



ABC Engineering

Transportation Impact Study Level IV Corporate Campus Springfield, Missouri

I hereby certify this report was prepared by me or under my direct supervision, and I am a duly Licensed Professional Engineer under the laws of the State of Missouri.

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Executive Summary

Background:

The site at 550 X Drive in Springfield, Missouri is the former regional headquarters of a financial institution. Located in the northeast quadrant of the Radio Drive and X Drive intersection, the proposed development would reuse the existing building as office space and develop the surrounding area for commercial uses. The purpose of this study is to determine if the completion of the proposed development will significantly impact the adjacent transportation and parking systems. The document is a Tier 4, Level III Transportation Impact Study.

Results:

The principal findings of this study are:

- Phase 1 of the proposed Corporate Campus development is expected to generate over 5,000 new trips during an average weekday, 437 new trips during the weekday p.m. peak hour and 422 new trips during the weekend Saturday peak hour.
- The full development will increase the expected new trips to 8,126 during an average weekday, 765 during the weekday p.m. peak hour, and 651 during the weekend Saturday peak hour.
- The Thoroughfare Plan for the City identifies the need for a future north-south collector road in this general area, which would be fulfilled by the proposed 12th Street extension.
- Based on planning-level thresholds used by the City, the Radio Drive corridor is currently approaching its capacity and will be over-capacity with this proposed development.
- The intersections of Radio Drive/Avenue A, Radio Drive/X Drive, and X Drive/10th Street have identified capacity issues during the peak periods.
- The 10th Street and 11th Street side-street movements are expected to have safety issues and may need mitigation even if intersections operations are acceptable.
- The proposed parking supply greatly exceeds the requirements and expected demand.
- Bicycle parking is not shown but will be required.
- Sight distance issues were identified at the X Drive/10th Street and X Drive/11th Street intersections.
- The car circulation is acceptable with no significant issues identified.
- Heavy truck movements in the site, particularly to/from the office and grocery store docking areas, have not been provided.
- Signing and striping for the proposed site have not been included in the concept plan for the site.

Recommendations:

The following items are recommended based on the analyses of this study:

- Extend Radio Drive's three southbound lanes to the north to immediately after the I-99 bridge.
- Extend the X Drive westbound right turn lane to approximately 300 feet.
- Extend the two-way section of Lakes Drive west to the proposed site access/12th Street extension.
- Limit the X Drive intersection with 10th Street to a ¾-access design.

- Limit the X Drive intersection with 11th Street to right-in/right-out only.
- Construct a roundabout at the X Drive/12th Street intersection to replace the existing traffic signal.
- Adjust signal timing at least every three years.
- Reduce the parking supply and provide more green space in its place.
- Provide short-term and long-term bicycle parking in excess of the required 37 spaces.
- Work with the City and CU Transit Services to extend the Transit Route 20 into the proposed development and create new stops adjacent to the proposed office building.
- Improve the existing bus stops at the Radio Drive/X Drive intersection.
- Convert a proposed sidewalk along the Avenue A extension to a trail.
- Provide locker rooms in the office building to encourage bicycle travel or walking.
- Provide a bicycle maintenance station near the office short-term or long-term parking.
- Provide ADA treatments for the sidewalks and trails at roadway crossings.
- Ensure the lighting is sufficient for pedestrian use of the sidewalks at night.
- Stripe pedestrian crosswalks at intersections.
- Develop a tree maintenance plan to avoid sight distance issues in the future.
- Ensure building advertisement signs do not encroach upon intersection sight distances.
- Provide the heavy truck movements for the internal site roadways and the movements to/from the office and grocery store docking areas.
- Ensure the signing and striping meets the requirements of the Manual on Uniform Traffic Control Devices.

This study is based upon a concept development plan dated XXX ##, ####. Assuming the general characteristics of the proposed development remain approximately the same as documented, minor changes in the final design are not expected to alter the results or recommendations of this study.

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1. Introduction

a. Purpose of Report

The site at 550 X Drive in Springfield, Missouri is the former regional headquarters of a financial institution. Located in the northeast quadrant of the Radio Drive and X Drive intersection, the property was vacated in 2014 as part of a corporate merger that created redundancy at this property. The proposed development would reuse the existing building as office space and develop the surrounding area for commercial uses.

The purpose of this study is to determine if the completion of the proposed development will significantly impact the adjacent transportation and parking systems. The report will satisfy the City of Springfield's requirements and follows the general guidelines for this type of evaluation. Based on the preliminary assessment for the site, attached, and discussions with the City, this document is a Level IV Transportation Impact Study.

b. Study Objectives Summary

Based on the Transportation Impact Study guidelines, the study objectives are:

- i. Document how the study intersections and roadways currently operate.
- ii. Forecast the amount of traffic and peak parking demand expected to be generated by the proposed development.
- iii. Examine the relationship to existing area transportation plans.
- iv. Determine how the study intersections and roadways will operate in the future with and without the proposed development.
- v. Evaluate the parking needs.
- vi. Examine the multi-modal facilities.
- vii. Analyze the sight distance at each access driveway.
- viii. Complete a site review from a transportation perspective.
- ix. Recommend appropriate mitigation measures if poor operations are identified.

The roadways corridors studied in this document include those surrounding the proposed site, which are:

- Radio Drive
- Avenue A
- X Drive
- 10th Street
- 11th Street
- 12th Street
- 13th Street
- Lakes Drive



The study intersections selected generally follow the Transportation Impact Study guidelines, which include all-way stop control, roundabout control, traffic signal control, and major side-street stop control intersections within one-mile of the proposed site accesses. Discussions with the City refined the initial list of study intersections, eliminating two intersections due to recent improvements that are expected to accommodate future traffic and adding another intersection. The added intersection is the opposite direction freeway ramp intersection. Although only one Interstate 99 (I-99) interchange intersection ramp is within the recommended study guideline areas, including the other ramp allows for a complete study of the interchange and two closely spaced signalized intersections. The study intersections for this report include:

- Radio Drive/Example Road/I-99 Westbound Ramps
- Radio Drive/Lakes Drive/I-99 Eastbound Ramps
- Radio Drive/Avenue A/Site Access 1
- Radio Drive/X Drive
- 10th Street/Site Access 2/X Drive
- 11th Street/Site Access 3/X Drive
- 12th Street/X Drive (site access)
- 13th Street/Lakes Drive/X Drive
- 12th Street/Lakes Drive

However, it should be noted traffic expected from the proposed development will have minor impacts on other corridors and intersections beyond those specific ones studied here. Furthermore, this study does not account for the existing roadway conditions such as pavement quality or appropriate drainage.

2. Development Site

a. Existing Site

The proposed development's official address is 550 X Drive and is located in the northeast quadrant of the Radio Drive and X Drive intersection. The site is zoned O – Office, but the developer is requesting a zoning change to PD – Planned Development district. The PD designation will allow for a wider variety of land uses, supporting an overall plan for the entire site.

Access to the site is currently provided via four access driveways; one to the north on Lakes Drive, one to the west on Radio Drive, and two to the south on X Drive. These access intersections currently allow for full movements with the Radio Drive access under traffic signal control.

b. Proposed Development

The site is expected to consist of office and commercial land uses. Specific uses were originally based upon the Month Day, Year concept plan, which was evaluated in a Preliminary Transportation Assessment, dated Month Day, Year. The current site plan is provided in the Appendix and has slightly revised land uses based on discussions with the City. The resultant land uses, and sizes are as follows:

- General Office – 267,000 square feet
- Corporate Headquarters (office) – 200,000 square feet
- Medical Dental Office – 30,000 square feet
- Hotel – 180 rooms
- Restaurants – 16,000 square feet
- Specialty Retail – 40,000 square feet
- Supermarket – 64,000 square feet

The development is anticipated to occur in two phases. The first phase will focus on the Corporate Headquarters, restaurants, and supermarket and is expected to be completed in year 20XX, three years from now. The second phase will complete the proposed development and is not expected until year 20XX, twenty years from today.

A total of 3,342 parking spaces will be provided on surface lots around the proposed site. Parking will be shared by all uses, although certain lots will be adjacent to specific land use buildings and could be considered exclusive by the driving public.

3. Existing Conditions

a. Corridor Characteristics

As mentioned, the proposed site is located on the northeast corner of the Radio Drive and X Drive intersection. Figure 1 in the Appendix shows the proposed site and surrounding roadway system. Table 1 shows the characteristics of the key roadway corridors around this site and within the study area.

Table 1 – Study Corridor Characteristics

Name	Designation ¹	Classification ²	Speed Limit	Daily Traffic Volume	Lanes	Fixed Route Transit ³	Peds/ Bicycles
Radio Drive N of I-99 S of I-99	CR 200	Primary Arterial	45 mph	16,100 36,000	4-Divided 6-Divided	1 route 30 min	Trail on west side
Avenue A	-	Collector	45 mph	7,600	4-Divided	-	Trail south side
X Drive	CR 220	Collector	45 mph	13,800	4-Divided	-	Trail south side
10th Street	-	Local	30 mph	1,200	2-Undivided	-	-
11th Street	-	Local	30 mph	500	2-Undivided	-	-
12th Street	-	Collector	35 mph	2,250	2-Undivided	-	Sidewalk both sides
13th Street	-	Local	30 mph	300	2-Undivided	-	-
Lakes Drive	-	Local	30 mph	2,300	2-Undivided	-	Sidewalks both sides

¹ I = Interstate, SH = State Highway, CR = County Road.

² Springfield – Greene County Comprehensive Plan and amendments.

