way diameter of 94 feet and a roadway diameter of 76 feet.

4. Sidewalks: Same as a Residential Street, except sidewalks shall not be required on cul-de-sacs less than 250 feet in length.
5. Parking: Permitted on one side only
6. Other Features: Same as a Residential Street

The design standard for **Residential Alleys** shall be as follows:

1. Right of Way: 18 feet wide
2. Pavement: 16 feet wide measured from edge of pavement (no curb and gutter)
3. Travel Lanes: Two-way traffic allowed
4. Maximum Length: 500 feet between connecting streets
5. Parking: Parking in alley prohibited
6. Setbacks: Garages, carports and open parking spaces shall be set back at least 5 feet from the right of way.
7. Utility Lines: Both overhead and underground utility lines may be installed in the right of way.

Local Non-Residential Street Design Standards

A **Non-Residential Street** is a low volume, low speed street which provides access to commercial, industrial, institutional, and other intensive land uses. Generally, only two travel lanes are needed. In some cases, these streets may carry considerable truck traffic, require wider driveways for access to loading docks, and have a need for on-street parking. Direct connections to collector and arterial streets are essential.

The design standard for a **Non-residential Street** shall be as follows:

1. Right-of-way: 66 feet wide
2. Pavement: 36 feet wide measured from back of curb
3. Turnarounds: Terminal streets shall have a turnaround at the closed end with an outside right-of-way diameter of 94 feet and a roadway diameter of 76 feet.
4. Sidewalks: 5 feet wide on both sides constructed 1 foot inside the right-of-way.
5. Parking: Permitted on both sides of the street.
6. Buffer Strip: 9 feet wide with trees permitted in the right-of-way subject to compliance with city policies and regulations.
7. Utility Easements: Same as a standard Residential Street

In place of the typical Non-residential Street, a request may be submitted at the time of preliminary plat review for approval of one or more of the following alternatives:

An **Option A** street will be considered when two or more of the following conditions exist: 1) the intended use and adjacent zoning is commercial, light industrial, office, and/or multi-family residential; 2) the expected average daily traffic (ADT) is less than 4,000; 3) the street is primarily intended to provide access to property and secondarily to serve through traffic; and 4) there is a nearby collector or arterial street to accommodate future traffic from surrounding land.

Option A streets shall conform to the following design standards:

1. Right-of-way: 60 feet wide
2. Pavement: 30 feet wide measured from back of curb
3. Parking: Not permitted on either side.
4. Other features: Same as a typical Non-residential Street

An **Option B** street will be considered when all of the following conditions exist: 1) the intended use and adjacent zoning is office and/or multi-family residential; 2) the street is not longer than 750 feet; 3) the expected average daily traffic is less than 1,000; 4) the street is intended to provide access to property and not serve through traffic; and 5) there is a nearby collector or arterial street to accommodate future traffic from the development of surrounding land.

Option B streets shall conform to the following design standards:

1. Right-of-way: 60 feet wide
2. Pavement: 30 feet wide measured from back of curb
3. Parking: Permitted on one side only
4. Buffer Strip: 9 feet wide with trees permitted as a typical Non-residential Street
5. Other features: Same as a typical Non-residential Street

An **Option C** street will be considered or may be required when two or more of the following conditions exist: 1) the intended use and adjacent zoning is intensive commercial and/or industrial; 2) the expected average daily traffic exceeds 4,000; 3) the street will serve a significant amount of through traffic; 4) the street will connect to two collector or arterial streets; 5) there will be a significant number of left turns to and from abutting driveways; and 6) there will be a significant amount of truck traffic.

Option C streets shall conform to the following design standards:

1. Right-of-way: 66 feet wide
2. Pavement: 38 feet wide measured from back of curb to provide for two 13' travel

lanes and a 12' two-way center turn lane.

3. Turnarounds: Terminal streets are not permitted
4. Parking: Not permitted on either side
5. Other Features: Same as a typical Non-residential Street

Neighborhood Collector Street Design Standards

A **Neighborhood Collector** is intended to collect traffic from surrounding residential areas and connect to major streets; serve local, non-residential land uses such as schools, churches, and parks; and promote neighborhood livability. These streets provide two traffic lanes for shared use by vehicles and bicycles at low to moderate driving speeds (30 mph), accommodate an average daily traffic volume of 1,500-3,500 vehicles, and generally, connect to only one arterial or major collector street. They may also provide direct access to property and contain on-street parking. Two types of Neighborhood Collector streets are allowed. Either type may be required or proposed provided a statement of justification is submitted for the subject location.

Option A streets are intended to provide direct access to property and provide some periodic on-street parking for abutting uses. The design standard shall be as follows:

1. Right-of-way: 60 feet wide
2. Pavement: 34 feet wide measured from back of curb
3. Travel Lanes: Two travel lanes each 13.5 feet wide
4. Sidewalks: 5 feet wide on both sides constructed 1 foot inside the right-of-way.
5. Parking: Permitted on one side of the street only. A bulb-out may be built near intersections to create recessed parking, calm traffic and assist pedestrians.
6. Driveways: Permitted on both sides of the street.
7. Buffer Strip: 7 feet wide with trees permitted in the right-of-way subject to compliance with city policies and regulations.
8. Utility Easements: Same as a standard Residential Street

Option B streets are intended to primarily collect neighborhood traffic and not provide direct access to property. The design standard shall be as follows:

1. Right-of-way: 60 feet wide
2. Pavement: 30 feet wide measured from back of curb
3. Travel Lanes: Two shared travel lanes each 15 feet wide
4. Sidewalks: 5 feet wide on both sides constructed 1 foot inside the right-of-way.

5. Parking/Driveways: Not permitted on either side
6. Buffer Strip: 9 feet wide with trees allowed as for Option A streets
7. Other features: Same as Option A streets

Major Collector Street Design Standards

A **Major Collector** is a mid-volume, multi-modal street (average daily traffic of 3,500-8,500 vehicles) which collects traffic from several neighborhoods and moves the traffic to the arterial network. These streets provide access to retail centers, office complexes, institutional uses such as colleges and hospitals, and multi-family residential areas. Major collectors typically have two, undivided travel lanes with a left turn lane at key intersections. A two-way center turn lane or intermittent raised median may be provided to manage access at high traffic locations. Typically, direct access to one and two-family residences is prohibited with consolidated driveways allowed for other uses when controlled as to location. No on-street parking is permitted.

The design standard for a **Major Collector** street shall be as follows:

1. Right-of-way: 66 feet wide
2. Pavement: 36 feet wide measured from back of curb
3. Travel Lanes: Two lanes each 12 feet wide
4. Bike Lanes: Striped bike lane on both sides 6 feet from back of curb
5. Sidewalks: 5 feet wide on both sides constructed 1 foot inside the right-of-way.
6. Parking: Not permitted on either side
7. Driveways: Controlled as to location and width for access management purposes.
8. Buffer Strip: 9 feet wide with trees permitted in the right-of-way located 4 feet from edge of street and sidewalk subject to compliance with city policies and regulations.
9. Utility Easements: Same as a standard Residential Street

In place of the typical Major Collector, a request may be submitted at the time of preliminary plat review for approval of one or more of the following alternative streets:

An **Option A** street will be considered or may be required when the following conditions exist: 1) the intended use and zoning of nearby land is one or two-family residential and/or large open land areas such as parks, churches, and schools; and 2) the street is intended to serve through traffic and not provide direct access to property.

Option A streets shall conform to the following design standards:

1. Right-of-way: 66 feet wide

2. Pavement: 32 feet wide measured from back of curb
3. Travel Lanes: Two shared use travel lanes each 16 feet wide
4. Bike Lanes: No striped bike lanes
5. Sidewalk/Pedway: A 5 foot wide sidewalk on one side and an 8 foot wide pedway on the other side constructed 1 foot inside the right of way.
6. Parking: Not permitted on either side
7. Driveways: Not permitted on either side
8. Buffer Strip: 9-10 feet wide with trees permitted as for a typical Major Collector
9. Other features: Same as a typical Major Collector

An **Option B** street will be considered or may be required when one or more of the following conditions exist: 1) the intended use and/or zoning of adjacent land is retail commercial, office, institutional or multi-family residential; 2) the expected average daily traffic exceeds 6,000; and 3) the street will or is likely to connect to two arterial streets.

Option B streets shall conform to the following design standards:

1. Right-of-way: 76 feet wide
2. Pavement: 44 feet wide measured from back of curb
3. Travel Lanes: Two shared use travel lanes each 16 feet wide plus a center two-way left-turn lane 12 feet wide.
4. Bike Lanes: No striped bike lanes
5. Pedway/Sidewalk: An 8 foot wide Pedway on one side and a 5 foot wide sidewalk on the other side constructed 1 foot inside the right of way.
6. Parking: Not permitted on either side
7. Driveways: Controlled as to location and width for access management purposes.
8. Buffer Strip: 8-9 feet wide with trees permitted as for a typical Major Collector
9. Other features: Same as a typical Major Collector

Minor Arterial Street Design Standards

A **Minor Arterial** is a mid-to-high volume multi-modal street (average daily traffic of 7,500-20,000 vehicles) which moves a large portion of internal city traffic. Minor Arterials usually connect to Major Arterials or Expressways and provide access to such traffic destinations as retail

shopping areas, employment centers, and many residential neighborhoods. These streets have a minimum of two, undivided travel lanes but may have up to four travel lanes with a raised median and left turn lane at intersections to manage traffic access. Typically, direct access to property is restricted and no on-street parking is permitted.

Three types of Minor Arterial streets are permitted. Each type may be allowed or required depending upon the surrounding land use pattern, traffic conditions or other circumstances.

An **Option A** street will be considered or may be required when the intended use or zoning of nearby land is predominantly residential or large open land areas such as parks, churches, and schools. Option A streets shall conform to the following design standards:

1. Right of way: 84 feet wide
2. Pavement: Total width is 40 feet measured from edge of shoulder.
3. Travel Lanes: Two lanes, each 12 feet wide.
4. Paved Shoulder: 8 feet on each side for bikes and emergency parking.
5. Drainage: Open channel or swale system without curb and gutter.
6. Sidewalk: 5 feet wide on one side constructed 1 foot inside the right-of-way.
7. Pedway: 8 feet wide on one side constructed 1 foot inside the right of way.
8. Parking: Not permitted on either side.
9. Driveways: Controlled as to location and width for access management purposes.
10. Buffer Strip: 14-15 feet wide on each side. Trees permitted in the right of way when located outside of the drainage channel and 4 feet from edge of sidewalk or Pedway subject to compliance with city policies and regulations.
11. Utility Easements: Same as a standard Residential Street.

An **Option B** street will be considered or may be required when the following conditions exist: 1) the intended use or zoning of nearby land is residential or large open land areas such as parks, churches, and schools; and 2) the average daily traffic volume of the street is projected to exceed 15,000 vehicles in 20 years. Option B streets shall conform to the following design standards:

1. Right of way: 100 feet wide
2. Pavement: Total width is 40 feet measured from edge of shoulder.
3. Travel Lanes: One 12 feet wide lane on each side of a 12 feet center median.

4. Other Features: Same as Option A

An **Option C** street will be considered or may be required when the intended use or zoning of adjacent land is predominantly commercial, industrial, office, or institutional. Option C streets shall conform to the following design standards:

1. Right-of-way: 84 feet wide
2. Pavement: 48 feet wide measured from back of curb
3. Travel Lanes: Two 12 feet wide travel lanes plus a 12 feet wide center, two-way left turn lane.
4. Bike Lanes: Striped 6 feet wide bike lane on each side measured from back of curb
5. Drainage: A curb and gutter system is most common
6. Buffer Strip: 10 feet wide on each side. Trees permitted in the right of way when located 6 feet from edge of street and 4 feet from edge of sidewalk or Pedway subject to compliance with city policies and regulations.
7. Other Features: Same as Option A

Major Arterial Street Design Standards

A **Major Arterial** is a high volume multi-modal street (average daily traffic of 15,000 or more vehicles) which handles the bulk of through traffic within the city. Major Arterials connect to expressways and freeways as well as provide access to major traffic destinations such as regional shopping centers and major universities. These streets usually have at grade intersections which are spaced well apart. It is very common for Major Arterials to have four lanes with a continuous raised median except for a left turn lane at major intersections. Direct access to property is usually prohibited or limited to right-in, right-out and no on-street parking is permitted.

Two types of Major Arterial streets are permitted. Each type may be allowed or required depending upon the surrounding land use, traffic conditions or other circumstances.

An **Option A** will be considered or may be required when vehicle speeds are moderate, right of way is limited, and access is restricted thereby mitigating the need for a median. Option A streets shall conform to the following design standards:

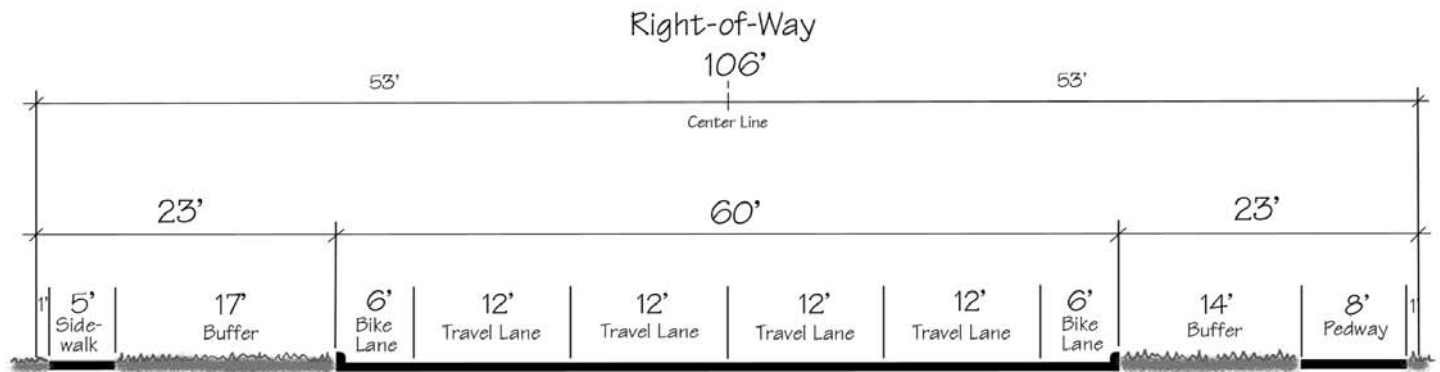
1. Right of way: 106 feet wide
2. Pavement: Total width of 60 feet measured from back of curb or edge of pavement
3. Travel Lanes: Four lanes each 12 feet wide
4. Bike Lanes: Striped 6 feet wide bike lane on each side measured from back of curb
5. Drainage: May be built with curb and gutter or an open swale

6. Sidewalk: 5 feet wide on one side constructed 1 foot inside the right-of-way
7. Pedway: 8 feet wide on one side constructed 1 foot inside the right of way
8. Parking: Not permitted on either side
9. Driveways: Controlled as to location and width for access management purposes.
10. Buffer Strip: 14-17 feet wide on each side. Trees permitted in the right of way located 10 feet from edge of street and 4 feet from edge of sidewalk or Pedway subject to compliance with city policies and regulations.
11. Utility Easements: Same as a standard Residential street.

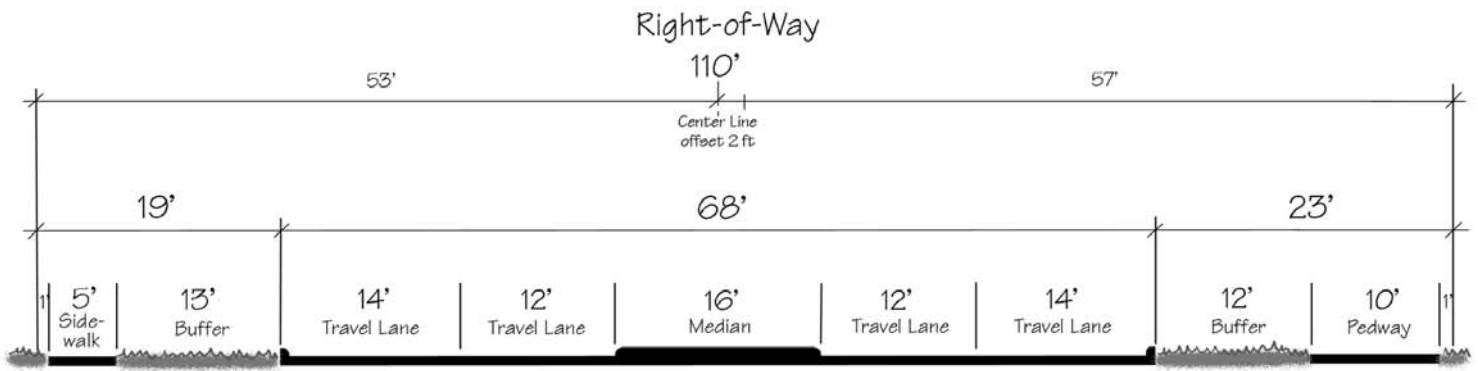
An **Option B** street will be considered or may be required when the projected average daily traffic volume of the street could reasonably exceed 20,000 vehicles in 20 years and/or the street connects to a freeway or expressway. Option B streets shall conform to the following design standards:

1. Right of way: 110 feet wide
2. Pavement: Total width of 52 feet measured from back of curb or edge of pavement
3. Travel Lanes: One 12 feet wide inner lane and one 14 feet wide outer lane on each side of a 16 feet wide center median which may include a 12' wide left-turn lane at intersections.
4. Bike Lanes: No bike lane on either side
5. Sidewalk: 5 feet wide on one side constructed 1' inside right of way
6. Pedway: 10' wide on one side constructed 1' inside right of way
7. Buffer Strip: 12-13 feet wide on each side. Trees permitted in the right-of-way located 8 feet from edge of street and 4 feet from edge of sidewalk or Pedway subject to compliance with city policies and regulations.
8. Other Features: Same as Option A

Requests for exceptions to the above design standards may be submitted at the time of preliminary plat review and shall be processed as a variance as provided by the Subdivision Regulations.

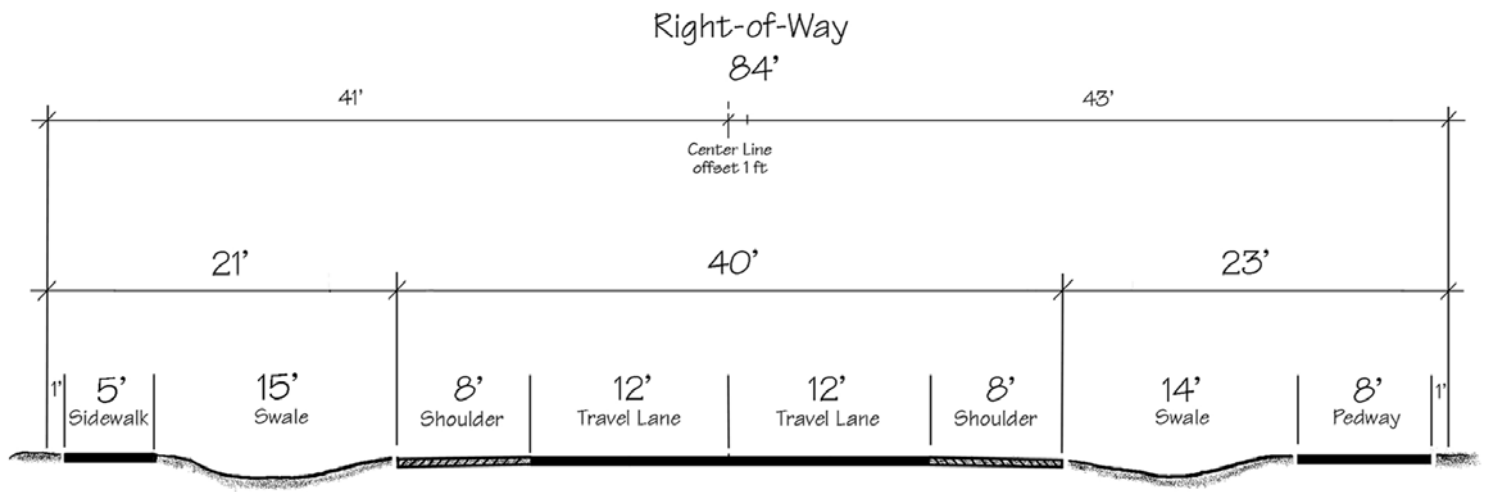


Major Arterial - Option 'A'

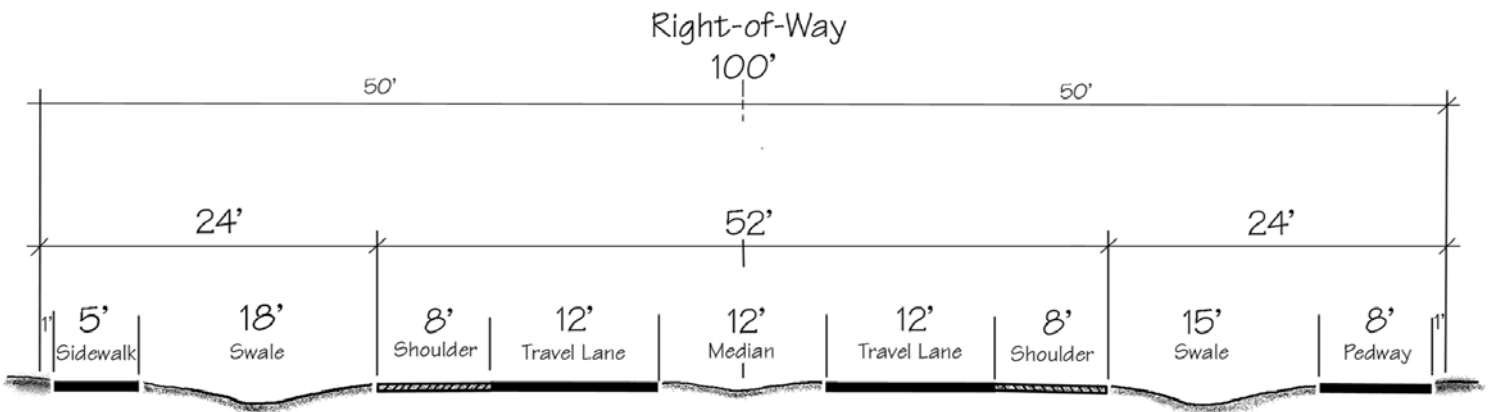


Major Arterial - Option 'B'

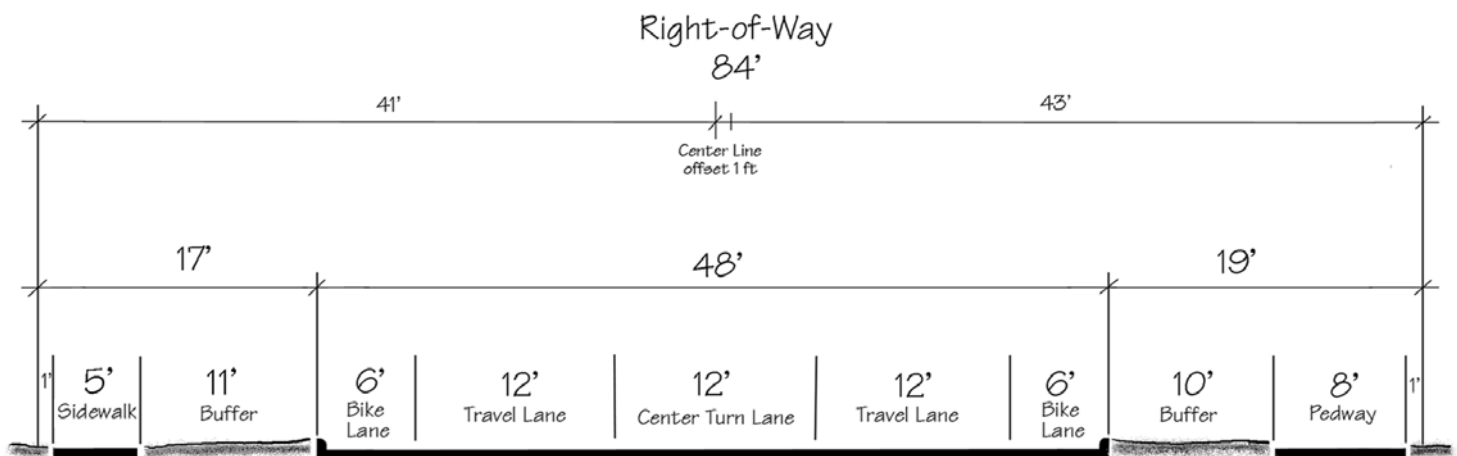
Major Arterials



Minor Arterial - Option 'A'

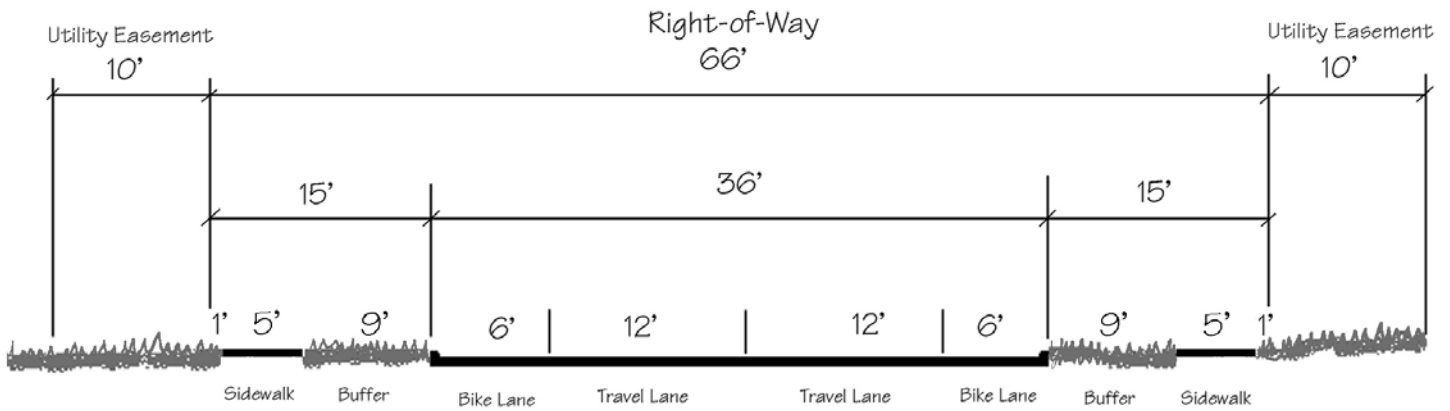


Minor Arterial - Option 'B'

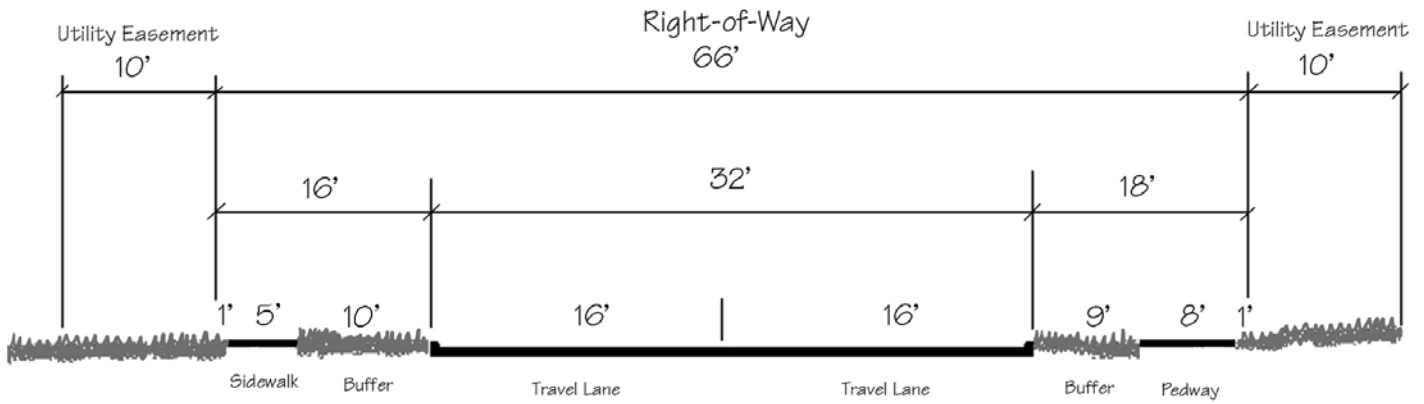


Minor Arterial - Option 'C'

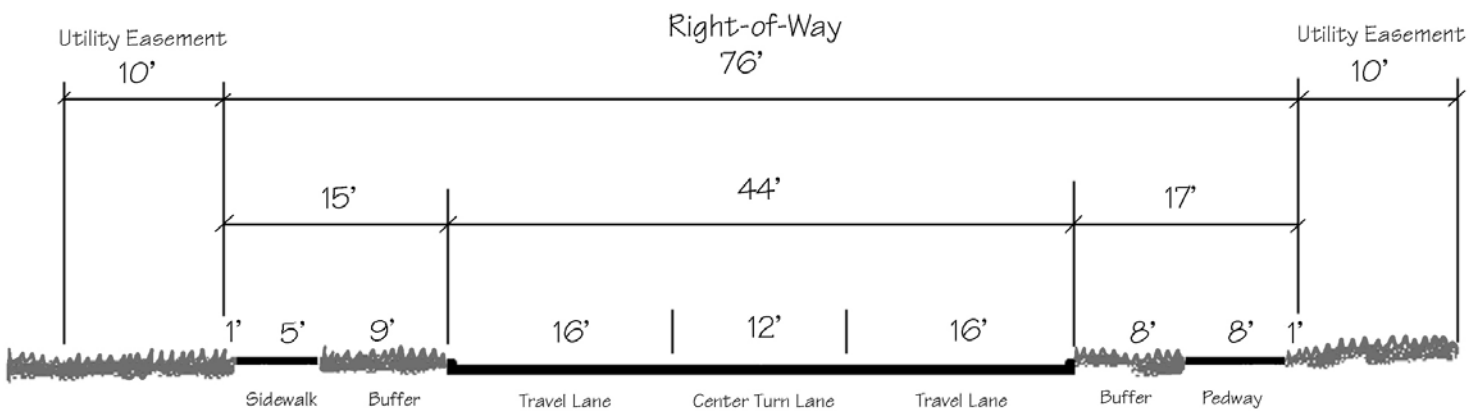
Minor Arterials



Major Collector

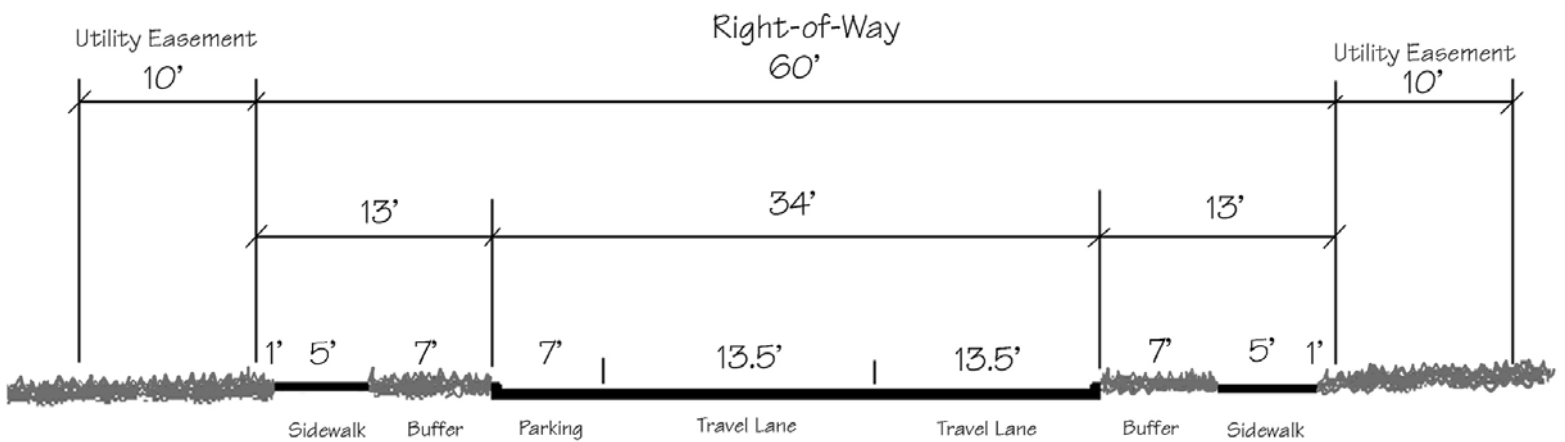


Major Collector 'Option A'

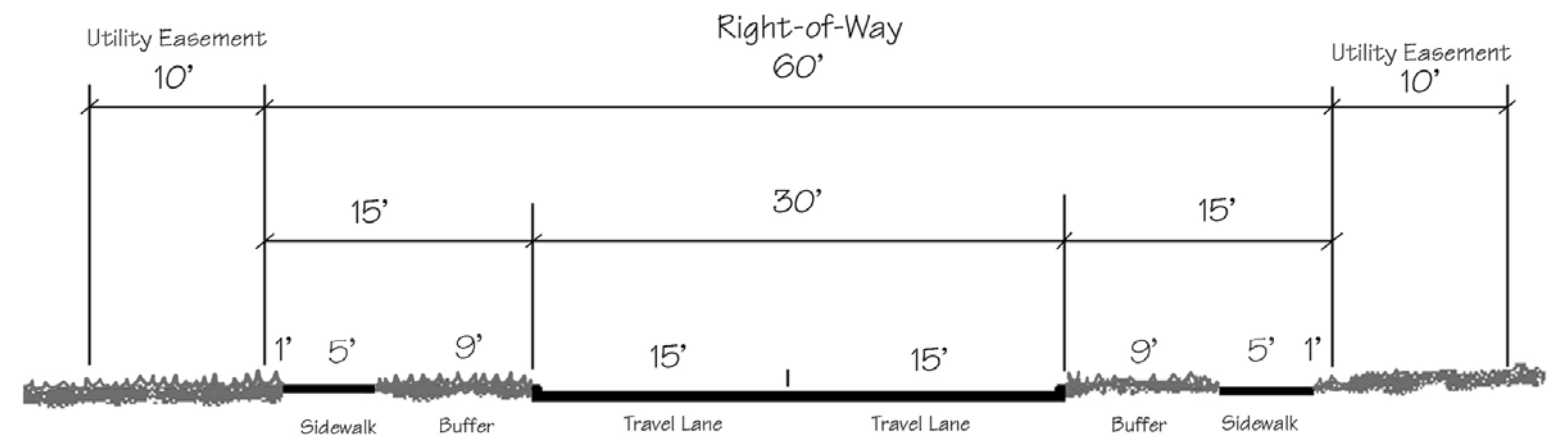


Major Collector 'Option B'

Major Collectors



Neighborhood Collector 'Option A'



Neighborhood Collector 'Option B'

Neighborhood Collectors

Appendix C:
July 11, 2012 Stakeholder Workshop
Meeting Notes



STAN SHAWVER, DIRECTOR

Boone County Northeast Traffic Study



Stakeholder Workshop Meeting Notes

Date:	July 11, 2012	
Time:	8:30 A.M. to 2:30 P.M.	
Location:	Boone County Commission Chambers	
Meeting Purpose:	Boone County, working in partnership with the City of Columbia and the Missouri Department of Transportation, is preparing a long-range transportation plan for the area bound by I-70, Mexico Gravel Road, Lake of the Woods Road, and Route Z. The study group conducted a technical workshop to prioritize future roadway improvements in this study area with a goal toward gaining consensus on priorities for long range improvements.	
Attendees:	Boone County Engineering Derin Campbell John Sullivan Jeff McCann Boone County Planning Thaddeus Yonke Uriah Mach Bill Florea Boone County Fire Gale Blomenkamp MoDOT Mike Dusenbergs Trent Brooks Mike Schupp Nicole Hood	City of Columbia John Glascock Scott Bitterman Richard Stone Pat Zenner CATSO Mitch Skov Rachel Bacon John Fleck CBB Shawn Leight Srinivas Yanamanamanda Shawn White Chris Brammeier

Discussion Points:

The study team provided an update of the work completed to date. The presentation is attached. The following meeting goals were discussed:

- Major Thoroughfare Plan
 - What roadways are needed to serve the ultimate build-out of the study area?
 - Can some of the proposed roadways be eliminated or downgraded?
 - Are we missing anything?
- Priorities
 - Which roads should be constructed first?
 - Are there triggers that will require specific projects?
 - How can these projects be phased over time?
- Agency Responsibility
 - MoDOT, Boone County, City of Columbia, Private Developers
- Funding



- What funding mechanisms exist to pay for all of this?
 - What are equitable ways to assign developer responsibility?
- Route Z/St. Charles Road
 - If the MoDOT Cost Share application is not successful, what are other options for improving the existing intersection?
- Subdivision Studies
 - Do the proposed site plans provide an appropriate internal roadway network considering future developments?