³ Number of routes around the proposed site followed by the frequency of transit service during the peak periods.

b. Transit

Transit Route 20 serves bus stops on Radio Drive at the X Drive intersection. This express bus provides service around the City approximately every 30 minutes throughout the day.

The bus stops are on either side of Radio Drive around the X Drive intersection. Additional bus stops are located to the north and south of the proposed site on Radio Drive, approximately ½-mile away.

c. Pedestrians/Bicycles

Sidewalks or a trail are available on most roadways surrounding the site. Pedestrian crossings and countdown timers exist at nearby signalized intersections. This allows for good pedestrian access to and around the site.

Although no designated bicycle lanes are within the study area, the trails are multi-purpose allowing for both pedestrians and bicyclists. The trail on Radio Drive provides connections to nearby parks and a regional trail.

d. Existing Parking

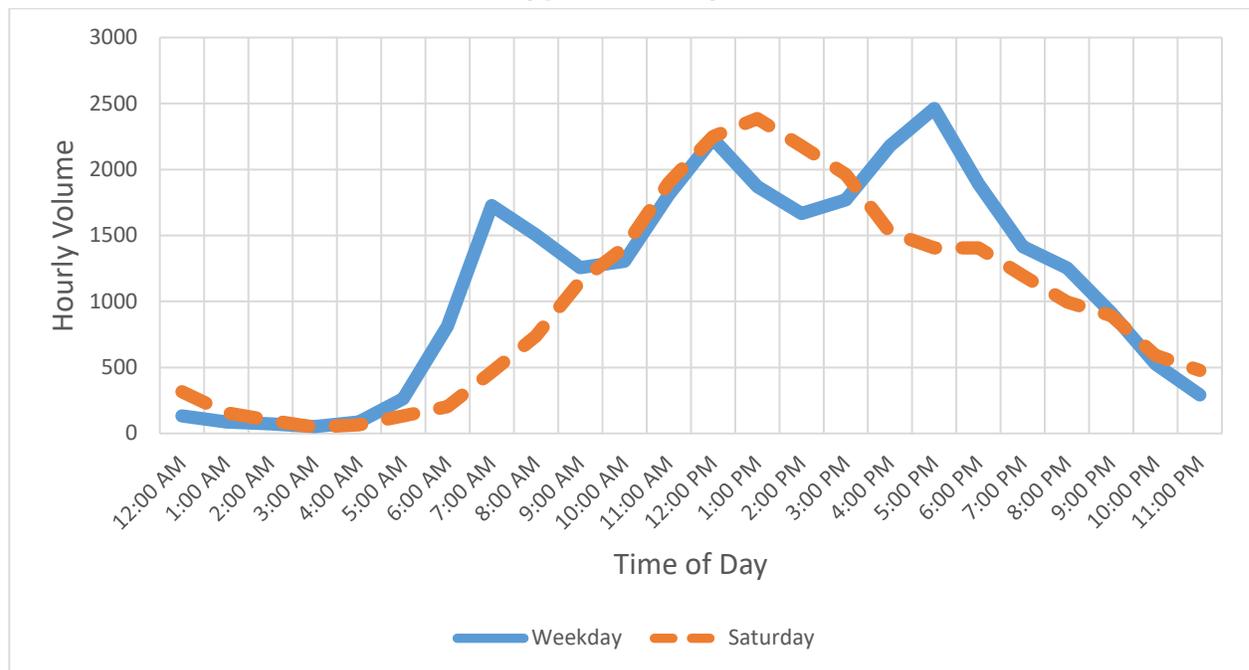
The existing site provides dedicated parking lots surrounding the building. This parking satisfied the City code for the prior office land use, which was dedicated to office use only and much smaller in size. On-street parking is not permitted on the surrounding public roads.

e. Traffic Volumes

Intersection video was collected at the existing study intersections under normal weekday conditions in Month, Year. Using these videos, 24-hour turning movement counts were obtained at the study intersections for a typical weekday and typical Saturday.

Chart 1 is a volume graph presenting the change in hourly traffic for a typical weekday and Saturday. The information is based upon the total traffic at the busiest study intersection of Radio Drive and X Drive. As shown, the counts revealed four general peak hours - weekday a.m., weekday noon, weekday p.m., and Saturday afternoon.

Chart 1 – Radio Drive/X Drive Typical Hourly Volume



As shown, the two highest peak hours are the weekday p.m. peak from 4:30 to 5:30 p.m. and the Saturday afternoon peak from 1 to 2 p.m. These peak hours were chosen

for review and used at the study intersections for analysis. The turning movement count data from the counts are contained in 15-minute intervals in the Appendix.

4. Forecasted Traffic

a. Site Traffic Forecasting

A trip generation analysis was performed for the development site based on the methods published in the *Institute of Transportation Engineers (ITE) Trip Generation Manual, 10th Edition*. Trip generation rates are provided by the same ITE manual as well as local data collected by Spack Consulting.

The ITE manual compiles studies from across the country to provide a national average traffic for various land uses. Spack Consulting collects current average traffic volumes for various land uses in the regional area for use in our studies. Local data is considered more relevant than the ITE national data as it is generally newer and accounts for our area's specific characteristics and driving habits. Per the procedure in the *Trip Generation Manual*, local trip generation data is used when possible and supplemented with national ITE data when local data is not available.

The trip generation includes a 10% reduction to account for strategies to encourage alternative modes of travel. Primarily concentrated in the office buildings, these strategies include real-time transit screens in the lobbies, locker rooms, indoor and outdoor bicycle storage, and a bicycle maintenance station. Additional discussion of these aspects is included in a later section.

For each analysis, the raw trip generation was divided among three types of trips – new, pass-by, and internal. Pass-by trips are those vehicles already on the roads which will stop at the development site in the future. Internal trips are those vehicles within the site visiting two or more stores. New trips represent traffic increasing the overall number of vehicles at the intersections. For the purposes of this study, the breakdown between these types of trip generation is:

- 20% Internal Trips.
- 15% Pass-By Trips (10% on Radio Drive and 5% on X Drive)
- 45% New Trips.

The remaining 20% of the site trip generation is designated toward three adjacent retail areas.

The resultant new trips generated by the proposed development are shown in Table 2, Phase 1, and Table 3, Phase 2. A detailed trip generation table showing the exact breakdowns is provided in the Appendix.

Table 2 – Phase 1 New Trip Generation

Land Use Code – Source ¹	Description & Size	Weekday Daily		Weekday PM Peak Hour		Saturday Peak Hour	
		In	Out	In	Out	In	Out
714 - ITE	Corporate Headquarters (200,000 SF)	413	413	2	61	5	6
Local	High Turnover Sit-Down Rest. (16,000 SF)	605	605	75	39	58	56
850 - ITE	Supermarket (64,000 SF)	1,777	1,777	157	151	175	169
NEW TRIPS TOTAL		2,795	2,795	234	251	238	231
NEW TRIPS WITH 10% MODE SHARE		2,516	2,516	211	226	214	208

¹ Local = Trip generation data collected by Spack Consulting in this regional area.

Table 3 – Phase 2 Full Development New Trip Generation

Land Use Code – Source ¹	Description & Size	Weekday Daily		Weekday PM Peak Hour		Saturday Peak Hour	
		In	Out	In	Out	In	Out
710 - ITE	General Office (267,000 SF)	676	676	26	134	40	34
714 - ITE	Corporate Headquarters (200,000 SF)	413	413	2	61	5	6
Local - Spack	Medical Dental Office (30,000 SF)	259	259	23	46	4	14
310 - ITE	Hotel (180 Rooms)	391	391	29	28	38	30
Local - Spack	High Turnover Sit-Down Rest. (16,000 SF)	605	605	75	39	58	56
820 - ITE	Retail (40,000 SF)	393	393	38	41	49	45
850 - ITE	Supermarket (64,000 SF)	1,777	1,777	157	151	175	169
NEW TRIPS TOTAL		4,514	4,514	350	500	369	354
NEW TRIPS WITH 10% MODE SHARE		4,063	4,063	315	450	332	319

¹ Local = Trip generation data collected by Spack Consulting in this regional area.

To be able to assign site generated trips to the roadway network, a directional trip distribution of the site traffic was developed. The following distribution took into account existing roadway traffic and access to the regional transportation system:

- 15% of the generated traffic to/from the north on Radio Drive.
- 20% of the generated traffic to/from eastbound I-99.
- 20% of the generated traffic to/from westbound I-99.
- 25% of the generated traffic to/from the south.
- 10% of the generated traffic to/from the west.
- 10% of the generated traffic to/from the east.

Traffic generated by the site development was assigned to the area roadways per this distribution pattern.

b. Non-site Traffic Forecasting

Based on Transportation Impact Study guidelines and further discussion with the City, the impacts of the proposed development are studied in year 20XX, the first year after opening, and year 20XX, ten-years after opening. To forecast future traffic volumes in the study area outside of the proposed development's traffic, specific other developments around the site and the general growth in traffic are considered.

Based on discussions with the City of Springfield, no other developments are expected in this area within the analysis timeframes. Therefore, future traffic volumes will be based upon the general growth alone.

Several sources were considered to determine general background growth in the area, including:

- Historic traffic data on the study roadways.
- 2030 forecast volumes from the Comprehensive Plan.
- Previous traffic studies in the surrounding area.

Based on this information, a growth rate of approximately 1.0% per year was calculated. This growth rate was applied to all movements in the study network except for those accessing the Corporate Campus, since those movements will only be increased with the development's forecast trip generation.

Applying this background growth rate to the existing traffic volumes established the 20XX and 20XX+20 No-Build forecasts.

c. Total Traffic

Traffic forecasts for the 20XX and 20XX+20 Build scenarios are established by adding the traffic generated by the proposed development for each phase to the non-site forecast volumes. The average daily traffic volume forecasts developed through this process are shown in Figure 2 of the Appendix. The resultant 20XX and 20XX+20 peak hour forecasts are provided in the capacity analysis files in the Appendix.

5. Relationship to Existing Planning

a. Vision 20/20

The Vision 20/20 Citizens group and its Transportation Focus Group worked to identify principles and policies for the Springfield-Greene County Transportation Plan. These principles serve as a summary of the transportation values of the community and provided guidance for the development of this document. The following transportation planning principles were considered to ensure the proposed development fits within the long-term transportation goals:

1. **Economy and Quality of Life:** Direct regional transportation investments and implement the Land Use and Growth Management Plan and strategies to support the economy and quality of life in the Springfield-Greene County urban area.
2. **Plan Consistency:** Make regional transportation investments consistent with this Transportation Plan.
3. **Roadway Efficiency:** Ensure that the Springfield-Greene County urban area roadway system is built and designed to maximize system efficiency, serve travel demand, provide for user safety, and integrate and enhance other travel modes.
4. **Access Control:** Provide an access-controlled roadway system, where necessary and feasible, based on land use, traffic demand, safety and cost.
5. **Road Right-of Ways:** Define and officially map rights-of-way for planned future highways and arterials within planned corridors, and where necessary, acquire right-of-way prior to development.
6. **Transit:** Promote the use of transit through incentives.
7. **Travel Demand:** Reduce the need for additional roadway capacity and maximize energy efficiency during peak hours through ridesharing, conventional transit, pedestrian and bicycle use, improved land use patterns, development site design, and Transportation System and Demand Management (TSM/TDM) strategies.
8. **Bicycle and Pedestrian Systems:** Develop and maintain safe, high-quality, continuous, barrier-free bicycle and pedestrian systems to function as integral parts of the area's transportation system.
9. **Freight:** Maintain a competitive freight transportation system including the region's commercial motor carriers, railroads, air cargo carriers, and intermodal connections in order to provide effective linkages to state, national and international markets. Design appropriate roadways to accommodate trucks and encourage the Missouri Legislature and MODOT to improve highway connections to other major cities, especially Kansas City and Memphis. Support airport development and the improvement of rail connections, trucking connections, inter-city bus, and the development of intermodal center.

10. **Planning Coordination:** The planning decisions and implementation of transportation programs and projects should be consistent with federal, state and regional environmental regulations, standards, programs and policies.
11. **Public Participation:** Promote public participation in formulating transportation policy and implementing transportation decisions.
12. **Paratransit:** Encourage the provision of paratransit and not-for-profit transportation services within the Springfield area, particularly for populations not served by the transit system.

As subsequent sections of this document will show, the entire transportation system is evaluated for potential improvements. Thus, the proposed development and suggested mitigation conforms to the principles of this planning document.

b. Ozarks Transportation Organization Major Thoroughfare Plan

The proposed development does not alter the surrounding roadway system, which already matches the thoroughfare plan. Access points around the development are also the same.

The Thoroughfare Plan does identify the need for a future north-south collector road, connecting Lakes Drive to X Drive and beyond if possible. This future collector would provide another route for travel to/from the shopping center to the east of the proposed site. The site plan shows this road on the east side, essentially extending 12th Street to a new intersection with Lakes Drive. This extension fulfills the need for a new collector in this area.

The proposed development is therefore consistent with this planning document.

6. Traffic Evaluation

a. Corridor Vehicular Analysis

While many factors contribute to a road feeling congested, the two biggest factors are volume, how many vehicles are using the road, and capacity, how many vehicles the road can accommodate a day. Transportation professionals use these pieces of information to create a ratio of volume to capacity. For example, a road with a volume to capacity ratio of 1.0, where the traffic demand is nearly equal to the traffic supply, will feel congested to motorists.

Below is a rough guide of the daily traffic volumes different types of roads can accommodate based on Exhibits 16-16 and 12-39 of the *Highway Capacity Manual, 6th Edition*. If the Average Daily Traffic (ADT) volume on a roadway is below the threshold, then it is considered un-congested. If the daily volume falls inside the range, the road is almost congested, and if the daily volume is over the threshold the road is congested.

- 2-Lane (one in each direction with left turn lanes at busy intersections and coordinated signals), undivided street, are considered congested with a volume between 8,900 to 18,300 vehicles per day.
- 4-Lane, undivided street (two in each direction with left turn lanes at busy intersections and coordinated signals), – 18,600 to 36,800 vehicles per day.
- 6-Lane, divided street (three in each direction with left turn lanes at busy intersections and coordinated signals), – 29,100 to 55,300 vehicles per day.

In comparison, Springfield/Greene County have developed their own road capacity/level of service guidelines for daily volumes by classification and type of road:

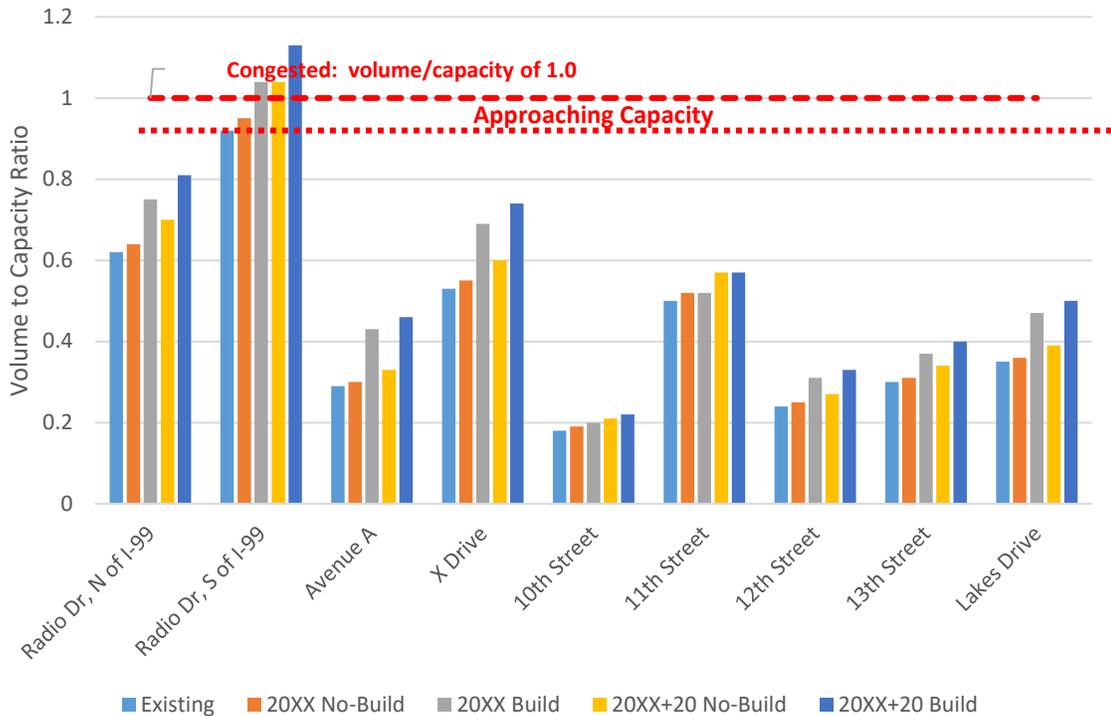
- 6-Lane, divided arterial – 39,000 vehicles per day.
- 4-Lane, divided arterial – 26,000 vehicles per day.
- 5-Lane, undivided arterial – 24,600 vehicles per day.
- 4-Lane, undivided arterial – 17,600 vehicles per day.
- 3-Lane, undivided arterial – 12,800 vehicles per day.
- 2-Lane, undivided arterial – 9,000 vehicles per day.
- 5-Lane, secondary arterial – 22,600 vehicles per day.
- 4-Lane, secondary arterial – 15,400 vehicles per day.
- 3-Lane, secondary arterial – 11,200 vehicles per day.
- 2-Lane, secondary arterial – 7,800 vehicles per day.
- 5-Lane, collector arterial – 19,600 vehicles per day.
- 4-Lane, collector arterial – 14,400 vehicles per day.
- 3-Lane, collector arterial – 9,400 vehicles per day.
- 2-Lane, collector arterial – 6,600 vehicles per day.

The above capacities represent physical capacity in ideal roadway conditions. Research from UC Berkley, for example, indicates quality of life along a residential

street is negatively impacted when the ADT exceeds 1,000 vehicles per day. Therefore, the 1,000 vehicle per day threshold is used for the capacity along neighborhood two-lane roads even though its physical capacity is approximately ten times larger.

To provide an initial planning level screening, Chart 2 provides volume to capacity ratios of the study corridors during each of the study years to determine if any of the roadway corridors are candidates for additional through lanes.

Chart 2 – Study Corridor Volume to Capacity



As shown, most corridors are able to accommodate the expected increases and do not indicate expected congestion based on planning-level thresholds. Radio Drive, south of I-99, exceeds the ‘approaches capacity’ (v/c ratio of about 0.85) and the capacity threshold. The high volume suggests increased congestion on the study corridor. However, the HCM does indicate the six-lane facility would have a higher threshold than that indicated by the Springfield/Greene County information. If the HCM capacity threshold is used, Radio Drive south of I-99 has sufficient planning-level capacity for the expected increases.

In either case, Radio Drive is a corridor to continue monitoring for future added improvements.

b. Intersection Vehicular Analysis

Individual intersections can perform poorly during peak periods while the overall roadway corridor is operating with an uncongested daily volume to capacity ratio lower than 1.0. Therefore, capacity analyses are performed for the study intersections to determine if they need improvements such as turn lanes or an upgrade in traffic control.