General Comments

- The study maps need to be updated to include other planned roadway improvements outside of the study area. The most recent CATSO map should be reviewed. Some specific examples include:
 - Connecting Lake of the Woods Road into Route PP
 - Extension of Battle Avenue north of Mexico Gravel Road
 - Extension of Route Z south of Richland Road
- Additional Roadways
 - The group considered adding an additional north/south collector roadway between Battle Avenue and Route Z, connecting the Clark Lane extension with and St. Charles Road (potentially ultimately connecting the Clark Lane extension with Mexico Gravel Road). It was pointed out that because of the way that Battle Avenue has been laid out this roadway is already shown on the CATSO long-range roadway plan.
- CBB should update speed limit exhibits.
 - Battle Avenue should be 45 mph (Note: the exhibit should reflect a potential school speed zone which will likely be put into place in the future when the schools open).
- Rice Road Extension
 - The group discussed an upcoming meeting with developers about a potential extension of Rice Road. Little was known about what the request would be but there was consensus that any major impacts of this extension should be considered in this study. (Note: the Rice Road extension meeting was subsequently held and it appears that the proposed extension would have little impact to this study. However, if a bridge were to be constructed at some time in the future connecting Rice Road with Vandiver Drive, some background traffic would be pulled off of study roadways such as Lake of the Woods to the new connection).
- City of Columbia/Boone County Partnerships
 - The need for coordination/partnerships between the City of Columbia and Boone County was discussed. These two agencies currently have very different philosophies with regards to road building. While Boone County maintains a position that they do not have funds to build new roads (deferring, rather, to the development community to get roads built) the City of Columbia has taken the stance that it is the City's responsibility to build arterial roadways to serve their citizens and the business community. These agencies will need to develop creative partnering agreements and work together to get roadways built.
 - One model would be for Boone County to plan for and reserve corridors for new roadways. This would include requiring property owners to plat and reserve right-of-way for roadways in the CATSO plan. This would provide a corridor for the City of Columbia to construct these roadways in the future. "Rolling Hills" was put forward of



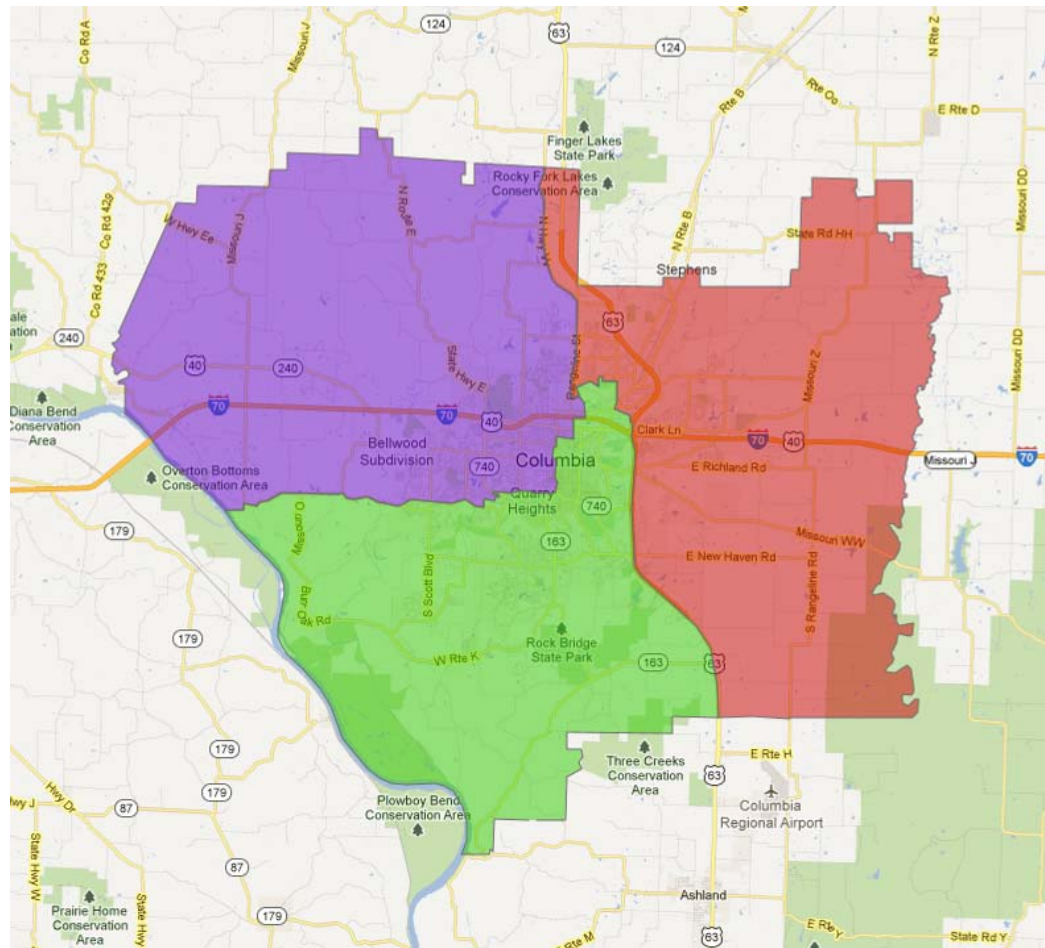
an example of how an intergovernmental agreement such as this could work. In this case the City of Columbia and Boone County shared the cost to build a roadway outside of the City's Limits (in Boone County) because the roadway would be important for the City as development and annexation occur.

- **Cost Estimates**

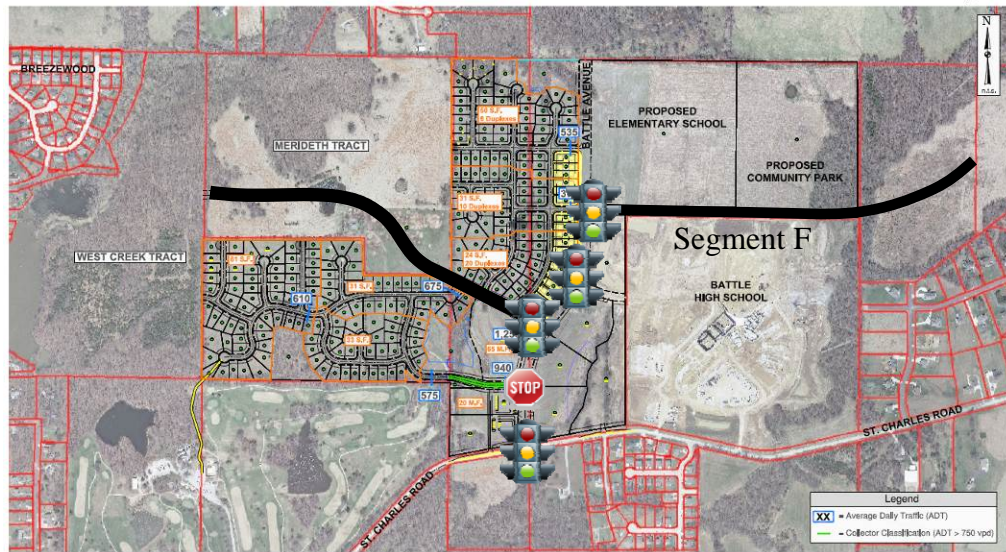
- CBB created lineal foot cost estimates based on functional classifications as provided by the City of Columbia and Boone County, typical sections from the City of Columbia, and pavement widths from Boone County. Lineal foot costs include: grading, aggregate base, pavement, shoulders, curb and gutter, drainage, signing and striping.
- Additional costs were added based on field observations/aerial photography for major drainage culverts and bridges/overpass.
- Right-of-way costs
 - Right of way acreage was calculated based on typical sections and \$7,500.00 per acre.
 - Easement acreage was calculated based on typical sections and \$5,000 per acre and 20 foot width.
- The following contingencies were factored into the cost estimates:
 - 15% base,
 - 15% Engineering/Surveying and Permitting, and
 - 9% Construction Inspection and Administration.
- The group was comfortable with these assumptions.

Battle Avenue Extension (Segments A, B, and D)

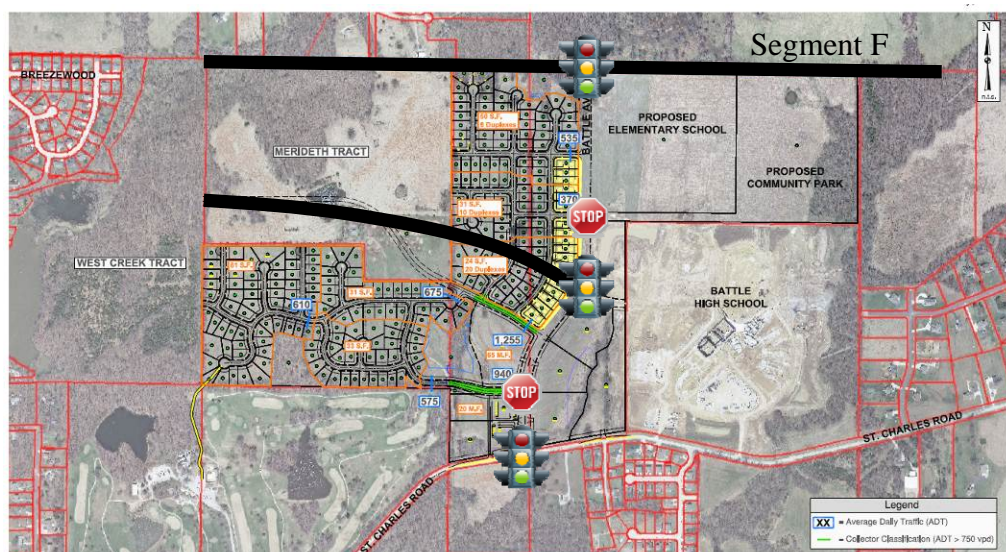
- Segments A, B, D are high priority improvements.
 - These roadways would provide a north-south arterial roadway and also serve Battle High School and proposed elementary school. Battle Avenue would connect the neighborhoods north and south of I-70.
- There will likely be commercial development at/near the intersection of Battle Avenue and St. Charles Road. CBB was asked to work with CATSO to reevaluate land use and make sure commercial uses are considered in the forecasts.
- Construction of Battle Avenue extension would be publically funded.
- A map showing current high-school boundaries is shown below:



- Extend Battle Avenue north to Mexico Gravel Road (Segment A)
 - The group agreed that this is a critical connection and should be given the highest priority.
 - The connection will feed the Battle High School and future elementary school from the north.
 - The fire district considered Segment A to be their top priority. Segment A provides secondary access into and out of the Battle High School and proposed elementary school. Two routes of access are critical to provide simultaneous emergency response ingress and citizen evacuation egress. Two access routes are also critical in the event that one access route is blocked.
 - A review of current site plans highlighted the need to evaluate access management along the section of Battle Avenue between St. Charles Road and Segment F.
 - Considering the proposed park/elementary school access, Battle High School access, Somerset Village access points, and intersection with St. Charles Road, current site plans show 5 separate intersections proposed within about 1,800 feet (or about 450 feet between intersections). Traffic signals may be desired at several of these intersections as is shown below. This would result in traffic signals that are located too close together.



- The group agreed that it would be better to show Segment F relocated on the north side of the elementary school and reconfigure the Somerset Village collector so that it ties in across from Spartan Drive (Battle High School). This would result in traffic signals at St. Charles Road, Spartan Drive (Battle High School)/relocated Somerset Village collector, and relocated Segment F. This would provide about 1,500 feet spacing between these traffic signals. Additional unsignalized intersections could be provided at 1) a second Somerset Village access point (between St. Charles Road and the Spartan Drive/relocated Somerset Village collector) and 2) the proposed park access road (between relocated Segment F and Spartan Drive/relocated Somerset Village collector). This is a more desirable intersection configuration.



- The group discussed how to get segment "A" constructed. There was agreement that, although developer participation is possible, construction of this portion of Battle Avenue would mostly likely be publically funded. The group agreed that a partnership between the



City of Columbia and Boone County (as discussed above) would be critical to getting this completed.

- Extend Battle Avenue south to connect with an extension of Clark Lane (Segment B)
 - The group agreed that this is a very critical connection and should be a high priority. This connection would feed the Battle High School and future elementary school from the south.
- Extend Battle Avenue south with Olivet Overpass to Richland Road (Segments D)
 - The group agreed that this is a critical connection and should be given a high priority. It will feed the Battle High School and future elementary school with traffic from south of I-70.
 - The alternate routes for this traffic include Richland Road to the Route Z overpass or the Lake of the Woods Road/St. Charles Road overpass. One of the primary benefits of this connection is that it would reduce traffic at the interchanges of I-70 with St. Charles Road/Lake of the Woods Road and Route Z interchanges by 10-15%.
 - An I-70 overpass would cost \$2-3M to construct.
 - Separate studies will be required to obtain MoDOT and FHWA permits for the I-70 overpass.
 - The group clarified that the overpass would tie into the proposed South Olivet Road extension to the South Outer Road.
 - If Segment D cannot be constructed to meet with South Olivet Road, an initial phase may be constructed to connect to the South Outer Road.
 - The construction of this roadway may require a Boone County/City of Columbia/MoDOT intergovernmental agreement.

Clark Lane Extension (Segments C, E, and I)

- This roadway is needed for two primary reasons:
 - Facilitate commercial development.
 - Provide an east-west arterial corridor to relieve traffic from St. Charles Road. St. Charles Road is narrow and has poor geometrics to serve as an arterial roadway. It would be difficult to straighten/widen St. Charles Road without major right-of-way and utility impacts. The Clark Lane extension corridor provides a good alternative corridor for an east-west arterial roadway in this part of the study area.
- The group discussed a general strategy for how this roadway could be completed. In the most likely scenario the development community would construct a collector roadway to provide connections to their businesses. Developers would be required to plat, dedicate right-of-way and construct a collector roadway. A public project would then be required to upgrade to an arterial roadway.
- Extend Clark Lane east to connect with an extension of Battle Avenue (Segment C)
 - Constructing "C" minimizes traffic on St. Charles Road. It may even be possible to cul-de-sac St. Charles Road in this section.
 - There was some discussion that the western portion of the Clark Lane extension may need to be a publically funded roadway. Coupled with improvement B this would provide an improved connection to Battle High School and the proposed future elementary school.
- Extend Clark Lane from Segment C to Segment G (Segment E)
 - This roadway would be required to facilitate future commercial development. As such, the development community would most first construct a collector roadway to provide



connections to their businesses. A public project would then be required to upgrade to an arterial roadway.

- Relocate I-70 NOR/ABC Drive (Segment I)
 - This connection would provide for a relocation of the North Outer Road which is important for Route Z/I-70 interchange operations. The relocation of the North Outer Road would provide better spacing between the I-70 interchange westbound ramp terminal intersection and North Outer Road intersection.
 - This connection should be placed to provide for an enhanced connection to the Columbia Area Jobs Foundation (CAJF) site and private developable area to the east of Route Z.

Proposed Collector Roadways (Segments F and G)

- East/west collector across Copper Creek to Battleground property (Segment F)
 - Planning for Segment F was expanded from its original limits (between Battle Avenue and North Battlefield Subdivision) to new limits (between Lake of the Woods Road and Route Z). This was partly due to concerns about allowing subdivision cross-access between the Merideth/West Creek Tracts and Breezewood/Molly Lane. This cross-access could result in these local roadways becoming “default” collector roadways. People are likely to use the local connections if they are in place and there is not a better alternative route. Breezewood and Molly Lane were not designed to collector roadway specifications and increased traffic volumes would be a problem for the residents along these routes. Therefore, the group felt that a collector roadway (extended Segment F) should ultimately provide a collector roadway connecting Battle Avenue and Lake of the Woods Road. Similarly, the group felt that this connection should extend to Route Z.
 - The fire district considers Route F as an important way to get secondary access into the neighborhoods in the north part of the study area. This is especially critical in the absence of Segment A.
 - Segment F should be broken down into sub areas for evaluation. Segment F will most likely be implemented in pieces (each with independent utility and different challenges).
 - West End (Battle Avenue to Lake of the Woods)
 - This segment is needed for connectivity.
 - Segment F is critical to avoid overloading Battle Avenue north of St. Charles Road. The western part of Segment F would provide a connection between Lake of the Woods and Battle High School/the future elementary school.
 - The consultant team will quantify the impact of this connection to traffic on Lake of the Woods Road. Lake of the Woods road is narrow with homes on it. It may be difficult to widen in the future. The consultant will also quantify the impact to the proposed roundabout at the intersection of St. Charles Road and Lake of the Woods Road.
 - The group discussed how to get this section of segment “F” constructed. The western end of Segment F is anticipated to have high construction costs (due to terrain); it may not be attractive for developers to construct. Segment F could be a shared project with partial public funding and developer responsibility. For instance, a developer could be asked to build the roadway with a public agency taking responsibility for major culverts and/or any required bridges.
 - A location study needs to be conducted to set the western portion of Route F.
 - The most logical route (from a roadway system standpoint) would be to connect the west end of this roadway midpoint along Lake of the Woods

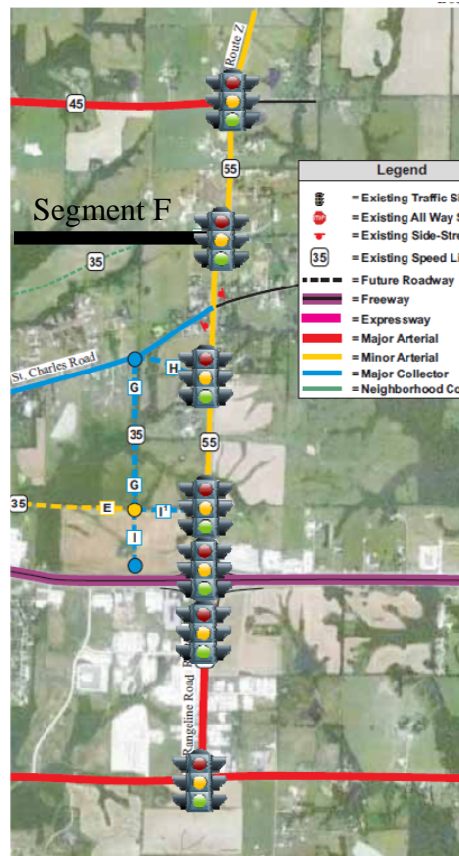


Road. However, this may be prohibitive due to terrain and existing development. Alternatively, the road could swing to the north and connect to Lake of the Woods road closer to Mexico Gravel Road. However, the impact of closely spaced intersections on the northern section of Lake of the Woods Road needs to be considered.

- The east end of this segment could connect at either Spartan Drive or on the north side of the Merideth Tract. Connecting on the north side of the Merideth Tract would provide an opportunity for a continuous roadway. Connecting to Spartan Drive could result in Segment F being off-set across Battle Avenue. It is possible, depending on how the Merideth Tract develops, that both connections could be provided.
- This study needs to consider the proposed alignments of Lake of the Woods Road, Mexico Gravel Road, and Route PP as shown on the most recent CATSO future roadway map.
- Center Section (near Battle Avenue)
 - The group recommended that the center portion of Segment F be located north of the proposed elementary school, as shown in CATSO long range plan.
 - This would provide for better signal spacing along Battle Avenue, with traffic signals anticipated at St. Charles Road, Battle High School, and Segment F. If connection is placed on the south side of the park then only 400' would be provided between Battle High School and Segment F (see previous discussion of Battle Avenue).
 - This would also provide an opportunity for a continuous roadway. Routing the center section of Segment F utilized the proposed park property south of the future elementary school could result in Segment F being off-set across Battle Avenue.
- North/south collector road (Segment G)
 - This roadway would be required to facilitate future commercial development. As such, the development community would most first construct a collector roadway to provide connections to their businesses. A public project would then be required to upgrade the roadway to a higher standard if required in the future.