The existing and forecasted turning movement volumes along with the existing intersection configurations and traffic control were used to develop the average delay per intersection in each study scenario. The delay calculations were done in accordance with the *Highway Capacity Manual, 6th Edition* using the Vistro software package. The full calculations for each study scenario, including Level of Service (LOS) grades and queue lengths, are included in the Appendix. Also, included in the Appendix is a guide explaining the Level of Service grade concept.

Chart 3 (weekday p.m. peak hour) and Chart 4 (Saturday peak hour) show the average peak hour delay per traffic signal-controlled intersection for each study scenario. The LOS D/E boundary of 55 seconds of delay per vehicle is considered the threshold between acceptable and unacceptable traffic signal operation in this area.

The initial signal timing for the existing conditions was provided by the City of Springfield. Based on ITE’s recommendation of updating traffic signal timing plans every three to five years, the signal timing plans for the future year analyses were optimized to best accommodate the forecasted traffic volumes.

Chart 3 – Weekday P.M. Peak Hour Delays: Signal Controlled Intersections

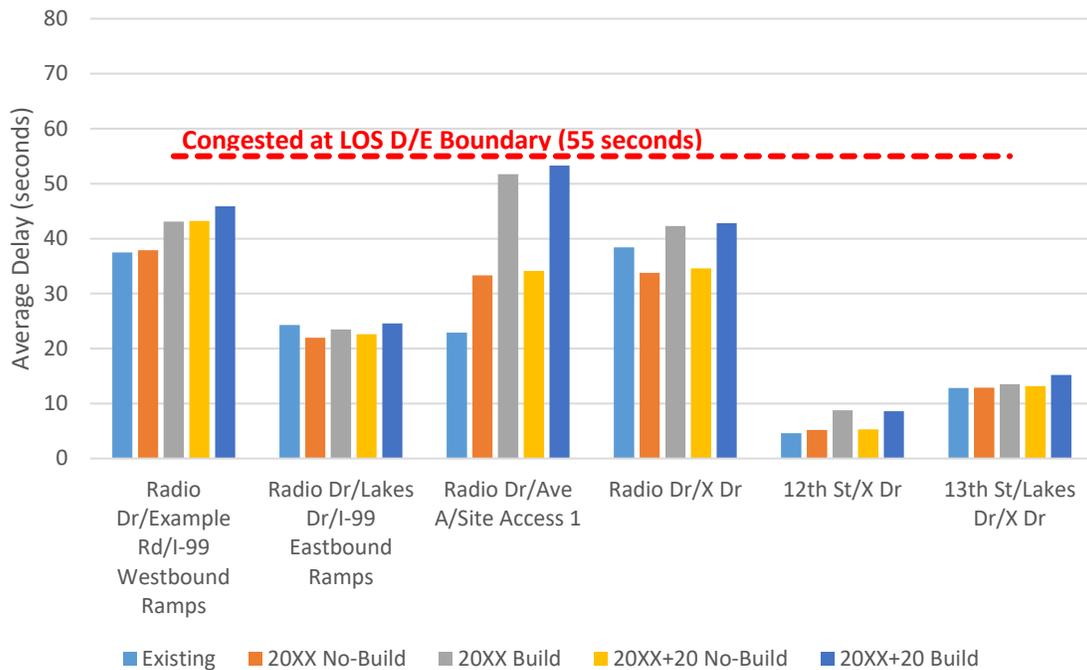


Chart 4 – Saturday Peak Hour Delays: Signal Controlled Intersections

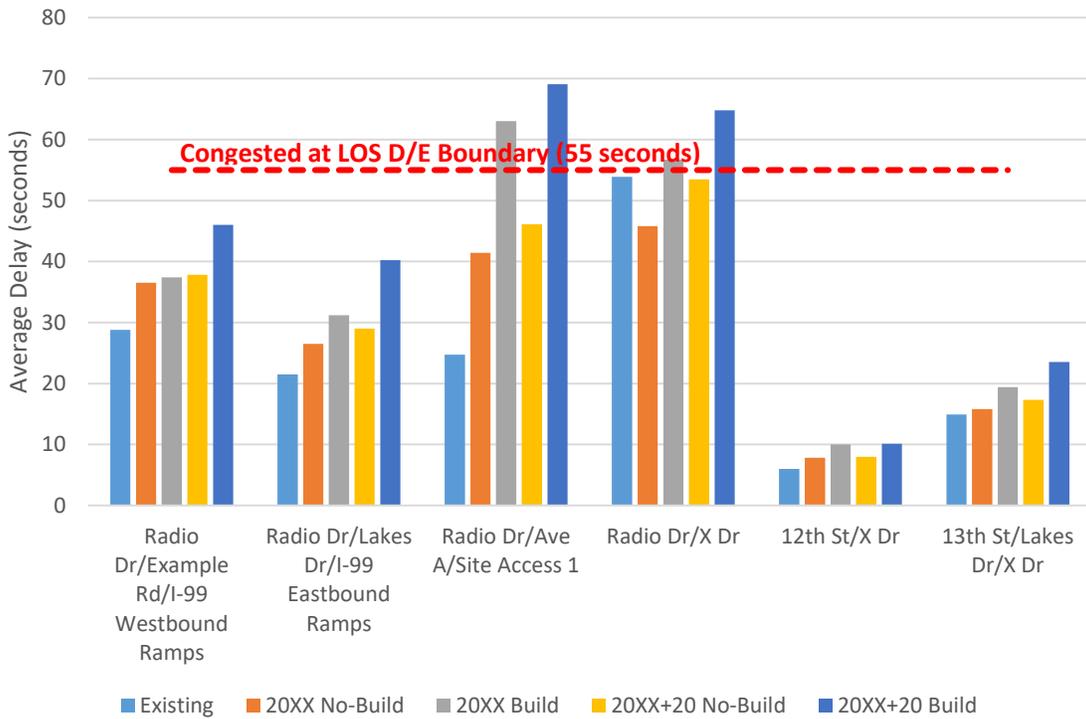


Chart 5 (weekday p.m. peak hour) and Chart 6 (Saturday peak hour) show the 95th percentile queue lengths on the busiest stop sign controlled approach at intersections with side street stop sign control. Average delays are not displayed for intersections with side street stop sign control because the vast majority of vehicles going through the intersection are on the main roadway and have zero delay, which leads to low overall average delays. At side street stop sign controlled approaches to busy roadways, the average delay for all the vehicles on the approach often exceeds 60 seconds. This can be the case for a few vehicles waiting at the stop sign where improvements would not be justified for the low traffic volume.

Instead of reporting average approach delays like the previous charts, Charts 5 and 6 show the 95th percentile queue as the measure of effectiveness at intersections with side street stop sign control. Based on our experience, improvements are not warranted at these types of intersections until the 95th percentile queue at a stop sign is in the five to ten vehicle range.

Chart 5 – Weekday P.M. Peak Hour Queues: Side Street Stop Sign Controlled Intersections

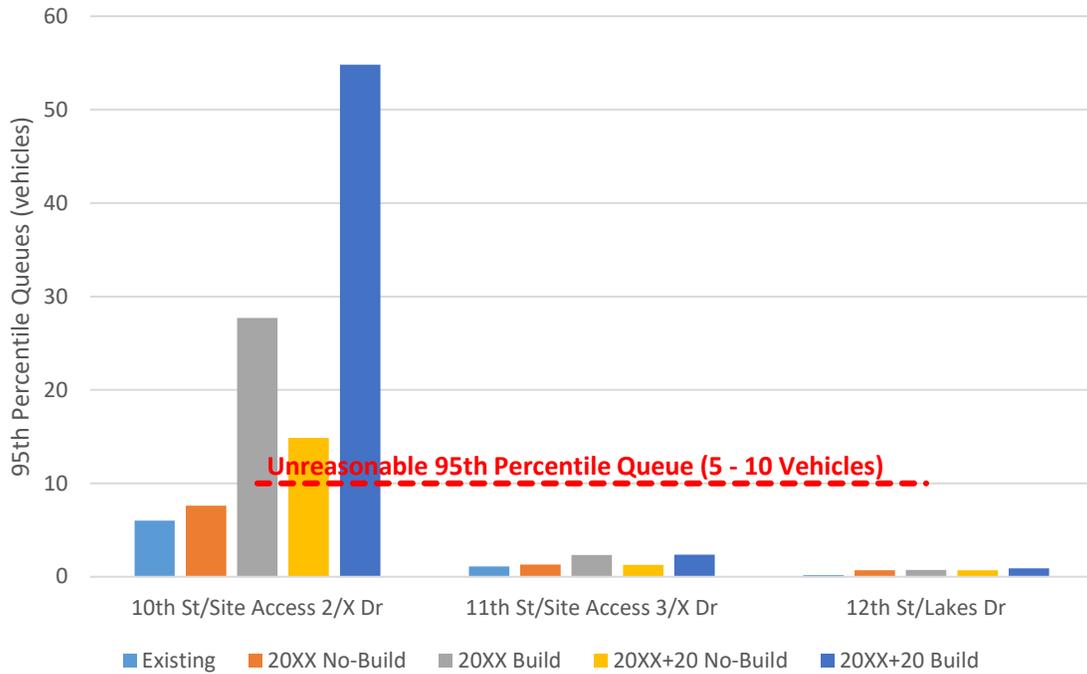
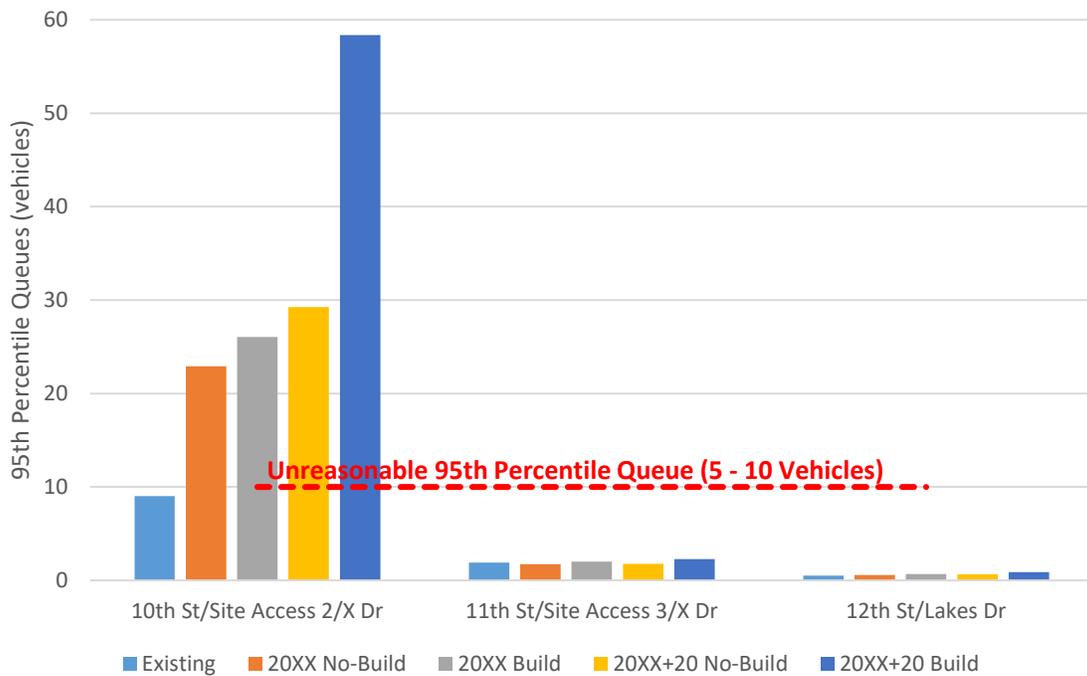


Chart 6 – Saturday Peak Hour Queues: Side Street Stop Sign Controlled Intersections



c. Vehicular Mitigation Analysis

Per the above analyses, most of the study intersections and corridors will operate acceptably throughout the study scenarios. However, the following intersections and corridors are identified as having sub-standard operation in the following scenarios:

- Radio Drive, south of I-99 in all scenarios
- Radio Drive intersections with Avenue A/Site Access and with X Drive in the Saturday peak hour Build Scenarios
- X Drive intersection with 10th Street in all scenarios

Alternatives were explored to provide appropriate mitigation at these locations, improving the vehicle operations. Generally, the least expensive alternative providing acceptable operations is recommended (i.e. stop signs over a traffic signal if stop signs will be sufficient). Based on these analyses, the following improvements are recommended to provide acceptable operations with reasonable queuing:

- Extend Radio Drive's three southbound lanes to the north, so they start immediately after the I-99 bridge. By providing three lanes for the Radio Drive southbound movement through that intersection, capacity for the movement increases, allowing a shift of green time to other movements. The eastbound right-turn movements should also operate more efficiently, with more ability to turn right on red due to more gaps in the southbound flow of traffic.
- Extend the westbound right-turn lane on the east leg of X Drive at the intersection with Radio Drive. Currently about 150 feet, the turn lane could be extended to 300 feet. This will prevent right-turning vehicles from getting caught in the queue for the through lane.
- Extend the two-way section of Lakes Drive west to a proposed access into the site. Providing for two-way traffic will allow motorists to easily travel between the proposed development and the adjacent retail area, reducing turning traffic on X Drive. An initial review of the current one-way section suggests that sufficient boulevard is available to provide for two lanes without major impact to the drainage culverts. However, a more thorough review of this concept should be completed to fully understand the potential impacts to the surrounding area.
- Limit access at the X Drive intersection with 10th Street to create a 3/4-access intersections. This change will eliminate the left-turn and through movements from 10th Street, the most dangerous type of side-street movement. Safety will greatly improve, and traffic operations will be more efficient. Motorists who previously turned left or traveled through from these side streets will be able to use other access points for their desired movement or complete a U-turn at an adjacent intersection on X Drive.
- Limit access at the X Drive intersection with 11th Street to right in/right out only. This change will eliminate the left-turn and through movements from the stop-controlled side-street as well as left-turn movements from the main line. Safety will greatly improve through the elimination of dangerous movements. Traffic

operations will also be better as the movements with high delays are eliminated. Motorists will be able to use other access points or perform U-turns at adjacent intersections to complete their desired movement.

- Construct a roundabout at the X Drive intersection with 12th Street to replace the signal system. This multilane roundabout would provide two circulating lanes for east-west traffic on X Drive and one circulating lane for north-south traffic on 12th Street. Although the current signal system would be expected to continue providing satisfactory traffic operations, a roundabout would be expected to improve both safety and operations. The roundabout would also provide a convenient point for U-turns associated with the access control at the X Drive intersections. A cursory review of the location showed sufficient space for the size of roundabout that would be needed and for the ability to reconstruct the approaches as needed for appropriate curves and splitter islands, although some right-of-way at the intersection corners may be needed to provide for the circular design.

In addition to the geometric changes outlined above, the signal timing and coordination plan will need to be updated to reflect the new volumes and traffic patterns. It is likely that a closer look at signal timing will further improve the traffic flow. Industry guidelines suggest updating traffic signal timing as part of routine maintenance of the roadway network, generally every three to five years or when conditions change significantly. Traffic pattern changes and volume growth that result from the new development will cause traffic signal timing for the area to quickly become dated.

The intersection operations were then re-analyzed assuming the proposed mitigation is completed. Charts 7 – 12 show the operation results for the Existing, 20XX+20 Build and Mitigation scenarios.

Chart 7 – Weekday P.M. Peak Hour Delays: Signal Controlled Intersections with Mitigation

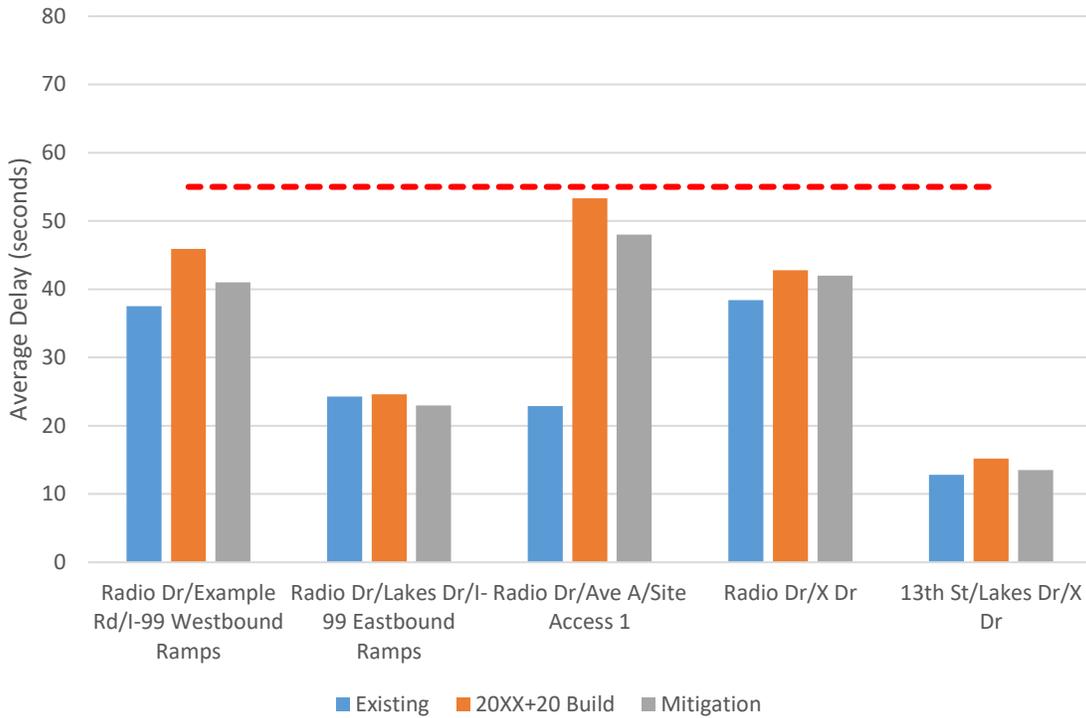


Chart 8 – Saturday Peak Hour Delays: Signal Controlled Intersections with Mitigation