Route Z

- Intersection placement needs to be carefully considered along Route Z. Ideally spacing should be about one-half mile. Per the diagram below one-half mile spacing of the major intersections (future traffic signals or roundabouts) can be achieved with the proposed plan between Mexico Gravel Road and the North Outer Road. Major intersection spacing would be less than one-half mile at the I-70 interchange (between the North Outer Road and the South Outer Road).

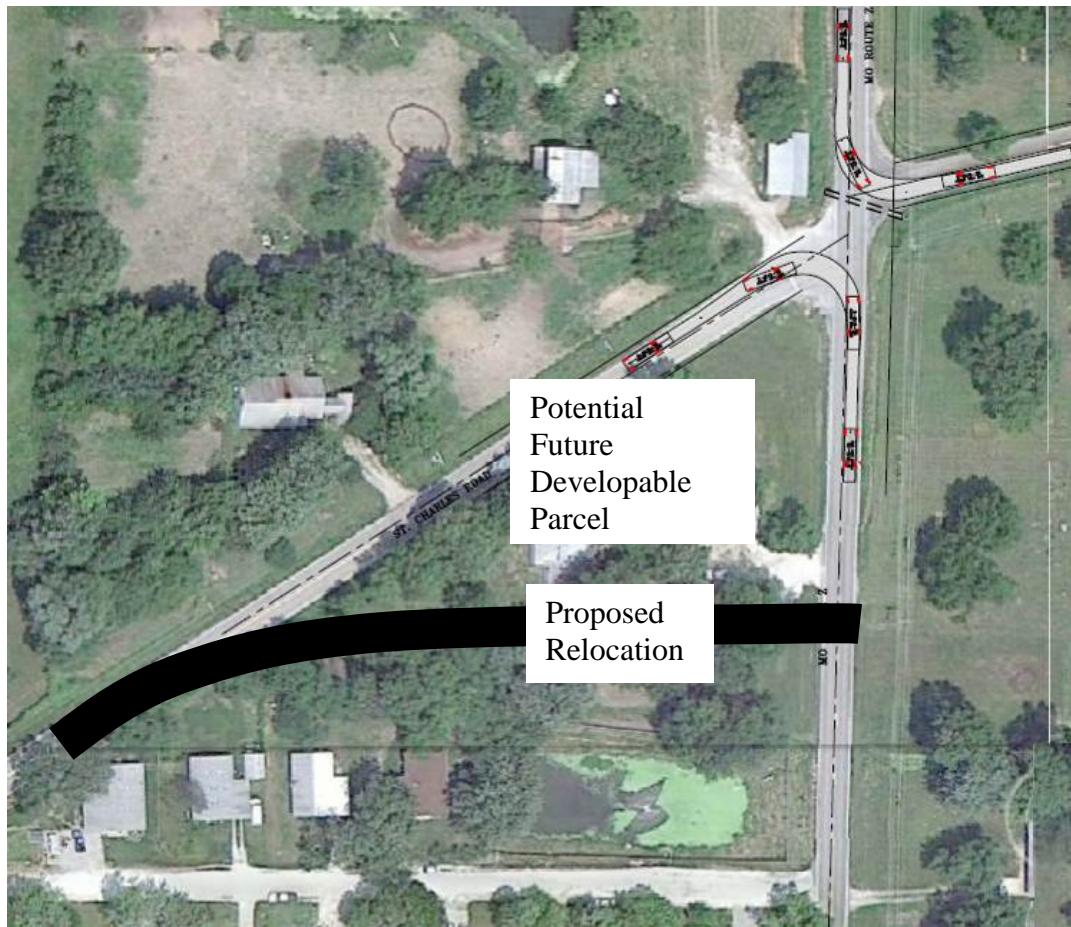


- A cost-share/economic development application has been submitted by MoDOT for improvements to the Route Z corridor. If approved, improvements would include:
 - Reconstructing the Route Z/I-70 overpass to three-lanes and providing dedicated southbound and eastbound right-turn lanes at the interchange. (Note, per the discussion below, if the Route Z over pass is reconstructed, it would be desirable to reconstruct with three lanes and shoulders such that it could be restriped to four-lanes in the future if traffic volumes warrant four-lanes on the bridge).
 - Adding shoulders to Route Z between I-70 and relocated St. Charles Road;
 - Constructing a roundabout at the intersection of Route Z and relocated St. Charles Road. (Note, this improvement would require that Boone County relocate St. Charles Road as shown in Segment H).
- Improvements from relocated St. Charles Road to Mexico Gravel Road could be submitted to MoDOT's Cost Share/Economic Development program as the second phase of Route Z improvements
- Relocate intersection of St. Charles Road/Route Z (Segment H)
 - The existing intersection of St. Charles Road and Route Z has several geometric deficiencies. The primary problems are 1) poor sight distance and 2) off-set skewed intersection resulting in poor turning radii. School busses can make all turns at the intersection if automobiles stop at the marked stop bars. However, eastbound traffic cannot see "around" the barn and tends to move forward past the stop bar. As a result, school busses cannot make the northbound to westbound left turning movement when there is a vehicle on the eastbound approach. This will become a much bigger issue when the Battle High School opens in 2013 and the future



elementary school is opened in the future. WB-50 trucks cannot make several of the turning movements at the intersection. See photo and auto-turn templates in the attached PowerPoint presentation.

- The fire district considers improving the St. Charles Road/Route Z intersection as a high priority. The Fire district considers this intersection as a dangerous condition given the Battle High School opening in 2013.
 - Two primary options were discussed to improve this intersection. CBB will complete additional work to evaluate these alternatives. The final decision about which alternative to pursue will be dependent upon 1) success of MoDOT cost-share/economic development application, 2) ability of Boone County to obtain right-of-way for relocated St. Charles Road, 3) cost of both options, and 4) short and long term traffic operations of the two alternatives.
- Option 1: Relocate St. Charles Road and tie into Route Z with a Roundabout (Segment H).
 - Pros:
 - Segment H addresses the long-term safety/geometric deficiencies at Route Z / St. Charles Road intersection. The proposed roundabout would provide good traffic operations on Route Z
 - This alternative is consistent with MoDOT's Cost Share/Economic Development application.
 - This option provides good access to the Columbia Area Jobs Foundation (CAJF) site and private developable area to the east of Route Z.
 - Cons:
 - Right-of-way has not been secured by Boone County for St. Charles Road relocation.
 - Existing Intersection: Relocating St. Charles Road provides some options for treating the existing St. Charles Road/Route Z intersection. The preference would be 1) Cul-de-sac, 2) create a right-in right-out intersection, or 3) improve radius for left turns at the existing intersection and create off-set intersections for St. Charles Road across Route Z.
 - Option 2: Relocate St. Charles Road along the southern boundary of the parcel in the southwest quadrant and create a T-intersection with Route Z.
 - Pros:
 - Improve radius for left turns at the existing intersection.
 - This option minimizes utility conflicts and moves the intersection further away from the historic barn which is creating sight distance problems. CBB will draw-up and generate cost estimate. See drawing below for a rough sketch.
 - A developable parcel would be created.



- Cons:
 - The alternative would be a complete take of the property. The existing home would have to be demolished.
 - This alternative would put St. Charles Road closer to the homes on Karen Avenue.
 - This alternative is NOT consistent with MoDOT's Cost Share/Economic Development application.
 - This alternative may not be a long term fix for traffic operations. It creates off-set intersections with St. Charles Road across Route Z. CBB will investigate traffic operations of this alternative.
- Karen Lane Access
 - Improving the intersection of St. Charles Road and Route Z provides an opportunity to “flip” Karen Lane access from Route Z to St. Charles Road. Karen Lane is currently gated on the St. Charles Road end. The gate was put into place to stop cut-through traffic from St. Charles Road to Route Z caused by the issues at the existing intersection. If the intersection is improved the gate could be moved to the Route Z end of Karen Lane thus providing access via St. Charles Road instead of directly onto Route Z.
- Route Z/ I-70 Interchange



- Future AADTs of 17,000 to 19,500 vehicles per day are anticipated at the Route Z/I-70 overpass. This bridge will be rehabilitated/reconstructed in 2013. If possible, it should be reconstructed with three lanes and shoulders such that it could be restriped to four-lanes in the future if traffic volumes warrant four-lanes on the bridge.

Subdivision Studies

- A collector roadway will be required through Somerset Village subdivision (especially when the Meredith and West Creek tracts are considered). It would be desirable to reconfigure this collector so that it ties in across from the Battle High School Drive (See Battle Avenue discussion).
- North Battleground Subdivision will not see high enough traffic volumes to warrant a collector roadway within the subdivision. However, the subdivision will have a cumulative impact on the local roadway system and should be subject to local traffic impact fees to mitigate their impact to local roadways. Two access routes will be required to provide for emergency responder access/evacuation.

Financing Summary

Segment	Responsible Agencies	Comments
A – Battle (North)	<ul style="list-style-type: none"> • Boone County • City of Columbia • May have developer participation 	May require a Boone County/City of Columbia intergovernmental agreement.
B – Battle (Center)	<ul style="list-style-type: none"> • Boone County • City of Columbia • May have developer participation 	May require a Boone County/City of Columbia intergovernmental agreement. Primarily a public project, but may have a private developer component.
C – Clark Lane (West)		
D – Battle (South)	<ul style="list-style-type: none"> • Boone County • City of Columbia • MoDOT 	May require a Boone County/City of Columbia/MoDOT intergovernmental agreement. Separate studies will be required to obtain MoDOT and FHWA permits for the overpass.
E – Clark Lane (Center)	<ul style="list-style-type: none"> • Development Community • Boone County • City of Columbia • MoDOT (intersection with Route Z) 	Developer driven for initial connection. Developers would be required to plat, dedicate right-of-way and construct a collector roadway. A public project would be required to upgrade to an arterial roadway.
I – Clark Lane (East)		
F – East-West Collector	<ul style="list-style-type: none"> • Development Community 	Most likely primarily developer financed roadway. The portion west of Battle Avenue is



	<ul style="list-style-type: none">• Boone County• City of Columbia	anticipated to have high construction costs; it may not be attractive for developers to construct. This portion could be a shared project with partial public funding and developer responsibility. For instance, a developer could be asked to build the roadway with a public agency taking responsibility for major culverts and/or any required bridges.
G – North-South Collector	<ul style="list-style-type: none">• Private	Most likely developer financed roadway.
H – St. Charles Rd/Route Z	<ul style="list-style-type: none">• Boone County• MoDOT	Currently being pursued as Boone County/MoDOT partnership through cost share/economic development application.

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August 3, 2012
August 8, 2012
August 30, 2012

Appendix D:

MoDOT Access Management Guidelines

**MISSOURI DEPARTMENT OF TRANSPORTATION
ACCESS MANAGEMENT
GUIDELINES**

2006

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1.0 ANALYSIS OF RETROFIT AND PERMIT APPLICATIONS

Where access is being managed on an existing roadway (a retrofit or permit project), it is often not possible to incorporate and attain all of the access management criteria due to economic, physical or other constraints. Care must be taken to balance economic interests with transportation needs. Economic impacts to business must be carefully considered and efforts must be made to mitigate those impacts. Collaboration with property owners and other stakeholders is the most effective method to achieve improvements that satisfy both operational and economic needs.

The collaboration process should begin in the early stages of the project. MoDOT staff should discuss the fundamentals and benefits of managed access with the stakeholders. Emphasis should be placed on safety and operational benefits and how those benefits can have a positive impact on property values and the business climate. Most stakeholders are more receptive after they gain an understanding of the concepts.

Understanding the concepts may not completely alleviate concerns. Adjoining property owners can remain hesitant to application of the principles on their individual properties. Personal meetings with each property owner to discuss and mitigate the needs of their site are often the best way to alleviate the concerns. Multiple meetings with some individuals may be necessary as proposals are discussed and their impacts are assessed. The resulting design may not be entirely satisfactory to either party. Instead the goal of the process should be to produce acceptable operational and safety impacts, while gaining consent of the stakeholders.

In cases where the access management criteria cannot be met, a detailed analysis should be performed to determine the optimum solution. This solution should strive to improve safety and operations along the roadway, and maintain uninterrupted flow on the transportation system and adequate access to the adjoining properties. Flexibility, good judgment, negotiation and compromise will be necessary to determine the right solution for each particular location.

While Highway Capacity Manual procedures can provide quick and reliable results for predicting whether or not a facility will be operating at or below capacity, they are generally limited in their ability to evaluate systems effects, queues and the effects of queues, and over saturated conditions. Additionally, there are several gaps in the Highway Capacity Manual procedures, such as roadways with the following:

- closely spaced traffic signals
- two-way left turn lanes
- roundabouts
- tight diamond interchanges
- freeway weaves
- other unique scenarios

In cases where Highway Capacity Manual procedures will not adequately analyze the roadway improvements, a microsimulation analysis may be appropriate. The VISSIM software package has been identified as the most capable of analyzing the limitations and gaps of the Highway Capacity Manual. In regards to roundabouts, the Highway

Capacity Manual may be used as a primary check of a roundabout's capacity, but additional operational analyses should use either the SIDRA or VISSIM software package.

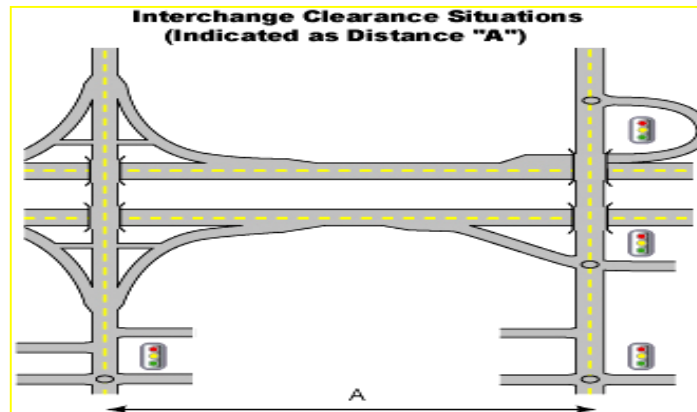
2.0 SPACING BETWEEN INTERCHANGES

What This Guideline Means

Adequate spacing is needed between grade-separated interchanges on high-speed roads to allow for safe and efficient weaving or changing of lanes for traffic that is entering and exiting. Generally, speeds are higher in rural areas; therefore, interchanges must be spaced farther apart there than in urban areas.

Interchange spacing decisions should be supported by an operational and level of traffic service analysis. Connectivity, speed, and safety should also be considered. In highly dense urban central city areas, the configuration of the local street system may require a closer interchange spacing to maintain connections and mobility.

Diagram



Guideline

Roadway Classification	In Current and Projected Urban Areas	In Rural Areas
Major	2– 3 miles *	2 – 5 miles
Minor	Generally Not Applicable	Generally Not Applicable

* Spacing less than two miles in urban areas may be considered, when analysis indicates the lesser spacing is acceptable. However, all other options should be considered, before spacing is reduced.

Spacing greater than the distances shown is advantageous for safety and operations. Distances shown are between the centers of interchanges.

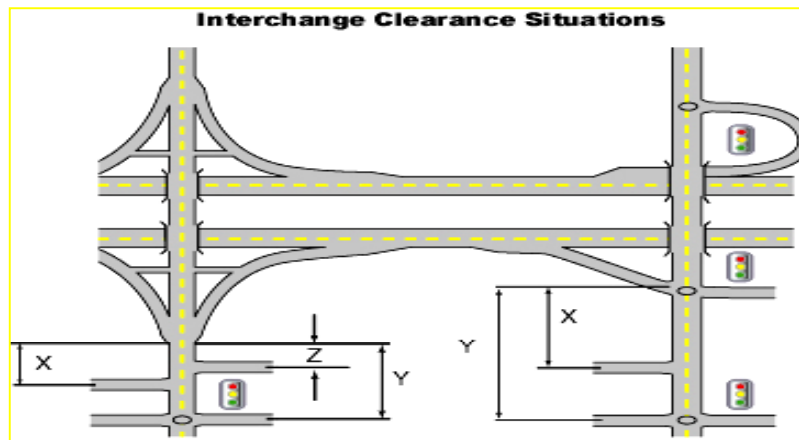
3.0 CLEARANCE OF FUNCTIONAL AREAS OF INTERCHANGES

What This Guideline Means

Adequate space is needed for traffic to make the transition from a road with interchanges to a road with at-grade access points. The functional area of the interchange is the area in which merging and diverging of traffic takes place. Drivers must travel along an exit ramp, find acceptable gaps, change lanes (weave), and merge within this distance.

A safe distance for this activity to occur should be provided from the end of the off ramp to the first driveway, median opening, or intersection with a public road. (This is measured from the point of intersection of the ramp baseline and roadway centerline.) When only right turns into or out of driveways or public roads are involved, a shorter clearance area may be used. These guidelines also apply to on-ramps and off ramps not associated with an interchange.

Diagram



X = Distance from baseline off-ramp to first right-in, right-out driveway/public road intersection.

Y = Distance from baseline off-ramp to first major public road intersection, full median opening, or left-turn opportunity.

Z = Distance from last right-in, right-out opportunity to baseline on-ramp.

Spacing greater than the distances shown is advantageous for safety and operations.

Guidelines for Interchange Area Clearance

Type of Area	Distance from Ramp to Right-In, Right-Out Driveway (X)	Distance to First Major Public Road Intersection, Full Median Opening, Or Left-Turn Opportunity (Y)*
Major	750 feet – 1,320 feet	1,320 feet – 2,640 feet
Minor	Generally Not Applicable	Generally Not Applicable

*Left turns should not be allowed in this section of roadway. The public road intersection is likely to become a signalized intersection as the interchange area develops. Right –in, right –out driveways configuration should include a non-traversable median.

Note: All ramp measurements are taken to or from baseline ramp.

Any clearance of less than the range contained in the above table should be supported by a study of alternatives to ensure safety and traffic flow. All reasonable alternatives, including relocating the interchange to a different location should be considered. Other alternatives to be examined may include installation of raised medians, construction of a single point urban interchange, the use of roundabouts at the ramp and or outer road intersections, or alternative access ways such as frontage and backage roads.

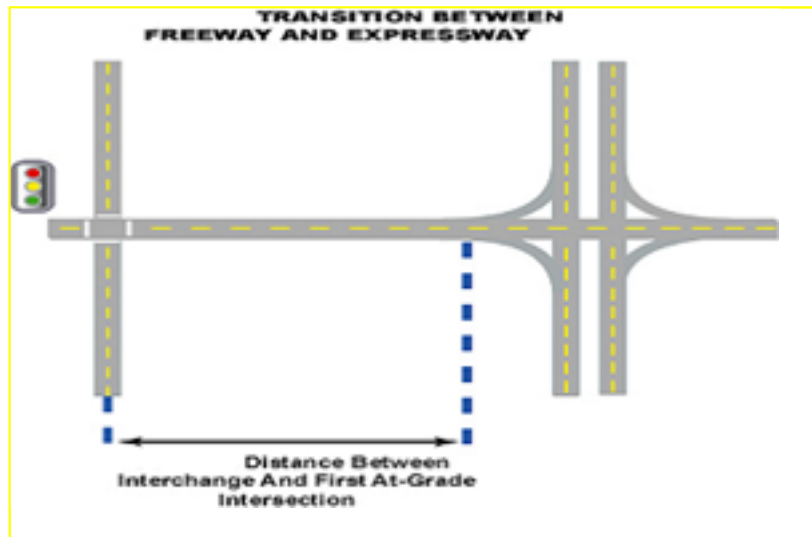
4.0 FREEWAY AND EXPRESSWAY TRANSITION

What This Guideline Means

Some major roads will consist of a mixture of freeway (with grade-separated interchanges and no driveway accesses) and expressways (with at-grade public road intersections and driveways). The transition between freeway and expressway must be carefully planned so drivers are well aware that a change in the access character of the roadway has occurred. This guideline does not apply to minor roads.

The following distances should be provided between the taper of the final ramp on a freeway cross section to the first at-grade intersection (and potentially the first traffic signal) on an expressway cross-section on the same facility.

Diagram



Guideline

Roadway Classification	In Current and Projected Urban Areas	In Rural Areas
Major - Freeway	No at-grade intersections	No at-grade intersections
Major - non Freeway	½ mile (2,640 feet) – 1 mile (5,280 feet)	1 mile (5,280 feet)
Minor	Generally Not Applicable	Generally Not Applicable

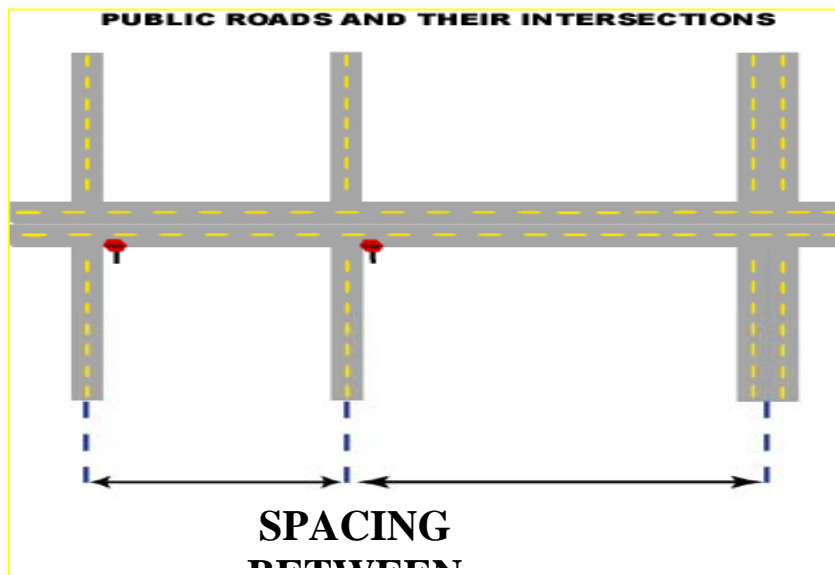
Spacing greater than the distances shown is advantageous for safety and operations.

5.0 AT-GRADE INTERSECTIONS SPACING

What This Guideline Means

This guideline provides for adequate spacing between intersections. Major roadways are mainly intended to serve through traffic and should have intersections that are spaced the farthest apart. Minor roadways provide some service to through traffic but also provide direct access to property; therefore, they can be placed closer together.

Diagram



Guideline

Roadway Classification	In Current and Projected Urban Areas	In Rural Areas
Major - Freeway	No at grade intersections	No at grade intersections
Major – Non Freeway	½ mile (2,640 feet) – 1 mile (5,280 feet)	> 1 mile (5,280 feet)
Minor	⅛ mile (660 feet) - ¼ mile (1,320 feet)	¼ mile (1,320 feet) - ½ mile (2,640 feet)

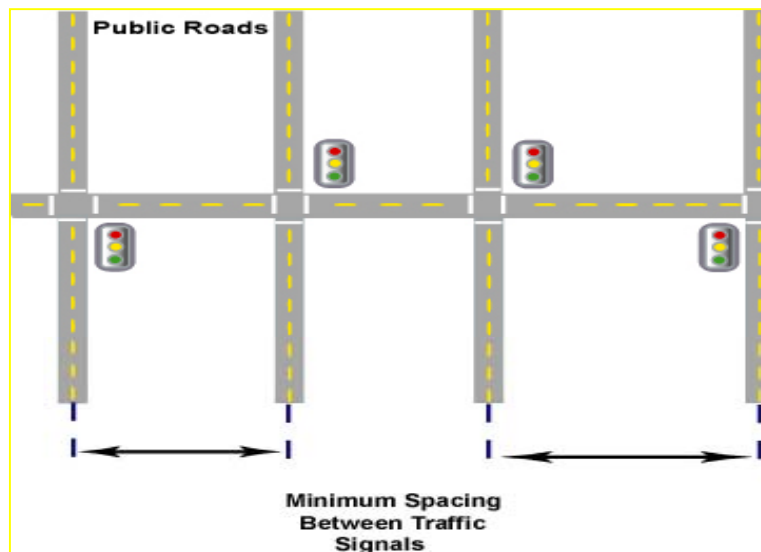
Spacing greater than the distances shown is advantageous for safety and operations.

6.0 TRAFFIC SIGNAL SPACING

What This Guideline Means

Appropriate signal spacing is needed to preserve efficient traffic flow and progression on urban arterial roadways; for instance, a quarter- or half-mile spacing allows traffic signals to be effectively interconnected and synchronized. Adequate spacing will also tend to reduce rear-end collisions and “stop and go” driving that increases congestion, delay, and air pollution. In urban areas, these guidelines were developed to allow for smooth operations given a 90-second total traffic signal cycle length.

Diagram



Minimum Guideline

Roadway Classification	In Current and Projected Urban Areas	In Rural Areas
Major - Freeway	Traffic signals not allowed	Traffic signals not allowed
Major – Non Freeway	½ mile (2,640 feet) to 1 mile (5,280)	See note below *
Minor	¼ mile (1320) to ½ mile (2,640 feet)	See note below *

* Rural traffic signals are generally isolated signals rather than signals placed in a progression along a route. Signals should be placed at least one mile (5,280 feet) apart because of high operating speeds in rural areas.

7.0 MEDIAN OPENING SPACING

What This Guideline Means

Openings in raised medians should only be provided to accommodate turning traffic in locations where this can be safely done. Where openings are provided, an adequate spacing between them is necessary to allow for weaving of traffic to preserve traffic flow and provide for safe lane changes and turns.

A full opening allows turns to be made in both directions; a directional opening allows turns to be made in only one direction. An example of a directional median would be one that allows left turns into a driveway but does not allow left turns to be made out.

Median openings should not be allowed under the following circumstances:

- On interstates or other freeways
- Within the functional area of an interchange
- Within the functional area of an intersection between two public roads
- At locations that have high accident rates

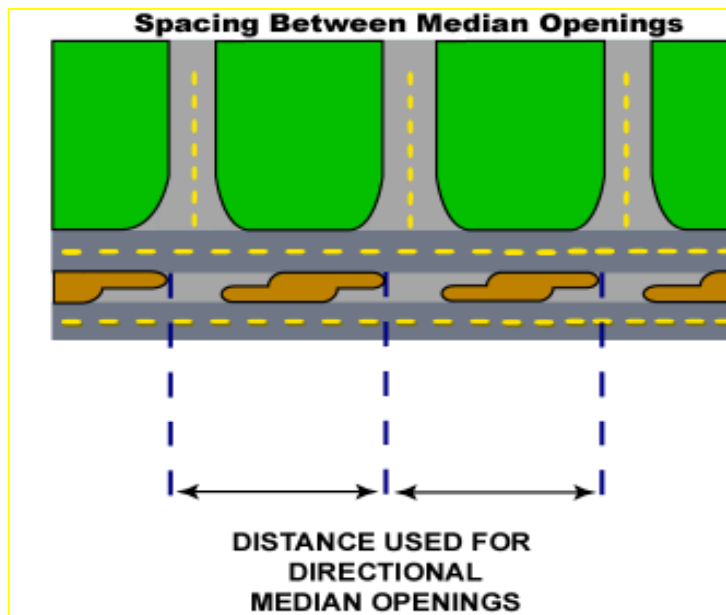
Under conditions of inadequate sight distance, median openings *shall not* be allowed.

Traffic studies should support the required length of queue storage for major traffic generators such as a shopping mall or industrial plant. For additional guidance on left turn queue storage see

Accommodating Safe U-Turns

In cases where left turns are restricted by lack of median openings, care must be taken to allow for U-turns to be made in a safe manner. U-turns can be safely accommodated through a variety of means, including signal phasing and timing, widening, and including physical design features such as turning lanes and “jug handles.” Where U-turns cannot be made safely, they should be explicitly prohibited. U-turn opportunities should be designed with an appropriate typical design vehicle.

Diagram



Minimum Guideline

Roadway Classification	In Current and Projected Urban Areas	In Rural Areas
Major - Freeway	No median openings allowed	No median openings allowed
Major – Non Freeway	1,320 to 2,640 feet (full) 660 to 1320 feet (directional)	1320 to 2640 feet (spacing should increase with higher posted speed)
Minor	1,320 feet (full) 660 feet (directional)	Generally not applicable

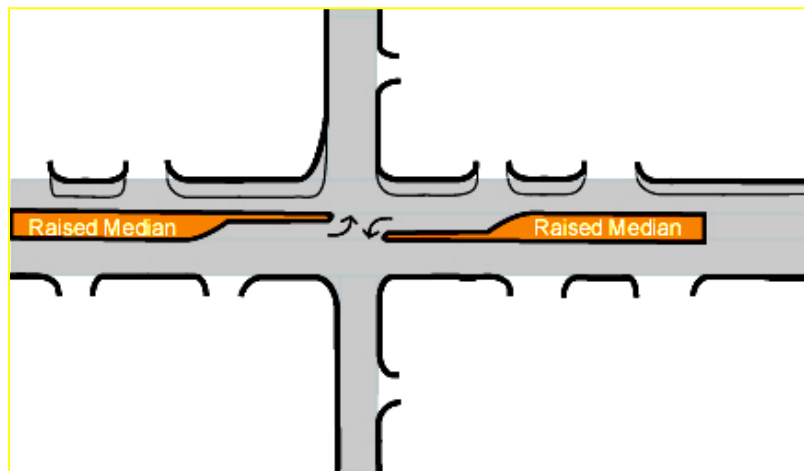
8.0 RAISED MEDIANS

What This Guideline Means

Raised medians are the most effective access management strategy on high-volume urban routes. Roadways with raised medians are at least 25 percent safer than multi-lane undivided sections and 15 percent safer than two-way left-turn lane cross sections in such high traffic situations.

In general, use of raised medians is recommended where current and projected traffic volume is greater than 28,000 average annual daily traffic (AADT). Raised medians are especially recommended in corridors where the traffic volume is high, the density of commercial driveways is high (over 20 -30 per mile in both directions), and other access management strategies such as driveway consolidation and corner clearance are not practical. Raised medians should be used on arterial facilities with three or more through traffic lanes in each direction.

Diagram



Guideline

Roadway Classification	In Current and Projected Urban Areas	In Rural Areas
Major - Freeway	Not applicable	Not applicable
Major – Non Freeway	Raised median when current and projected traffic exceeds 28,000 AADT	flush median
Minor	Raised median when current and projected traffic exceeds 28,000 AADT	flush median

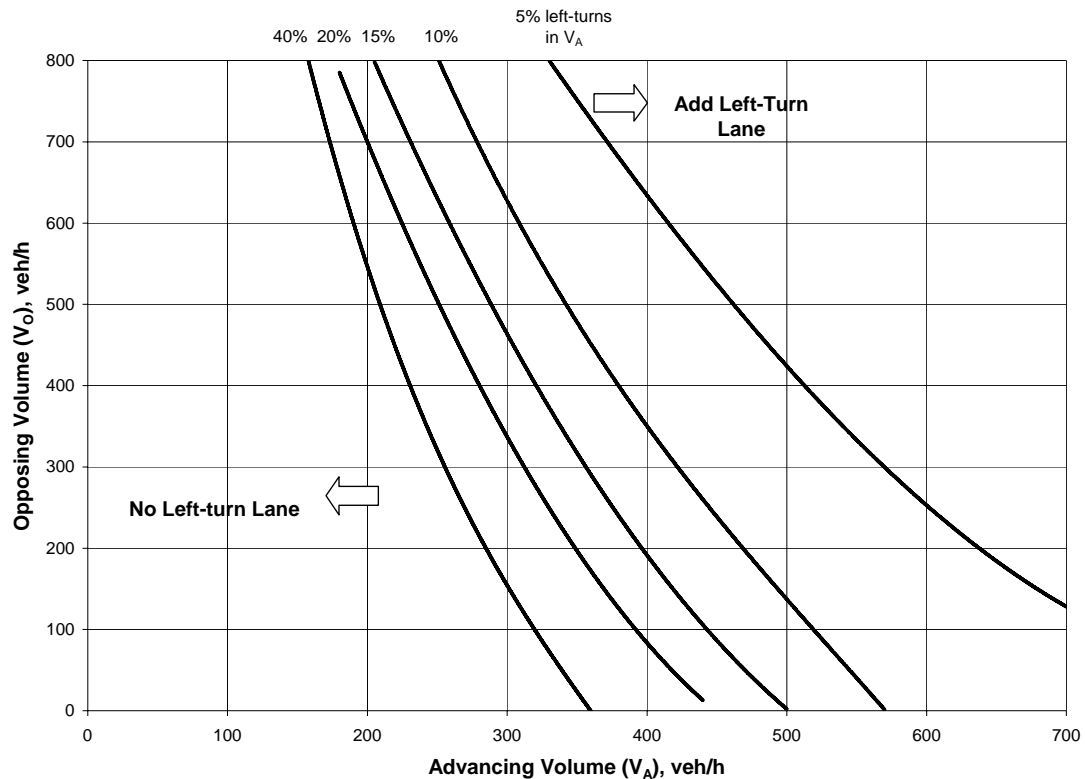
9.0 AUXILIARY ACCELERATION AND TURNING LANES

What This Guideline Means

Dedicated left- and right-turn lanes should be provided in situations where traffic volumes and speeds are relatively high and conflicts are likely to develop at public road intersections and driveways between through and turning traffic. Auxiliary lanes are an asset in promoting safety and improved traffic flow in such situations. Some major applications for and considerations for the design of auxiliary lanes are as follows:

- Installing a right-turn acceleration lane. These lanes allow entering vehicles (those that have turned right from a driveway or minor public road onto the major route) to accelerate before entering the through-traffic flow. Acceleration lanes should be considered on roadway segments, intersections and driveways with high traffic volumes where speed differential could result in unacceptable conflicts and/or delay. Acceleration lanes may also be appropriate where crash experience indicates a problem with right-turning, entering vehicles. The right-turn acceleration lane should be of a sufficient length to allow safe and efficient merge maneuvers. The design length, tapers, and other features of right-turn acceleration lanes should be guided by a traffic study.
- Installing auxiliary left-turn lanes. Such lanes, installed in the roadway center, are intended to remove turning vehicles from the through traffic flow. This should reduce the frequency of rear-end collisions at locations where there is considerable left-turn ingress activity, such as major driveways and minor public road intersections. Left-turn lane warrants are shown in the following figures. To use the figures, peak hour traffic counts, including directional splits, will be required, which may be obtained from District Traffic Staff. In addition, the ITE Trip Generation Manual may be used as an estimate for peak hour traffic counts. For design year analyses, appropriate growth rates will be required, which may be obtained from Planning Staff.
- The use and design of auxiliary left-turn lanes should be guided by a traffic study. In general, auxiliary left-turn lanes must be long enough to accommodate a safe deceleration distance and to provide adequate storage of a queue for expected peak hour turning traffic. The Engineering Policy Guide should be consulted for appropriate storage and deceleration lengths.

Left Turn Lane Guideline for Two-Lane Road ≤ 40 mph (60 km/h)



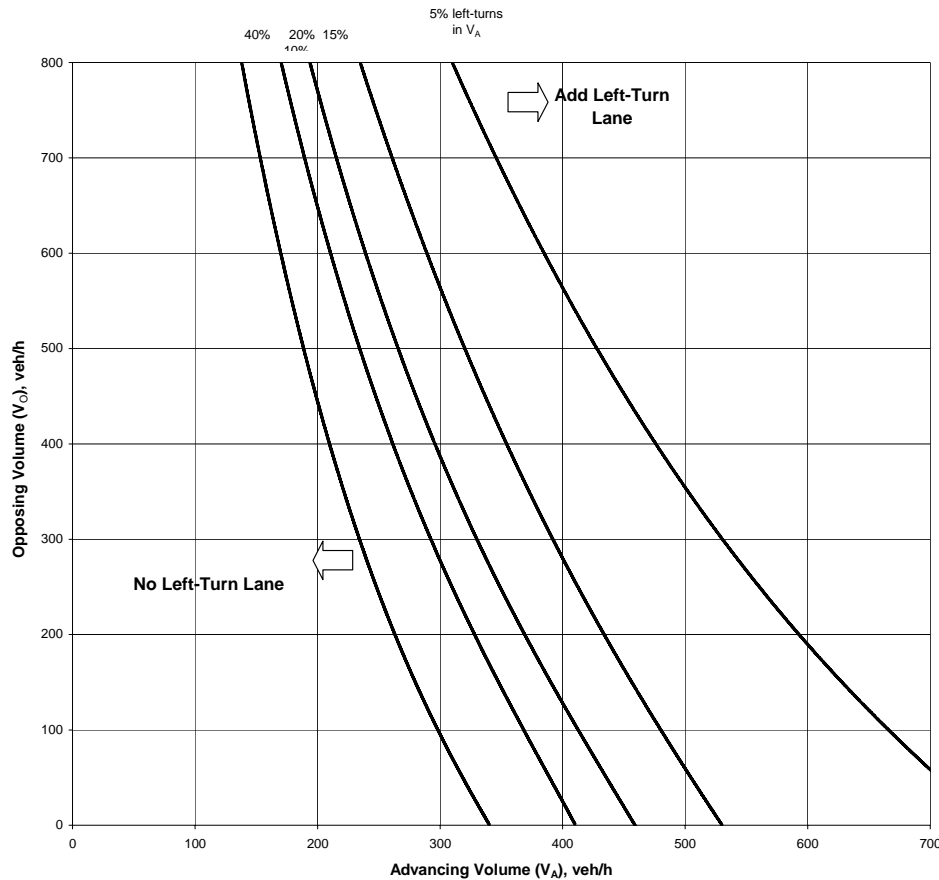
The following data are required:

1. Opposing Volume (veh/hr) - V_O - The opposing volume should include only the right-turn and through movements in the opposite direction of the left turning vehicle.
2. Advancing Volume (veh/hr) - V_A - The advancing volume should include the right-turn, left-turn and through movements in the same direction as the left turning vehicle.
3. Operating Speed (mph) - The greater of design or posted speed.
4. Percentage of left turns in V_A

Left turn lane is not needed for left turn volume less than 10 vph. However, criteria other than volume, such as crash experience, may be used to justify a left turn lane.