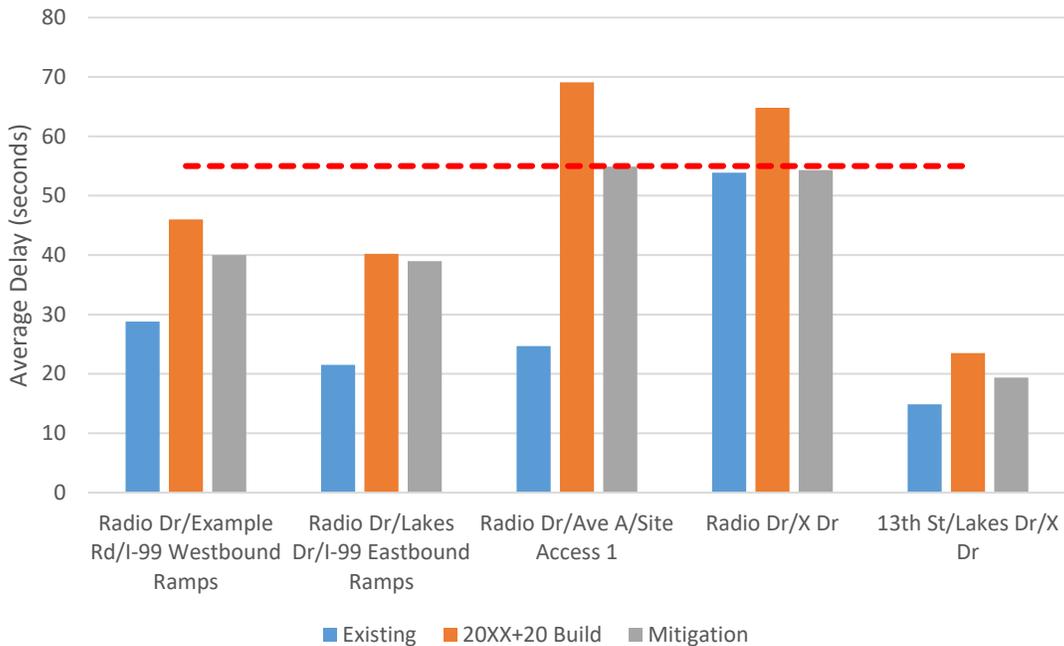


Chart 9 – Weekday P.M. Peak Hour Delays: Roundabout Controlled Intersections with Mitigation

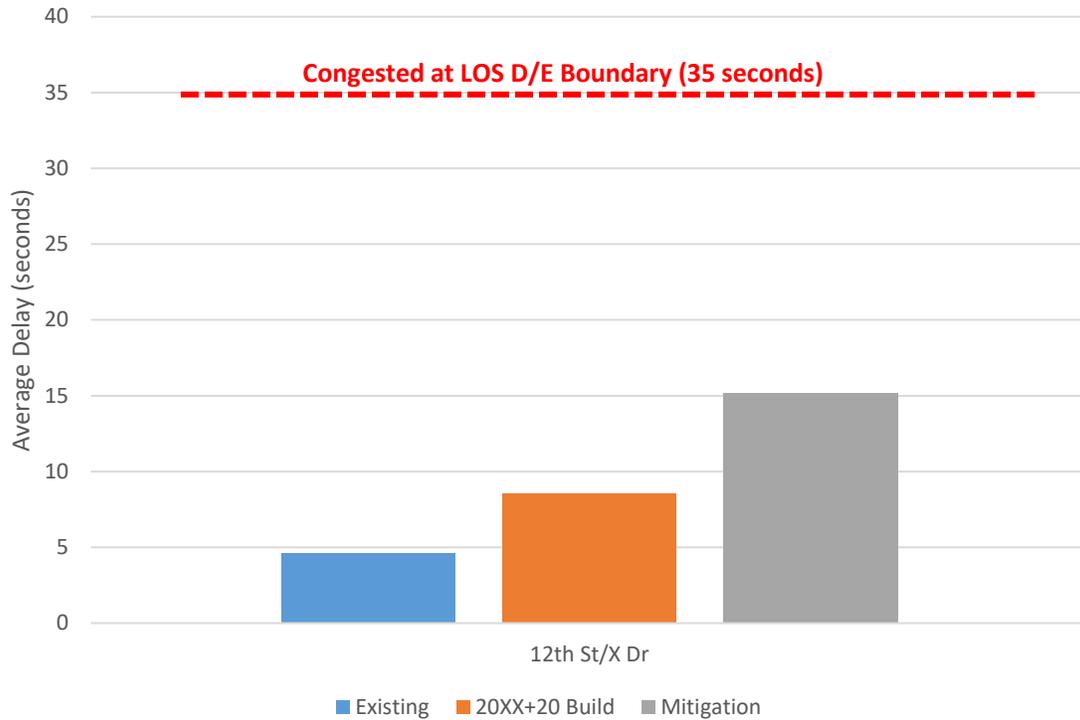


Chart 10 – Saturday Peak Hour Delays: Roundabout Controlled Intersections with Mitigation

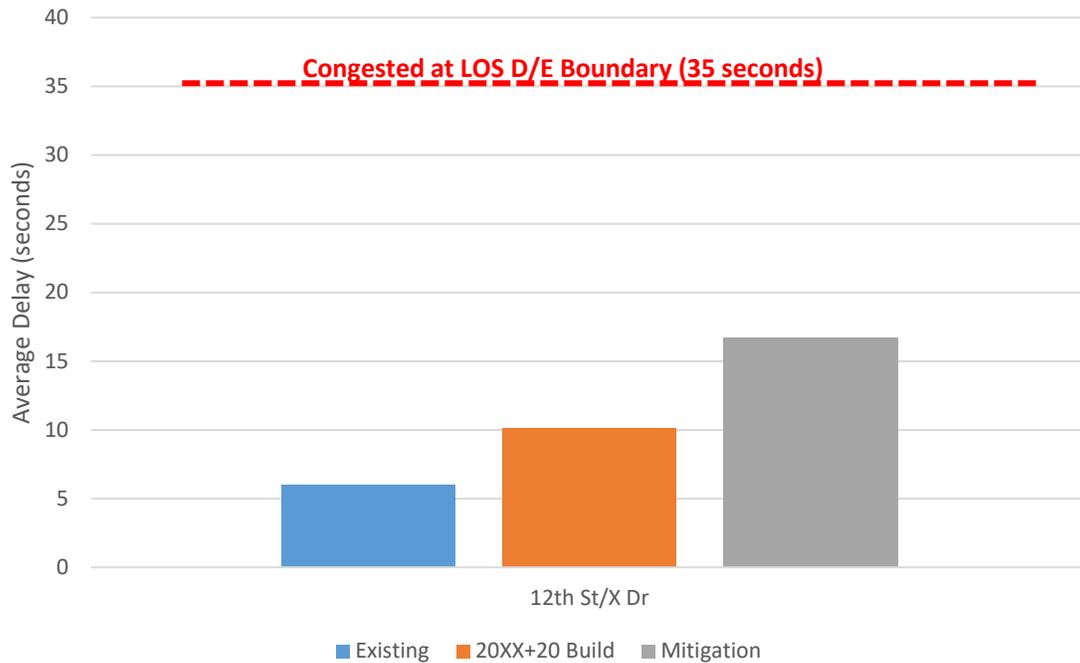


Chart 11 – Weekday P.M. Peak Hour Queues: Side Street Stop Sign Controlled Intersections with Mitigation

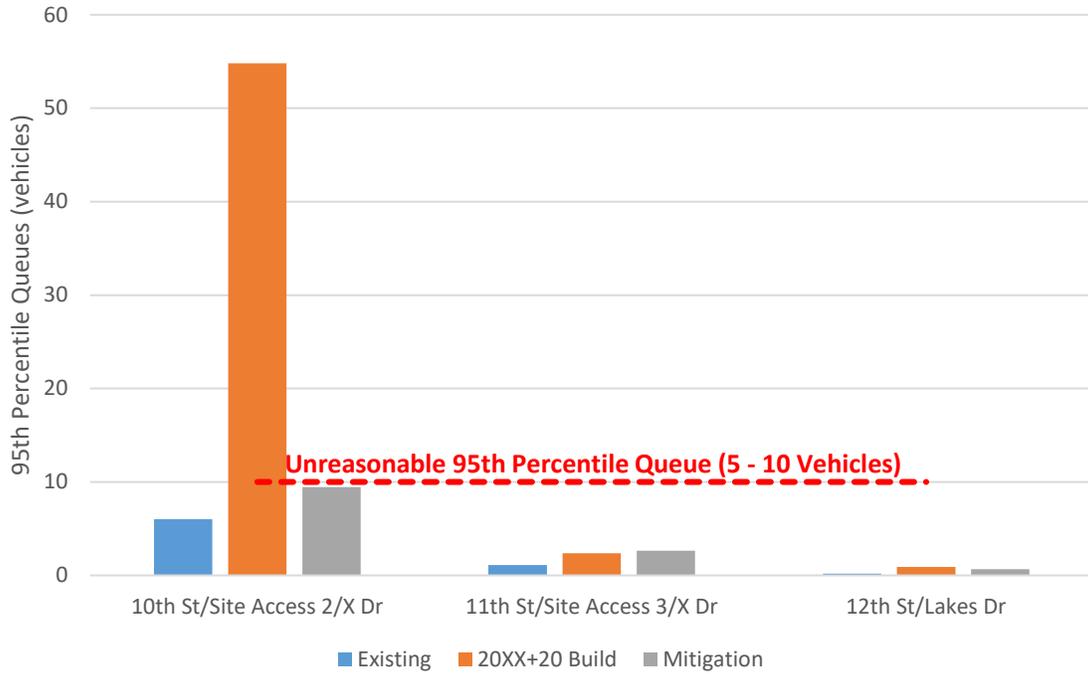
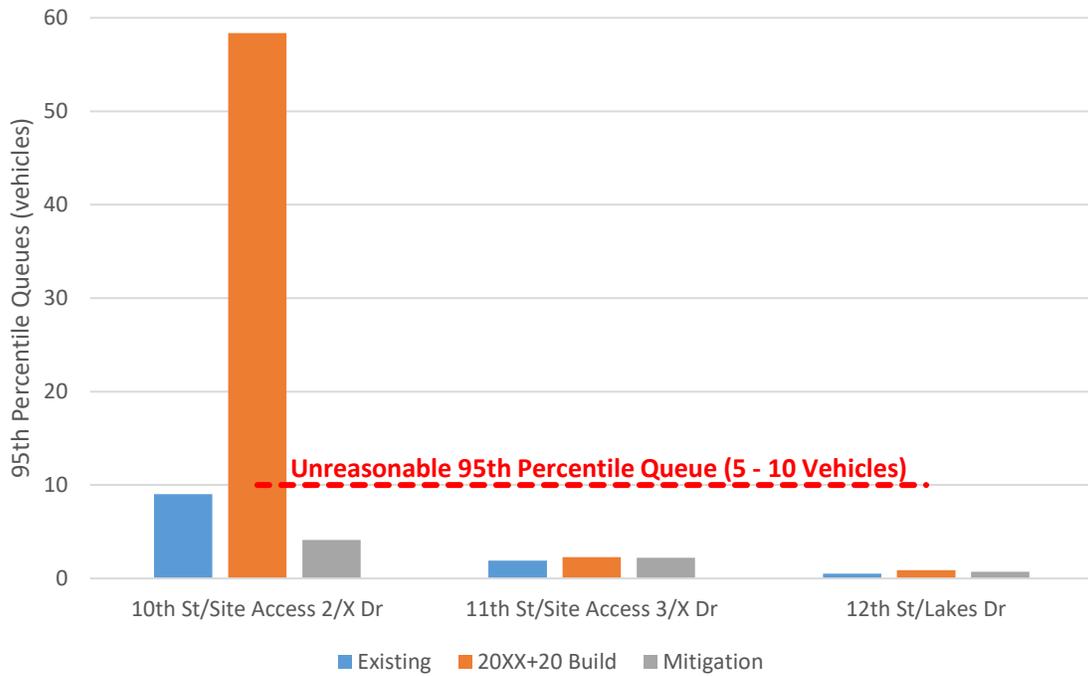