The appropriate trend line is identified on the basis of the percentage of left-turns in the advancing volume, rounded up to the nearest percentage trend line. If the advancing and opposing volume combination intersects above or to the right of this trend line, a left-turn lane is appropriate.

Left Turn Lane Guideline for Two-Lane Road - 45 mph (70 km/h)



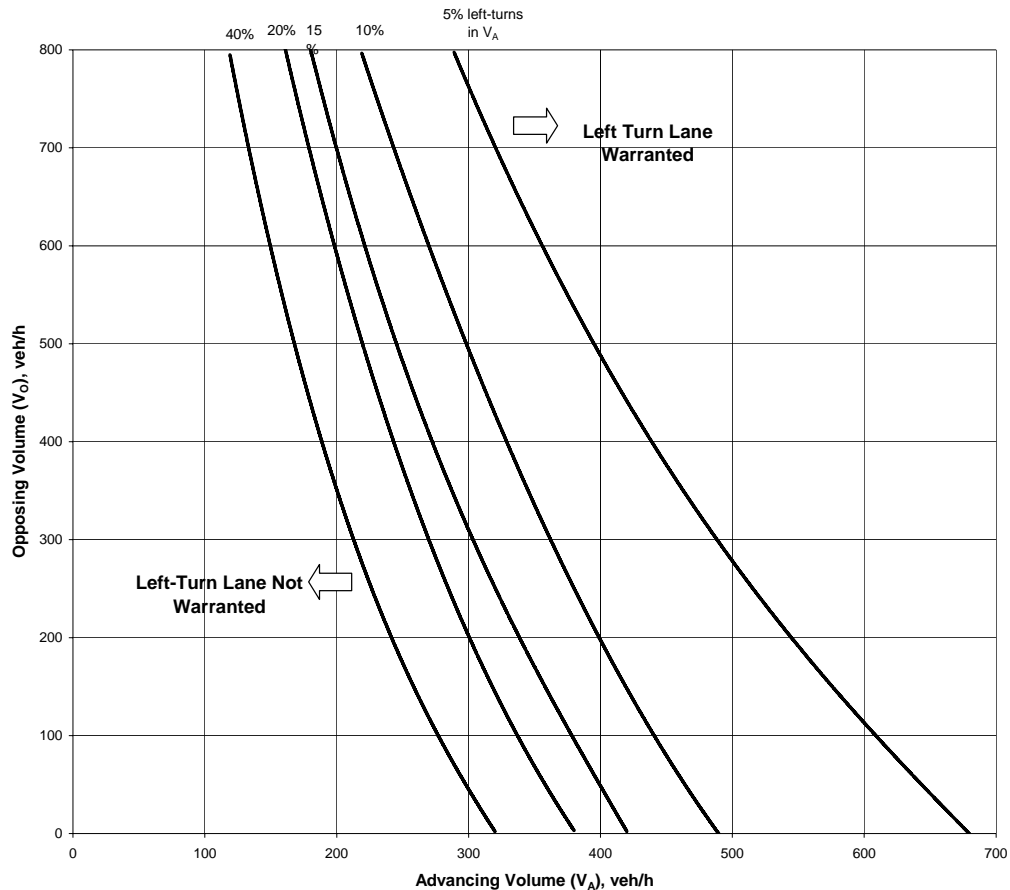
The following data are required:

1. Opposing Volume (veh/hr) - V_O - The opposing volume should include only the right-turn and through movements in the opposite direction of the left turning vehicle.
2. Advancing Volume (veh/hr) - V_A - The advancing volume should include the right-turn, left-turn and through movements in the same direction as the left turning vehicle.
3. Operating Speed (mph) - The greater of design or posted speed.
4. Percentage of left turns in V_A

Left turn lane is not needed for left turn volume less than 10 vph. However, criteria other than volume, such as crash experience, may be used to justify a left turn lane.

The appropriate trend line is identified on the basis of the percentage of left-turns in the advancing volume, rounded up to the nearest percentage trend line. If the advancing and opposing volume combination intersects above or to the right of this trend line, a left-turn lane is appropriate.

Left Turn Lane Guideline for Two-Lane Road - 50 mph (80 km/h)



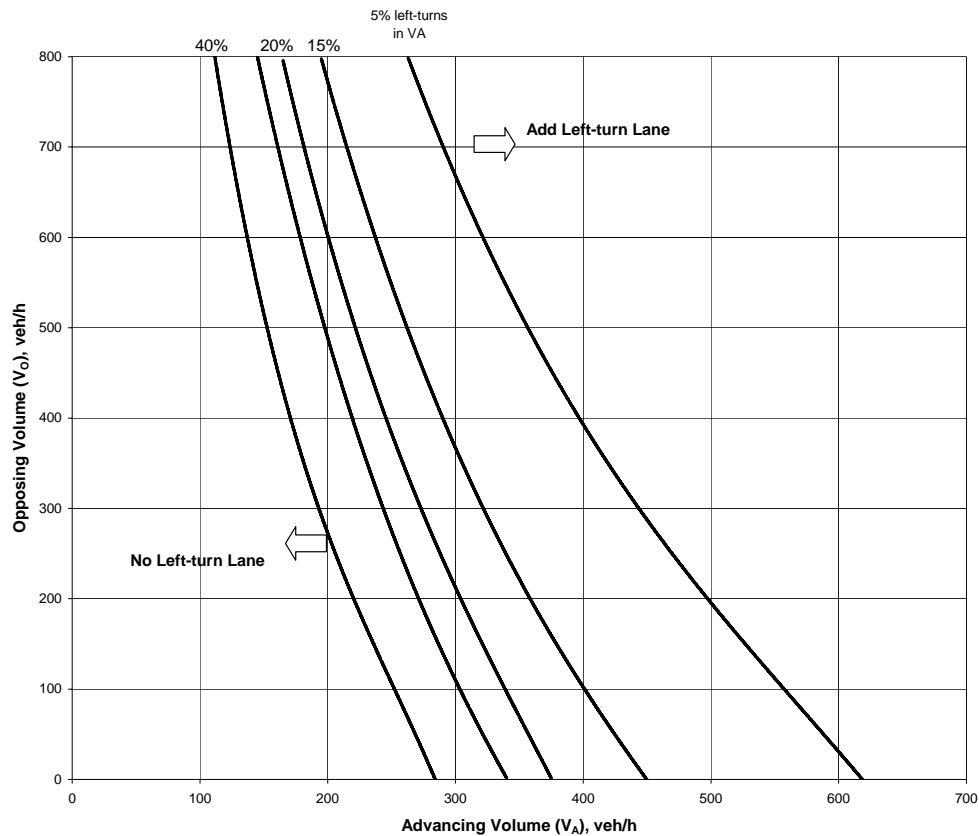
The following data are required:

1. Opposing Volume (veh/hr) - V_O - The opposing volume should include only the right-turn and through movements in the opposite direction of the left turning vehicle.
2. Advancing Volume (veh/hr) - V_A - The advancing volume should include the right-turn, left-turn and through movements in the same direction as the left turning vehicle.
3. Operating Speed (mph) - The greater of design or posted speed.
4. Percentage of left turns in V_A

Left turn lane is not needed for left turn volume less than 10 vph. However, criteria other than volume, such as crash experience, may be used to justify a left turn lane.

The appropriate trend line is identified on the basis of the percentage of left-turns in the advancing volume, rounded up to the nearest percentage trend line. If the advancing and opposing volume combination intersects above or to the right of this trend line, a left-turn lane is appropriate.

Left Turn Lane Guideline for Two-Lane Road - 55 mph (90 km/h)



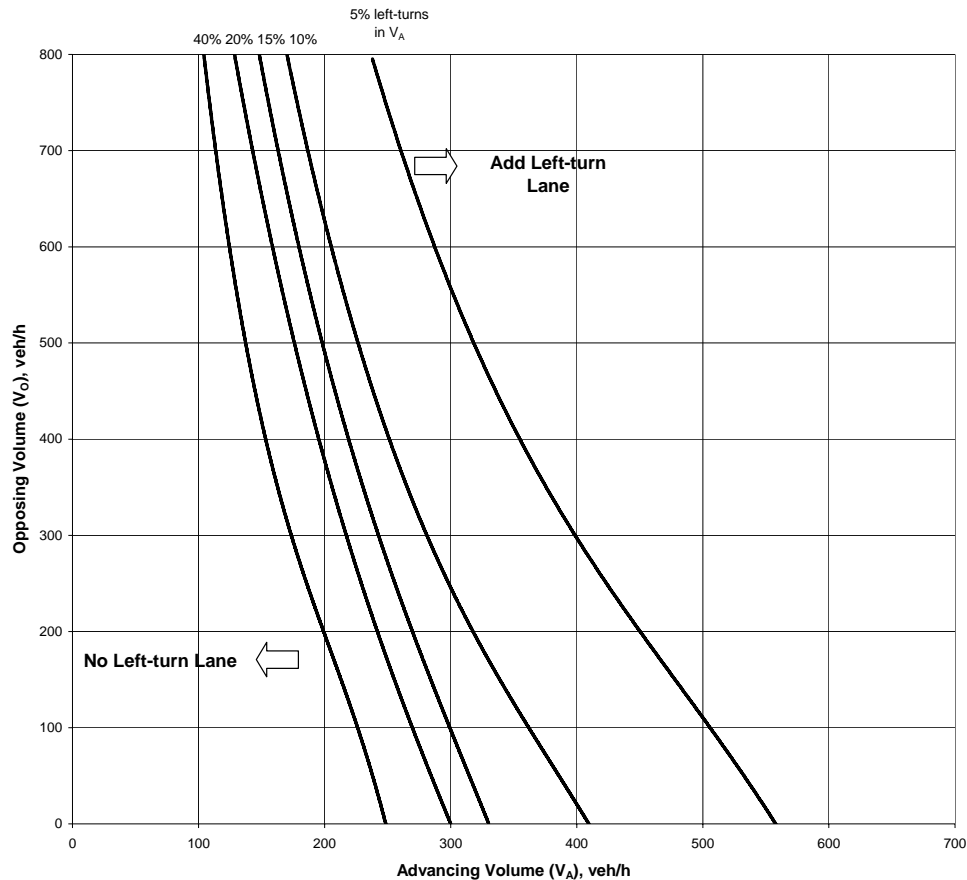
The following data are required:

1. Opposing Volume (veh/hr) - V_O - The opposing volume should include only the right-turn and through movements in the opposite direction of the left turning vehicle.
2. Advancing Volume (veh/hr) - V_A - The advancing volume should include the right-turn, left-turn and through movements in the same direction as the left turning vehicle.
3. Operating Speed (mph) - The greater of design or posted speed.
4. Percentage of left turns in V_A

Left turn lane is not needed for left turn volume less than 10 vph. However, criteria other than volume, such as crash experience, may be used to justify a left turn lane.

The appropriate trend line is identified on the basis of the percentage of left-turns in the advancing volume, rounded up to the nearest percentage trend line. If the advancing and opposing volume combination intersects above or to the right of this trend line, a left-turn lane is appropriate.

Left Turn Lane Guideline for Two-Lane Road ≥ 60 mph (100 km/h)



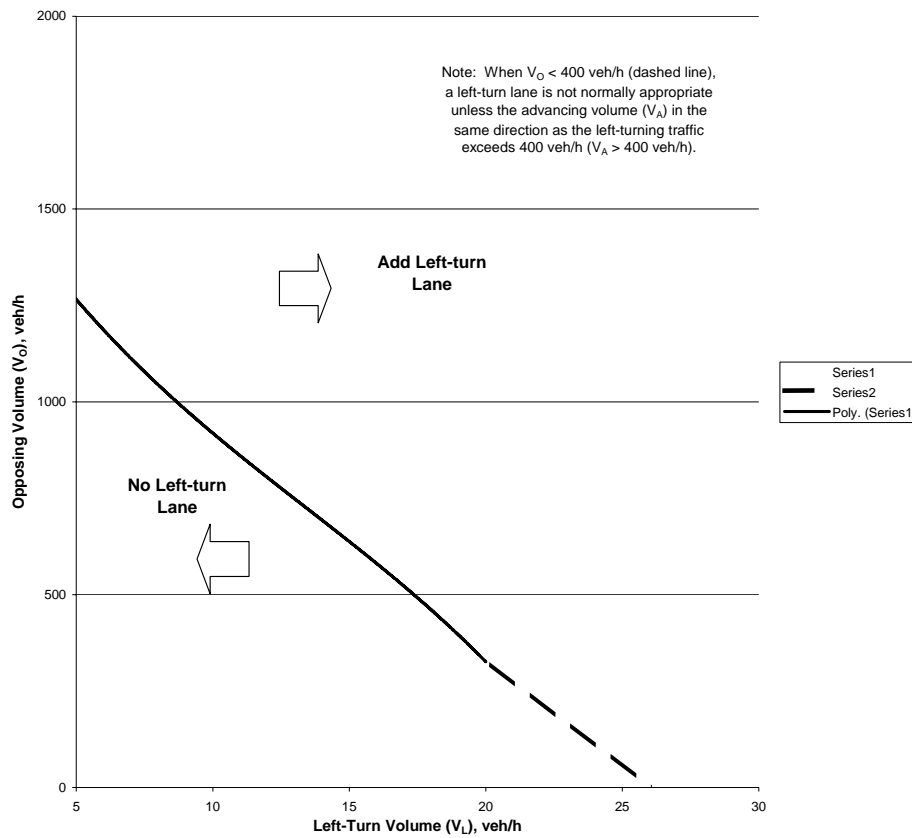
The following data are required:

1. Opposing Volume (veh/hr) - V_O - The opposing volume should include only the right-turn and through movements in the opposite direction of the left turning vehicle.
2. Advancing Volume (veh/hr) - V_A - The advancing volume should include the right-turn, left-turn and through movements in the same direction as the left turning vehicle.
3. Operating Speed (mph) - The greater of design or posted speed.
4. Percentage of left turns in V_A

Left turn lane is not needed for left turn volume less than 10 vph. However, criteria other than volume, such as crash experience, may be used to justify a left turn lane.

The appropriate trend line is identified on the basis of the percentage of left-turns in the advancing volume, rounded up to the nearest percentage trend line. If the advancing and opposing volume combination intersects above or to the right of this trend line, a left-turn lane is appropriate.

Left Turn Lane Guideline for Four-Lane Undivided Roadway



The following data are required:

1. Opposing Volume (veh/hr) - V_O - The opposing volume should include only the right-turn and through movements in the opposite direction of the left turning vehicle.
2. Left-Turn Volume - V_L

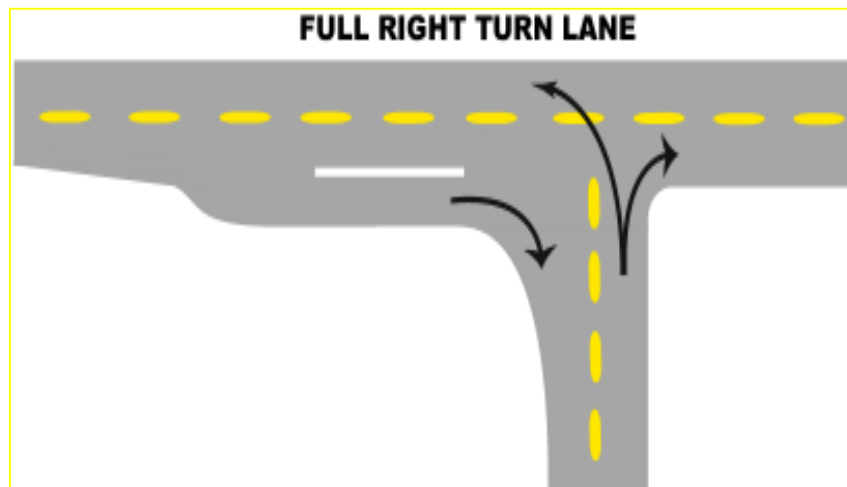
If the opposing and left-turn volume combination intersects above or to the right of the trend line, a left-turn lane is appropriate.

- Installing auxiliary right-turn lanes. The use of dedicated right-turn lanes should also be guided by a traffic study. In general, dedicated right-turn lanes should be provided in both rural and urban areas on two lane routes as shown in the figures below. Right-turn lane warrants are shown in the following figures. To use the figures, peak hour traffic counts, including directional splits, will be required, which may be obtained from District Traffic Staff. In addition, the ITE Trip Generation Manual may be used as an estimate for peak hour traffic counts. For design year analyses, appropriate growth rates will be required, which may be obtained from Planning Staff.

Dedicated right turn lanes should also be strongly considered in situations where:

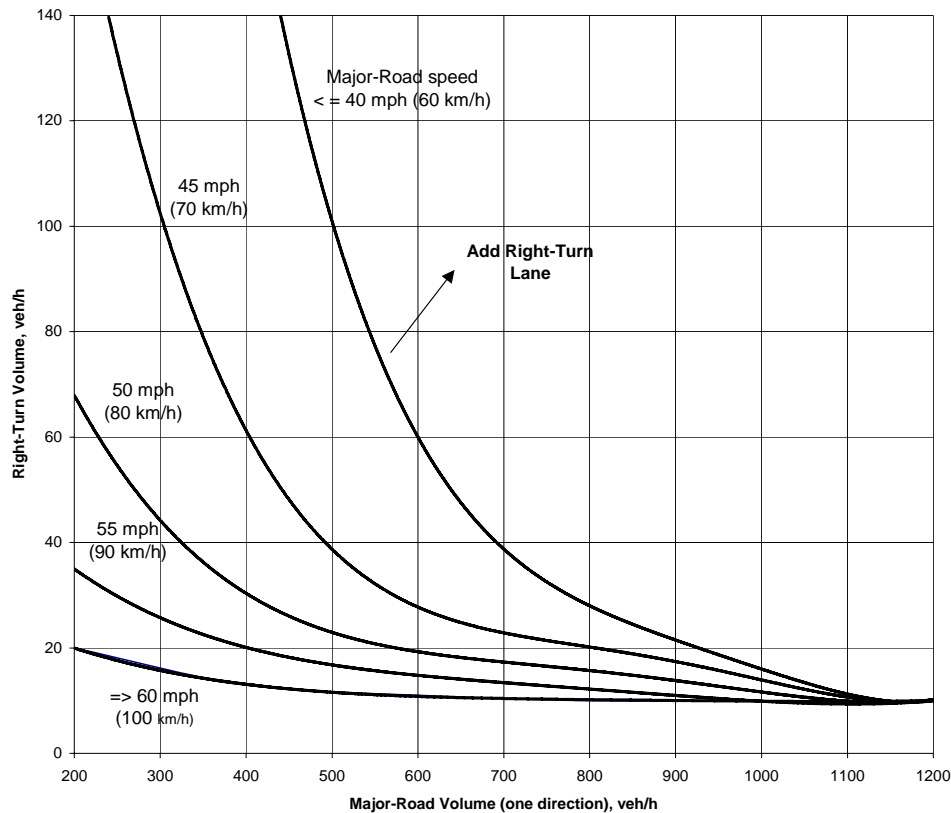
- Poor internal site design and circulation leads to backups on the mainline. Auto-oriented businesses with short drive-through lanes or poorly-designed parking lots would be prime examples of this situation.
- The peak hour turning traffic activity is unusually high (e.g. greater than 10 percent of the daily total.)
- Operating speeds on the mainline route are very high (greater than 60 miles per hour) and right turns would generally not be expected by drivers.
- The driveway or minor public road intersection is difficult for drivers to see.
- The driveway entrance is gated or otherwise must be entered very slowly.
- Right turning traffic consists of an unusually high number of trailers or other large vehicles.
- The intersection or driveway angle is highly skewed.
- Rear end collision experience is unusually high at a location.