Chart 12 – Saturday Peak Hour Queues: Side Street Stop Sign Controlled Intersections with Mitigation



As shown, the proposed mitigation brings the intersection delays and vehicle queues back to acceptable levels for each of the study intersections. The proposed roundabout at the intersection of X Drive with 12th Street does represent an increase in average delay compared to the operations under traffic signal control. However, the results are still acceptable, and the roundabout represents a safer option for the intersection. In addition, the roundabout better facilitates U-turns compared to the traditional intersection design, which will improve compliance at the proposed limited access intersections.

The full results are provided in the Appendix. Figure 3 also shows the recommended improvements for the study area.

7. Parking Evaluation

a. Automobile Parking Forecasting & Analysis

Parking to be Provided On-Site

The proposed redevelopment will continue to provide parking by surface lots. Each development will have access to parking directly in front of their individual building along with access to shared spaces as needed during busier times. A total of 3,342 parking stalls are planned, which matches the earlier concepts.

Parking Required by City Code

According to the City of Springfield's Land Development Code, Section 36-455, off-street parking is required. The tables in that section define the following minimum requirements for each land use:

- Boarding, rooming, and lodging houses at one space for each lodging room.
- Business or professional offices and public administration buildings (except medical and dental offices) at one space per 350 square feet of total building floor area.
- Medical and dental offices and clinics at one space per 250 square feet of total building floor area.
- Restaurants with no pick-up window or drive-thru service require one space per 80 square feet of total building floor area.
- General retail uses at one space for each 250 square feet of total building floor area.
- Supermarkets and grocery stores require one space for each 250 feet of total building floor area.

Although reductions in the maximum parking required are available based on cooperative plans and provided bicycle parking, no reductions are taken for the purposes of this study. Table 4 shows the breakdown of the parking requirements.

Table 4 – City of Springfield Parking Requirements

Land Use	Development Units	Quantity	Minimum Required Vehicle Stalls
General Office	KSF	267.0	763
Corporate Headquarters	KSF	200.0	572
Medical Dental Office	KSF	30.0	120
Hotel	Rooms	180.0	180
High Turnover Sit-Down Rest.	KSF	16.0	200
Retail	KSF	40.0	160
Supermarket	KSF	64.0	256
Required Parking Stalls			2,251

The proposed parking exceeds these minimum City requirements.

Expected Parking Demand - ITE

The Institute of Transportation Engineers (ITE) has put together a document, *ITE Parking Generation, 4th Edition*, that compiled parking demand data from different land uses. Using that data, peak period parking demands were calculated for both land uses of this development for a non-Friday weekday, a Friday and a Saturday. Similar to the trip generation data, Spack Consulting has also collected local data which is used in place of the ITE information when possible. Those peak period parking demands are summarized in Table 5.

Table 5 – ITE Peak Period Parking Demands¹

Land Use Code – Source	Description & Size	Peak Parking Demand (Occupied Stalls)		Peak Parking Time	
		Weekday	Saturday	Weekday	Saturday
ITE – 701	Office Building, Suburban – 467,000 Square Feet	1,327	N/A*	09:00 – 11:00	N/A*
Local	Medical-Dental Office Building, Suburban – 30,000 Square Feet	101	26	14:00 – 17:00	10:00 – 13:00
ITE – 310	Hotel, Suburban – 180 rooms	161	216	22:00 – 05:00	22:00 – 06:00
Local	High-Turnover, Sit-Down Restaurant – 16,000 Square Feet	199	260	18:00 – 20:00	18:00 – 22:00
ITE – 820	Shopping Center – 40,000 Square Feet	151	187	13:00 – 14:00	13:00 – 14:00
ITE – 850	Grocery Store – 64,000 Square Feet	242	251	12:00 – 20:00	13:00 – 18:00

¹ Unadjusted parking generation based on ITE's *Parking Generation, 4th Edition*.

*The office parking demand will be minimal or zero over the weekend. ITE does not provide weekend parking information for office land uses.

With these different land uses, it is unlikely that the various land uses will experience their peak parking demand at the same time based on the peak parking times. Even if all the peak parking occurred at once, the proposed supply is well in excess of this total number.

Assuming the strategies in this report are implemented, the parking demand could be even less than identified here. Based on the City code and the expected demand, the proposed automobile parking supply is well above the needs. It is recommended the parking supply be reduced, potentially in favor of green space. If the demand turns out

to be above the needs expected, the green space could be converted to parking in the future.

b. Bicycle Parking Forecasting & Analysis

Off-street bicycle parking is required by the City to “promote effective traffic circulation, reduce congestion, encourage a reduction of impervious automobile parking area, provide facilities that promote alternative transportation options, and endorse a healthy lifestyle.” The bicycle parking requirement is based on the amount of off-street vehicle parking.

As stated earlier, the proposed parking supply is 3,342 parking stalls. Using the City’s ratio of bicycle to automobile parking, a minimum of 37 bicycle parking spaces are required.

The current site plan does not specify where bicycle parking will be located. From experience, we recommend providing two types of parking based on the individual land uses. Short-term parking is intended for retail areas or visitors to residential/office buildings. This parking is typically outdoors and located conveniently to the front doors. At least two short-term bicycle parking spots are recommended for the front door of each proposed building.

Long-term bicycle parking is typically covered and intended for use by workers or residents. Bicycles may be parked in these spots for several hours at a time as opposed to the typically less than an hour turn-over at short-term spaces. Long-term parking is recommended for at least the office land uses and, ideally, would number at least 30 spaces.

If the short- and long-term recommendations are implemented, the provided bicycle parking would be well in excess of the minimum parking required and encourage more bicycle use among the workers, visitors, and patrons of the proposed development.

8. Multi-Model Evaluation

a. Transit Use

As mentioned, Transit Route 20 currently runs along Radio Drive with stops at the intersection with X Drive near the proposed development. Given the number of workers, visitors, and patrons expected in the area, the developer is recommended to work with the City and CU Transit Services to extend the transit route into the site. Including one stop near the proposed office will significantly increase the likelihood of transit use and reduce the dependency on vehicle travel.

The new transit route could use the Avenue A and 12th Avenue extensions into the site along with X Drive to complete a circuit through the site and back to Radio Drive. With traffic signals and a proposed roundabout, the key intersections have appropriate traffic control for the safety of the bus travel.

Assuming a route accommodation is made, the internal site bus stops should provide covered benches, lighting for safety, and potentially heat lamps or warmers to encourage use during winter months. A real-time transit screen would also better inform transit users of when to expect the next bus.

Whether the bus route is changed or not, a connection between the development and the existing bus stops at the Radio Drive and X Drive intersection should also be provided. The existing bus stops also need basic maintenance to ensure the provided amenities meet the needs of the users.

As part of the strategy to reduce the trip generation for the proposed site (the trip generation included a 10% reduction to account for strategies to encourage alternative modes of travel), the proposed office buildings are recommended to provide real-time transit screens in the lobbies. These screens will provide the latest transit information on the adjacent route and encourage more transit use among the site's workers.

b. Bicycle Travel

Bicycle parking was discussed in a separate section and both short-term and long-term parking is recommended. Beyond the parking, bicycle use can be encouraged by infrastructure improvements to the site plan and internal building amenities. As mentioned, Radio Drive, Avenue A, and X Drive all have adjacent trails for bicycle use. These trails represent the larger trail network in the City and provide for travel to many other parts.

The current site plan shows a trail on the east side of the 12th Street extension, providing a north-south route across the development and a connection to the trail on X Drive. At least one of the sidewalks provided on either side of the Avenue A extension is recommended to become a wider trail. This change would provide an east-west trail connection through the development and a connection to the Radio Drive trail. With

these two new trails, the proposed site will have improved bicycle access throughout the area.

For the office buildings, locker rooms and a stand-alone bicycle maintenance station is recommended. Locker rooms with showers will allow employees to use bicycle travel from farther parts of the City.

A bicycle maintenance station is a low-cost method to encourage bicycle use. The adjacent picture shows one type of maintenance station that could be installed in the development. If provided near short-term bicycle parking, these stations are a great amenity for riders, providing basic repair tools along with an air pump for inflating tires.



c. Pedestrian Travel

The concept plan shows sidewalks or trails along the internal roads as well as connections along the exterior of parking lots. These sidewalks provide a structure for walking around the site and between land uses without the need to drive.

A further improvement is recommended to provide sidewalk connections to all buildings, including those internal to parking areas. Providing clear connections to every building will encourage this travel by providing a safe facility and indicating pedestrian travel areas to drivers.

The sidewalk facilities should also be well lit using pedestrian lighting, although potential spillover from parking lot and roadway lighting may be sufficient. Proper ADA treatments for the roadway crossings are also necessary. Internal intersections should provide crosswalk striping to further indicate the pedestrian nature of the area.

9. Sight Distance Review

As discussed in the Preliminary Assessment, which is provided in the Appendix, a basic sight distance check was completed using the AASHTO time-based methodology for sight distance evaluation. The results for each intersection are provided in Table below.

Table 6 – Sight Distance Checks

Intersection	Threshold	Looking to the north or west			Looking to the south or east		
		# of Evals	Lowest	Average	# of Evals	Lowest	Average
Ave A at Radio Dr	7.5	10	12.9	13.7	10	10.8	12.1
10 th St at X Dr		10	5.8	6.4	10	11.1	12.5
11 th St at X Dr		10	12.5	12.9	10	7.1	7.5
12 th St at X Dr		10	8.2	8.7	10	13.0	13.6

As shown in the table, the 10th Street intersection at X Drive is short of the requirement. The 11th Street intersection at X Drive meets the requirement using the average, but the lowest values are below the threshold.

The proposed roadway mitigation will change these two critical intersections to 3/4-access and right-in/right-out only access, respectively. With the side street left turn and through movements eliminated, the sight distance to the west is unimportant. The proposed roundabout at the intersection of X Drive with 12th Street will also reduce the vehicle speeds approaching the 10th Street and 11th Street intersections.

Based on these changes, the sight distance will meet the necessary requirements and no issues are expected.

Internally, the concept plan shows several internal intersections and crossing locations around the site. At internal speeds of 30 mph, approximately 330 feet is necessary in each direction at these crossing locations. Using the provide concept plan, this distance was laid out at the crossing locations. Based on these simple checks, sight distance is sufficient around the site.

With the proposed trees near and within the road (medians), proper tree maintenance will be important in the future. Low hanging branches will need to be removed and the canopy may need to be trimmed back to avoid impacts to the sight distances and to travel in general.

The concept plan did not identify building advertisement sign locations. If used, their locations should also be reviewed carefully to ensure any signs do not block sight distance.

10. Site Review

a. Concept Site Plan Review

The concept site plan contained in the Appendix was reviewed to determine if the plan meets city requirements, provides appropriate circulation, and minimizes conflicts. Following are key transportation elements of the concept site plan:

- i. Car Circulation: Primary and secondary roads provide access throughout the site and no significant issues were identified. The parking areas are off secondary roads with no potential for vehicles backing into the primary roads. Internal intersections are well spaced, avoiding potential queuing back to Radio Drive or X Drive.

The roadway layout uses horizontal curves, which will help keep vehicle speeds at the posted 30 mph or lower. The roadway layout does not have a direct path between Radio Drive and X Drive (at least one turn is necessary), suggesting 'cut-through' traffic should be minimized.

- ii. Truck Circulation: Truck movements were not provided with the concept plan and should be reviewed. In particular, heavy truck movements to/from the office docking and grocery store docking areas are of concern. These trucks need to be provided sufficient space to enter the docking area, back up to the docks, and then return to the roads. These movements are recommended to be developed and reviewed before approval of the concept plan.

Loading is also recommended to occur outside the peak commuter periods (6 – 9 a.m. and 3 – 6 p.m.) if possible. Building managers will need to work with their regular suppliers.

- iii. Signing & Striping: The internal roads and access to the larger roadway system are required to follow the Manual on Uniform Traffic Control Devices. These requirements include stop signs at intersections, yellow and white pavement markings on the internal roads, and regulatory speed limit and lane use signs where appropriate. The signing and striping plan will need to be reviewed before approval.

11. Conclusions and Recommendations

The Transportation Impacts of the proposed development were thoroughly studied, and the principal findings are:

- Phase 1 of the proposed Corporate Campus development is expected to generate over 5,000 new trips during an average weekday, 437 new trips during the weekday p.m. peak hour and 422 new trips during the weekend Saturday peak hour.
- The full development will increase the expected new trips to about 8,126 during an average weekday, 765 during the weekday p.m. peak hour, and 651 during the weekend Saturday peak hour.
- The Thoroughfare Plan for the City identifies the need for a future north-south collector road in this general area, which would be fulfilled by the proposed 12th Street extension.
- Based on planning-level thresholds used by the City, the Radio Drive corridor is currently approaching its capacity and will be over-capacity with this proposed development. The Highway Capacity Manual suggests higher capacity thresholds in which Radio Drive remains under its capacity.
- The intersections of Radio Drive/Avenue A, Radio Drive/X Drive, and X Drive/10th Street have identified capacity issues during the peak periods.
- The 10th Street and 11th Street side-street movements are expected to have safety issues and may need mitigation even if intersections operations are acceptable.
- The proposed parking supply greatly exceeds the minimum requirements and the expected demand.
- Bicycle parking is not shown but will be required.
- Sight distance issues have been identified at the X Drive intersections with 10th Street and with 11th Street.
- The car circulation is acceptable with no significant issues identified.
- Heavy truck movements in the site, particularly to/from the office and grocery store docking areas, have not been provided.
- Signing and striping for the proposed site have not been included in the concept plan for the site.

The following recommendations are made based on the above findings:

- Extend Radio Drive's three southbound lanes to the north, so they start immediately after the I-99 bridge. This change will provide extra capacity at the intersection without needing to modify the bridge.
- Extend the X Drive westbound right turn lane to approximately 300 feet, helping to prevent right turning vehicles from being caught in the through lane queues.
- Extend the two-way section of Lakes Drive west to the proposed site access and 12th Street extension. Providing for two-way travel will allow motorists easy access between major developments in this area (including the proposed) and keep some vehicles from needing to use the major roads.

- Limit the X Drive intersection with 10th Street to a ¾-access design, eliminating the side-street left turn and through movements. The safety of the intersection will improve with this design and traffic operations will become more efficient. The adjacent intersections will provide for U-turn movements if needed.
- Limit the X Drive intersection with 11th Street to right-in/right-out only, eliminating all left turn movements and side-street through movements. Safety and operations will improve under this design, and the high delay movements are eliminated. The adjacent intersections will provide for U-turn movements if needed.
- Construct a roundabout at the X Drive intersection with 12th Street to replace the existing traffic signal. The multilane roundabout will provide better safety and operations than the current signal as well as better facilitate U-turn movements for the proposed reduced access intersections along X Drive.
- Adjust signal timing at least every three years to reflect the current volumes and driving trends of the area.
- Reduce the parking supply and provide more green space in its place. Reducing parking will avoid empty looking parking lots and the associated cost, both to the development and to the environment, of maintaining empty lots. If the development demand is higher than expected for some reason, the green spaces could be converted to parking in the future.
- Provide short-term and long-term bicycle parking around the development in excess of the required 37 spaces. Short-term parking should be convenient to building front doors. Long-term parking is primarily for the office and would encourage a different mode of travel for workers.
- Work with the City and CU Transit Services to extend the Transit Route 20 into the proposed development and create new stops adjacent to the proposed office building. The new stops should be provided with covered benches, lighting, potentially heat lamps or other warming source for winter months, and a real-time transit screen.
- Improve the existing bus stops at the Radio Drive/X Drive intersection.
- Convert a proposed sidewalk along the Avenue A extension to a trail to provide for east-west bicycle travel and a connection to the Radio Drive trail.
- Provide locker rooms in the office building to encourage bicycle travel or walking.
- Provide a bicycle maintenance station near the office short-term or long-term parking (or both) to encourage bicycle travel.
- Provide ADA treatments for the sidewalks and trails at roadway crossings.
- Ensure the lighting is sufficient for pedestrian use of the sidewalks at night.
- Stripe pedestrian crosswalks at intersections to encourage their use and better identify crossing areas for drivers.
- Develop a tree maintenance plan to avoid sight distance issues in the future as the proposed trees mature.
- Ensure building advertisement signs do not encroach upon intersection sight distances.
- Provide the heavy truck movements for the internal site roadways and the movements to/from the office and grocery store docking areas.

- Ensure the signing and striping meets the requirements of the Manual on Uniform Traffic Control Devices.

12. Appendix

A. Figures

B. Preliminary Assessment

C. Traffic Counts

D. Trip Generation Tables

E. Capacity Analysis Backup

- Weekday PM Peak Existing
- Saturday Peak Existing
- Weekday PM Peak 20XX No-Build
- Saturday Peak 20XX No-Build
- Weekday PM Peak 20XX Build
- Saturday Peak 20XX Build
- Weekday PM Peak 20XX+20 No-Build
- Saturday Peak 20XX+20 No-Build
- Weekday PM Peak 20XX+20 Build
- Saturday Peak 20XX+20 Build
- Weekday PM Peak Mitigation
- Saturday Peak Mitigation