Diagram



As with any auxiliary turning lane, dedicated right-turn lanes should be designed based on the results of a traffic study.

Right Turn Lane Guideline for Two-Lane Roadway



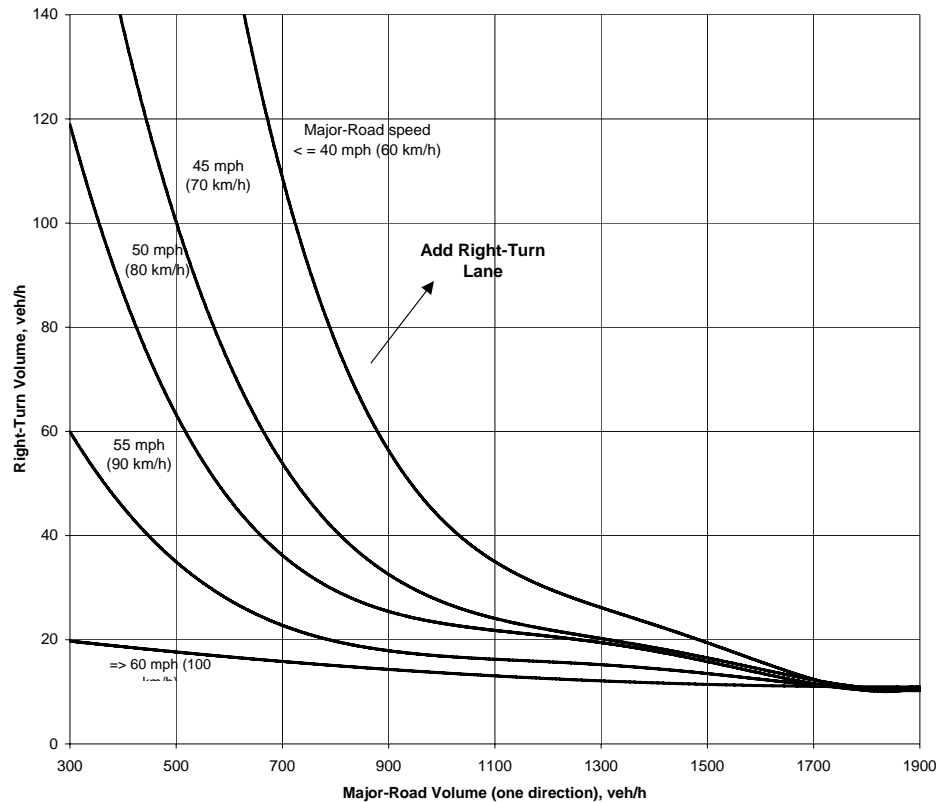
The following data are required:

1. Advancing Volume (veh/hr) - The advancing volume should include the right-turn, left-turn and through movements in the same direction as the right turning vehicle.
2. Right Turning Volume (veh/hr) - The right turning volume is the number of advancing vehicles turning right.
3. Operating Speed (mph) - The greater of design or posted speed.

Note: Right turn lane is not needed for right turn volume less than 10 vph. However, criteria other than volume, e.g. crash experience, may be used to justify a right turn lane.

If the combination of major-road approach volume and right-turn volume intersects above or to the right of the speed trend line corresponding the major road operating speed, then a right-turn lane is appropriate.

Right Turn Lane Guideline for Four-Lane Roadway



The following data are required:

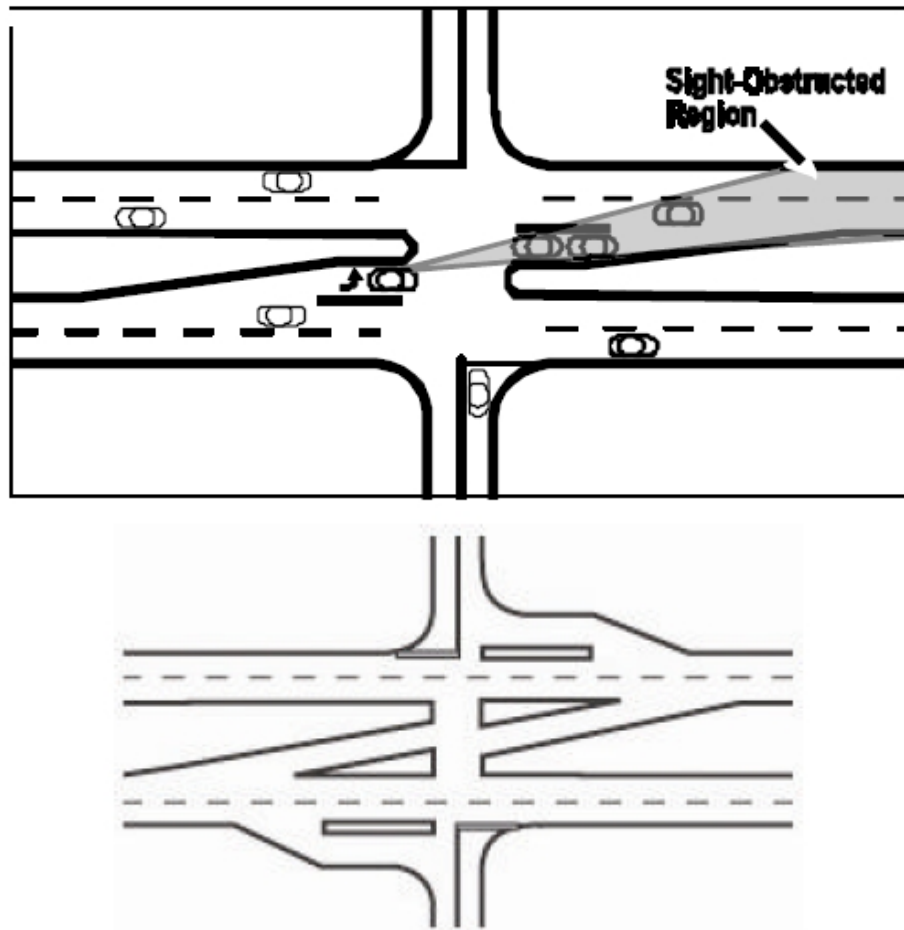
1. Advancing Volume (veh/hr) - The advancing volume should include the right-turn, left-turn and through movements in the same direction as the right turning vehicle.
2. Right Turning Volume (veh/hr) - The right turning volume is the number of advancing vehicles turning right.
3. Operating Speed (mph) - The greater of design or posted speed.

Note: Right turn lane not warranted for right turn volume less than 10 vph. However, criteria other than volume, e.g. crash experience, may be used to justify a right turn lane.

If the combination of major-road approach volume and right-turn volume intersects above or to the right of the speed trend line corresponding the major road operating speed, then a right-turn lane is appropriate.

- **Offset Right- and Left- Turn Lanes**

Vehicles in the right-turn lane tend to obstruct the vision of drivers waiting at the stop bar of the minor roadway. One way to reduce the obstruction of the minor roadway drivers' view is to offset the right-hand turning bay to the right. Similarly, vehicles in the opposing left-turn lane block the views of left-turning vehicles from the opposite direction, as shown in the figure below. An example intersection with offset right- and left-turn lanes is shown below. Offsetting left-turn lanes to the left as far as practical improves the visibility of opposing traffic. By improving the visibility of opposing traffic, drivers can more effectively use available gaps. Offsetting right-turn lanes to the right gives drivers on the minor approach (at the stop bar) an unobstructed view of oncoming traffic in the near expressway lanes, which allows for more effective use of gaps.



Rural Expressway Intersection Synthesis of Practice and Crash Analysis
Center for Transportation Research and Education – October 2004

Consideration should be given to offset right- and left-turn lanes lane in locations with high mainline operating speeds, large percentage of turning trucks, unique sight distance issues, or crash experience where investigation of crash diagrams indicates a safety benefit may be obtained from an offset turn lane. Care should be taken when implementing offset auxiliary turn lanes to ensue the horizontal geometry of the roadway does not negate the line-of-sight improvement.

10.0 TWO-WAY LEFT-TURN LANES (“Five-Lane” Facilities)

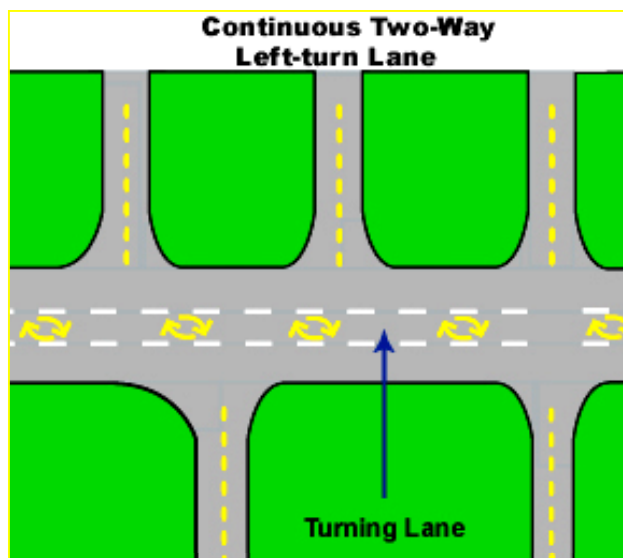
What This Guideline Means

Two-way left-turn lanes may be effective as an access management tool when used in conjunction with other techniques such as driveway consolidation and corner clearance. TWLTL cross sections work best in situations where traffic volume and the density of driveways is relatively low, and the proportion of left-turning vehicles is relatively high. TWLTL's are recommended in places where commercial driveways make up a substantial portion of total driveways and where the percentage of vehicles turning left at peak hour is approximately 20 percent or greater.

TWLTL's may be inappropriate where the commercial driveway density is above the driveway spacing guideline. Research indicates that when commercial driveway density is over 24 per mile (12 per mile in each direction), crash rates increase significantly. This roughly equates to an average driveway spacing of 440 feet. TWLTL configurations should generally be avoided unless driveway density can be kept at that level or below, or other viable alternatives do not exist.

TWLTL configurations are not recommended along high traffic volume (over 28,000 AADT) urban routes; in such situations raised medians are at least 25 percent safer than multilane undivided sections and 15 percent safer than TWLTL cross sections. TWLTL configurations should not be used on facilities with more than four through-traffic lanes, e.g., to create a “seven lane” facility. Crash experience with such large roadway cross sections is poor.

Diagram



Guideline

Roadway Classification	In Current and Projected Urban Areas	In Rural Areas
Major - Freeway	Not applicable	Not applicable
Major – Non Freeway	May be used when appropriate if AADT in design year is less than 28,000; otherwise use a raised median	Not recommended
Minor	May be used when appropriate if AADT in design year is less than 28,000; otherwise use a raised median	Not recommended

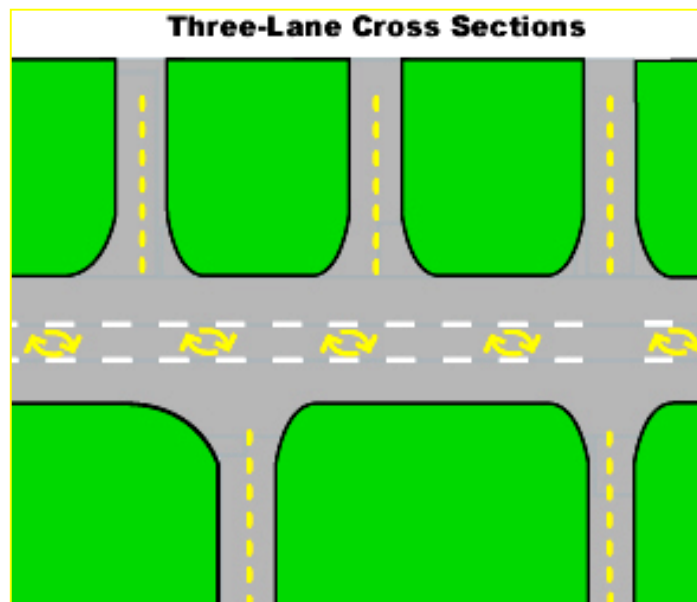
11.0 THREE-LANE CROSS SECTIONS

What This Guideline Means

Three-lane cross sections (two through lanes with a TWLTL in the center) are approximately 25 percent safer than an undivided four-lane road and can provide comparable capacity provided that intersections are well designed. They work best in situations where traffic volumes are moderate and where the proportion of vehicles turning left is high. The use of TWLTL's should be discouraged in rural areas, as their use in high speed, low volume situations can lead to increase in head on crashes. They should also be avoided in urban areas where the design year traffic is expected to grow beyond 17,500 AADT. TWLTL's are best used in situations where driveway density is low to moderate (e.g., below 24 commercial driveways per mile, which equates to a spacing of about 440 feet between driveways).

This guideline does not refer to third lanes used as passing, turning, or climbing lanes in rural areas.

Diagram



Guidelines

Roadway Classification	In Current and Projected Urban Areas	In Rural Areas
Major - Freeway	Not applicable	Not applicable
Major – Non Freeway	May be used when appropriate and where AADT in design year is less than 17,500	Not recommended
Minor	May be used when appropriate and where AADT in design year is less than 17,500	Not recommended

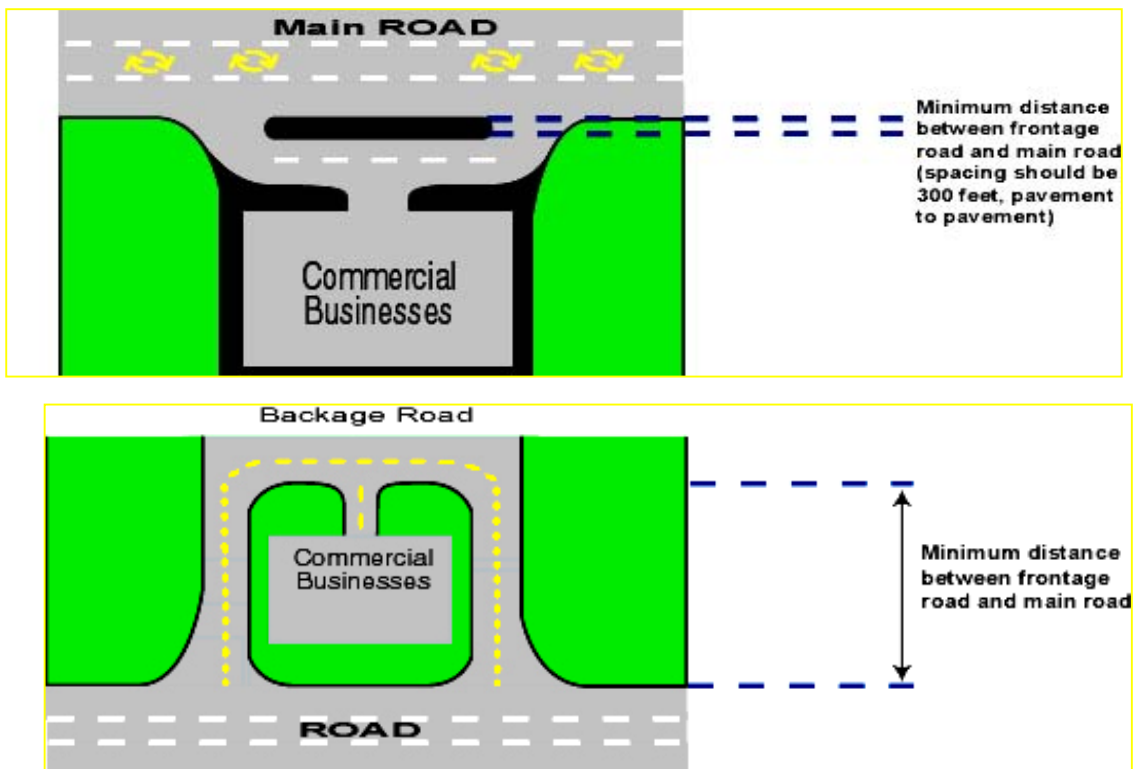
12.0 FRONTAGE AND BACKAGE ROADS

What This Guideline Means

Frontage and backage roads provide alternative access to property and help remove turning traffic from the through traffic on a mainline route. A frontage road provides alternative access at the front of properties while a backage road provides alternative access at the rear of properties.

Frontage and backage roads can dramatically improve safety and operations. However, a common mistake involves placing frontage or backage roads in close proximity to the mainline. Placing frontage roads very close to mainline roads can create additional opportunities for delay, congestion, and crashes because insufficient storage (“throat length”) is provided for entering and exiting vehicles.

Diagrams



Guideline

Backage roads should be spaced approximately 300 feet or more from the mainline route. Measurements should be taken from pavement edge to pavement edge. Backage roads are more advantageous than frontage roads because they minimize visual distractions and headlight glare on both the mainline and backage road. The backage configuration is particularly conducive to ownership by other governmental entities. Frontage roads may be more appropriate on freeways, especially those where MoDOT will maintain and operate the outer road system. See “Clearance at Functional Area of Interchanges” for further spacing recommendations.

13.0 DRIVEWAY SPACING

What This Guideline Means

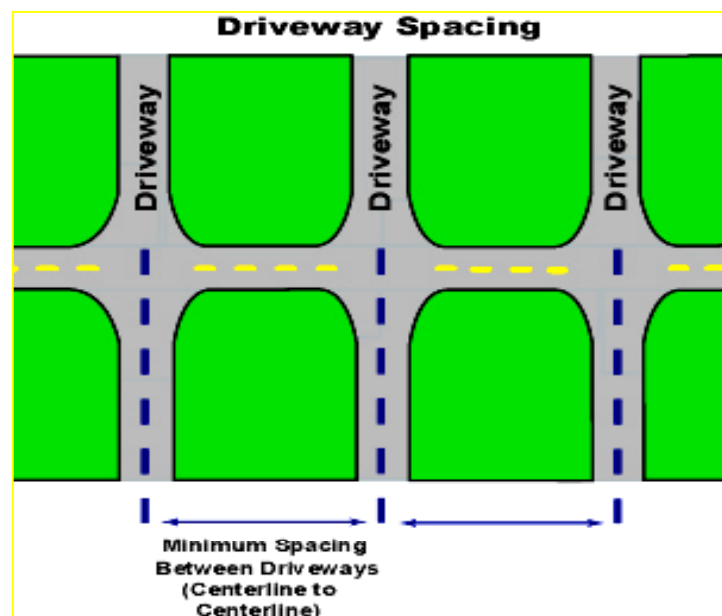
This guideline describes the recommended spacing between private driveways necessary to preserve both safety and traffic flow. Spacing between driveways must be longer on higher speed routes in rural areas than in urban areas. In urban areas, these guidelines allow for about one driveway per city block face on non freeway- major roadways and two driveways per block face on minor roadways.

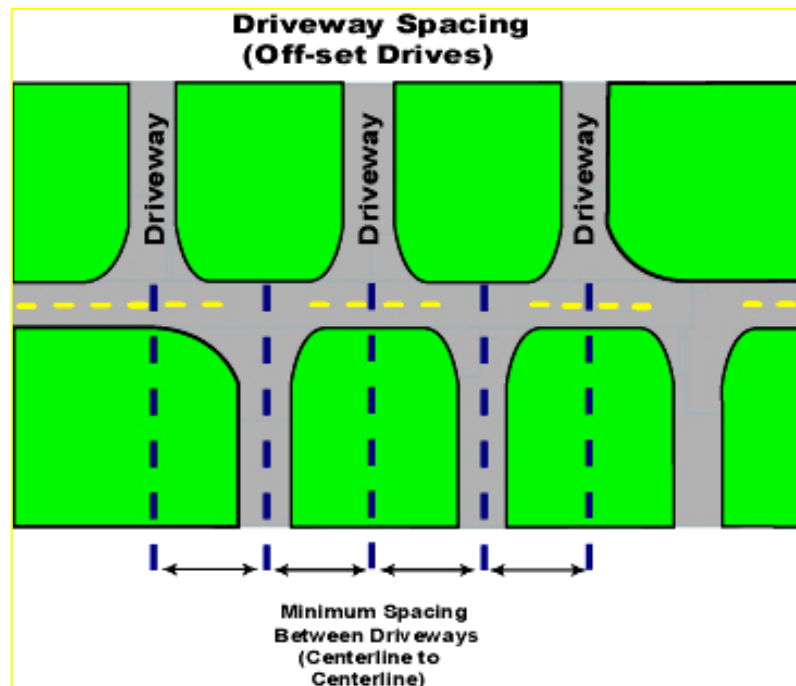
In order to preserve spacing, direct access should be moved to local streets (not arterials) where possible. In particular, access for corner lots should be moved to a lower traffic side street whenever possible. Access can often be better accomplished on major streets through such means as frontage and backage roads, joint access, cross access, and shared driveways. This guideline only applies where sight distance allows. Driveways should *not* be allowed where sight distance is inadequate even if the driveway spacing guideline would allow them.

Driveway accesses should be provided on local and collector streets (“side streets”) rather than arterials wherever possible. Driveways should also be lined up across the public roadway from each other whenever possible. When driveways are not lined up, the spacing should be measured from the closest driveway on either side of the road, except where a non-traversable (e.g., raised) median exists.

On urban routes where non-traversable medians exist, shorter driveway spacing may be acceptable for right-in, right-out driveways only.

Diagrams





Guideline

Roadway Classification	In Current and Projected Urban Areas	In Rural Areas
Major - Freeway	No driveways	No driveways
Major – Non Freeway	440 to 660 feet	660 to 1,320 feet *
Minor	220 to 330 feet	330 to 440 feet *

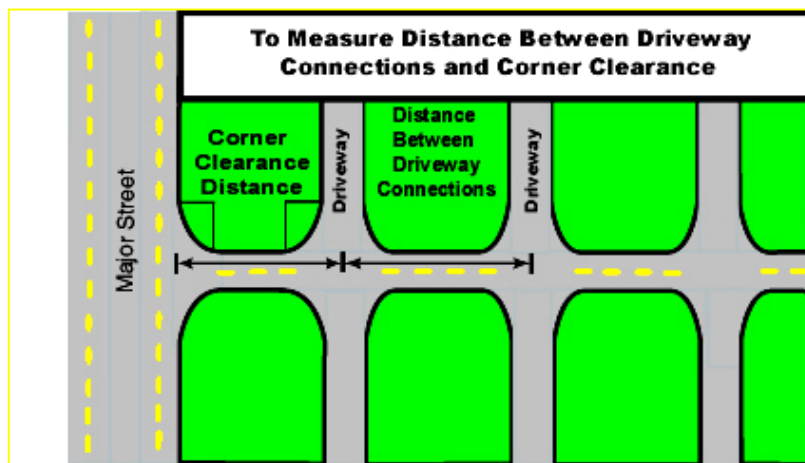
* The urban guideline may be applied in developed areas that are not urban, for example, cities with populations under 5,000. On collectors in cities with population under 5,000, the guideline is 220 feet (same as the urban guideline).

14.0 DRIVEWAY CORNER CLEARANCE

What This Guideline Means

Corner clearance represents the distance between the corner of the intersection of two public roadways and the next private driveway. It is important to provide enough distance between the corner and the first driveway to effectively separate conflict points and to allow drivers enough time to make safe maneuvers. When corners are not adequately cleared, crash rates and delay increase. These guidelines correspond to the driveway spacing guidelines for the same roadway classification. However, maintaining adequate corner clearance is more critical for safety and operations than mid block driveway spacing. *This guideline only applies where the sight distance guideline allows.*

Diagram



Guideline

Roadway Classification	In Current and Projected Urban Areas	In Rural Areas
Major - Freeway	No driveways	No driveways
Major – Non Freeway	440 to 660 feet	660 to 1,320 feet *
Minor	220 to 330 feet	330 to 440 feet *

* The urban guideline may be applied in developed areas that are not urban, for example, cities with populations under 5,000. On collectors in cities with population under 5,000, the guideline is 220 feet (same as the urban guideline).

15.0 SPACING / CLEARANCE FOR RIGHT-IN, RIGHT-OUT DRIVEWAYS

What This Guideline Means

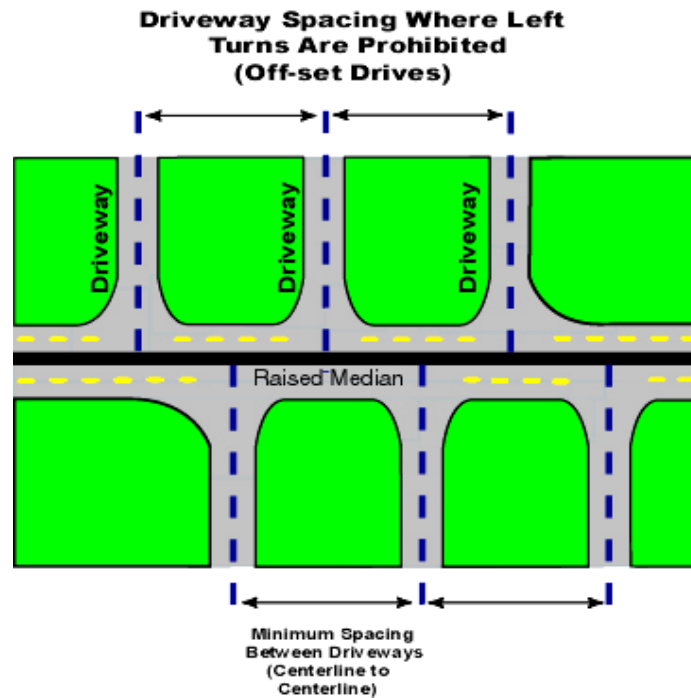
This guideline describes the recommended spacing and corner clearance for driveways along roadways in urban areas that have a non-traversable median and speed limits at or below 45 miles per hour. A non-traversable median restricts left-turn movements into and out of driveways. Adequate spacing between driveways and corner clearance are both important to maintain safety and traffic flow. Spacing between driveways should be greater on higher speed routes and in rural areas than in urban areas because of higher posted speed limits.

Research and experience in other states indicates that on urban routes *where non-traversable medians exist*, shorter driveway spacing and corner clearance upstream from an intersection is acceptable for right-in, right-out driveways. This guideline provides for double the number of right-in, right-out driveway access points compared to situations where left turns into and out of driveways are permitted. It also provides for a shorter clearance distance from corners to the last driveway upstream from the corner. For safety reasons, the downstream corner clearance similar to situations where no non-traversable median is present. This shorter guideline for right-in right-out driveways *should not* be used where a non-traversable median does not exist (e.g., where there is a continuous left-turn lane.) The shorter spacing is also not recommended in rural areas, where higher operating speeds prevail.

Experience has shown that a shorter guideline for right-in, right-out drives is appropriate where there is a physical barrier that prevents left turns (e.g., a non-traversable median). Regulatory restrictions on left turns (e.g., “No Left Turn” signs) and small traffic islands do not prevent left turns.

Direct access should be moved to local streets (not arterials and collectors) where possible. Access can be better accomplished on major roadways through techniques such as frontage and backage roads, joint access, cross access, and shared driveways. These guidelines only apply where sight distance allows. *Driveways should not be allowed where sight distance is inadequate even if the spacing guideline would allow them.*

Diagram



Guidelines, in Urban Areas *

Roadway Classification	Spacing between Right-In, Right-Out Driveways on Roadway with a Restrictive Median	Upstream Corner Clearance for Right-In, Right-Out Driveways on Roadway with a Restrictive Median**
Major - Freeway	No driveways	No driveways
Major – Non Freeway	220 to 330 feet	220 to 330 feet
Minor	110 to 165 feet	110 to 165 feet

* The urban guideline may be applied in rural but developed areas that are not urban, for example, cities with populations under 5,000. On collectors in cities with population under 5,000, the recommended spacing is 110 feet (same as the urban guideline).

** Downstream corner clearance guidelines should be similar to the main corner clearance guideline even when a non-traversable median exists.

16.0 DRIVEWAY GEOMETRICS

The design of driveways affects the speed of traffic turning into and out of driveways and in turn the speed differential between through traffic and turning traffic. Large speed differentials are associated with higher crash rates and diminished traffic operations.

Driveway designs should always be based on the results of a study of the traffic likely to use them; these guidelines are presented to illustrate good practices for driveway designs.

Lining Up Driveways Across Roadways

Driveways should be as closely lined up with driveways across roadways without non-traversable medians to the maximum extent possible even if less spacing between driveways is the result.

Angle of Intersection to the Public Roadway

- Driveways that serve two-way traffic should have angles of intersection with the public road of 90 degrees or very near 90 degrees. Two-way traffic driveways with skews greater than 20 degrees should be discouraged.
- One-way traffic driveways should have skews between 0 and 30 degrees.

Right-Turn (Approach) Radius

Approach radii should be large enough to allow entering vehicles to do so at a reasonable rate of speed. The following are suggested as acceptable approach radii and are measured from the edge of the driving surface of the roadway. Any maximum approach radius is allowable for driveways.

Right-Turn Radius for Driveways	Urban Areas (At or below 45 mph Posted Speed)	Rural Areas (Greater than 45 mph Posted Speed)
Residential Driveways	10 feet	25 feet
Commercial Driveways	25 feet	50 feet
Industrial Driveways	Design to handle typical large truck that uses the driveway	Design to handle typical large truck that uses the driveway

Inside radii should be determined on a case-by-case basis given driveway angle, traffic volume, and other relevant factors. Sites that generate substantial large truck traffic need inside larger radii to accommodate the wheel path of the turning trucks.

Driveway Width

No driveways should have widths less than 20 feet. Driveways of greater than 54 feet should be strongly discouraged unless they contain a raised median to separate traffic lanes. Driveways that serve one-way traffic should be from 20 to 30 feet wide. Driveway widths should be measured from the face of curb to the face of curb at the point of tangency. Any medians contained in the driveway are above and beyond the widths in the table. Appropriate widths for various levels of traffic and directions of access are shown in the table below:

Driveway Traffic Category	Average Daily Traffic Using Driveway	Peak Hour Traffic Using Driveway	With Two-Way Access	With One-Way Access
Residential	0 – 100	0 – 10	20* feet - 30** feet	NA
Low Volume Commercial/Industrial	< 1500	< 150	28 feet** - 42 feet***	20 feet*
Medium Volume Commercial/Industrial	1,500 – 4,000	150 – 400	42 feet*** - 54 feet****	20 feet* - 30 feet**
High Volume Commercial/Industrial	> 4000	> 400	Determined through a traffic study - normally 42 feet or greater	Generally not applicable

* One-lane driveways.

** Driveway striped for two lanes.

*** Driveway striped for three lanes.

**** Driveway striped for four lanes.

All commercial and industrial driveways should be curbed on approach.

Driveways and Accommodation of Pedestrians

In current and future urban places, all driveways should adequately accommodate pedestrians using sidewalks or paths. The least practical width should be used to accommodate pedestrians. Medians should be considered on driveways, four lanes or wider, to provide a refuge for pedestrians.

Driveways and Accommodation of Bicycles

Where a driveway crosses a bicycle, the driveway and the bicycle facility should be designed so as to accommodate the safe crossing of bicyclists.

Tapers

The distance between the entrance and exit tapers of adjacent driveways should be 50 feet or greater. If not, the tapers should be eliminated and the shoulder paved to form a turn lane.

Driveway Throat Length

The throat length is the distance between the street and the parking lot served by a driveway. An adequate throat length helps to keep traffic conflicts within a parking lot to an acceptable level and provides space on the driveway for incoming and outbound traffic. The following throat-length guidelines are suggested:

- For low traffic volume commercial and industrial driveways (below 150 peak hour vehicles in both directions), the shortest desirable driveway throat length is 20 feet (about one 20-foot car length).
- For medium traffic volume commercial and industrial driveways (150 – 400 peak hour vehicles in both directions), the shortest desirable driveway throat length is 60 feet (about three 20-foot car lengths).
- For high-volume driveways (over 400 peak hour vehicles in both directions) such as a shopping center entrance, the adequate throat length should be determined by the results of a traffic study.

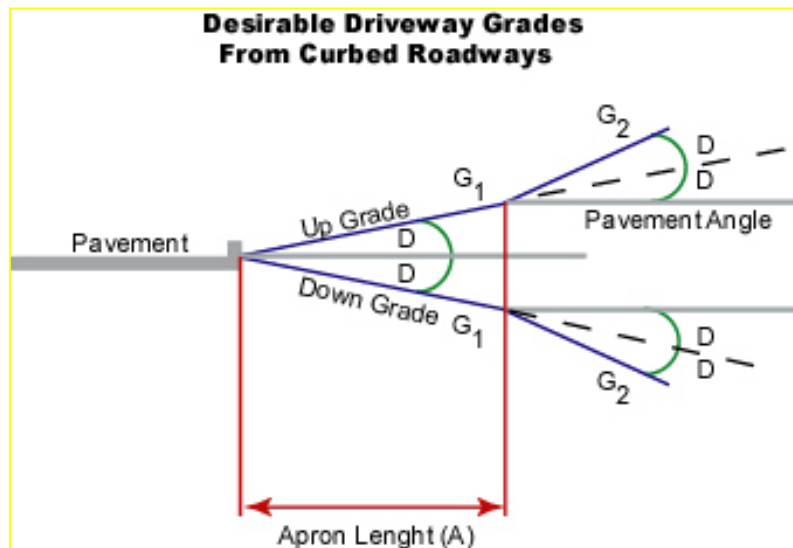
Vertical Geometrics (Driveway Grade Change)

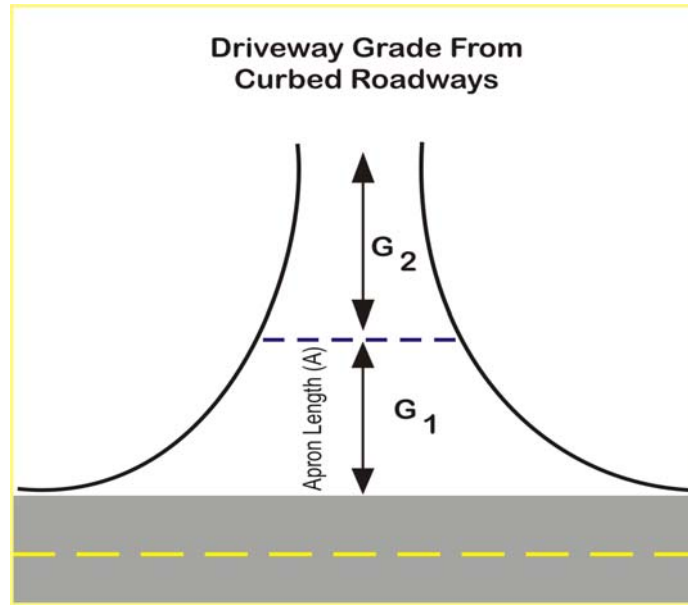
Access driveways on arterial roadways should be designed to allow vehicles to proceed into or out of the driveway at a speed that will prevent large speed differentials between turning and through traffic. Required apron lengths, desirable grade changes and maximum allowable grade changes are shown in the table below. The apron is a relatively flat area where the driveway meets the public roadway. These guidelines apply to all types of driveways, including for residential, commercial and industrial uses. Driveways should have a minimum grade change of approximately 1 percent to provide for adequate drainage. Either an upgrade or downgrade can be used.

Roadway Classification	Apron Length ("A" in the Diagram)	Desirable Grade Change, ("D" in the Diagram) Urban	Desirable Grade Change, ("D" in the Diagram) Rural
Major - Freeway	No driveways	No driveways	No driveways
Principal Arterial	25-30 feet	1%-4%	1%-3%
Minor Arterial	15-20 feet	1%-5%	1%-4%

Notes: The Apron Length is shown as "A" and grade change as "D" on the diagram below.
The grade may change along the course of the driveway, as indicated by G_1 and G_2 . In such cases, it is very important to ensure that the minimum apron length is maintained.

Diagrams





Driveway Surfacing

Required driveway surfaces depend on the roadway they are entering:

Roadway Classification	In Current and Projected Urban Areas	In Rural Areas
Major - Freeway	No driveways	No driveways
Major- Non Freeway	Paved	Paved, except for residential and field entrances
Minor Arterial	Paved	Paved, except for residential and field entrances. Unpaved driveways are acceptable on collectors

Having paved driveways is most critical on major roadways to keep the speed differential between through and turning traffic as low as possible. As noted before, all commercial and industrial driveways should be curbed on approach.

17.0 PARKING ON FACILITIES

What This Guideline Means

Parking should not be allowed on highway facilities that are primarily intended to serve through-traffic movement (major roadways). On-facility parking should not generally be allowed along minor roadways in rural areas since these roadways allow for high travel speeds. Parking may be allowed on urban minor roadways, if an engineering study indicates that it is safe to do so and that the parking will not hinder traffic operations.

Normally, only parallel parking should be allowed. Angle parking may be used in a central business district to promote a “walkable community”.

Local governments have the ability to prohibit or restrict parking within their jurisdiction.

Recommended Guideline

Roadway Classification	In Current and Projected Urban Areas	In Rural Areas
Major	No parking	No parking
Minor	Parking should be studied but may be allowed when appropriate.	No parking*

* The urban guideline may be applied on minor roadways in developed areas that are not urban, for example, cities with populations under 5,000.