LAWRENCE FIELD OPERATIONS FACILITY
Combined Facility for the Municipal Services and Operations Organization (MSO)
Northeast of E 19th Street & O’Connell Road
CFS Project Number 191196

Traffic Study

July 2, 2020

Owner:
The City of Lawrence
6 East 6th Street, Lawrence, Kansas 66044

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Introduction

This traffic study for the field operations campus in the City of Lawrence, Kansas, has been prepared at the request of the City of Lawrence in accordance with the City’s Traffic Study Guidelines. The City of Lawrence is constructing a new field operations campus on the eastern side of the city which will consolidate several departments into one secure location. The 168 acre site will be northwest of the intersection of E 19th Street & O’Connell Road. Proposed staff includes 223 full-time and 13 part-time personnel with some individuals making multiple site trips to and from the facility throughout the day. The facility will be constructed to accommodate a growth in city staff to align with the growth of Lawrence over the next 50 years with an estimated 355 full-time and 21 part-time personnel.

There will be at least one new roadway connection to public streets with a major access point connecting to the intersection of E 19th Street & O’Connell Road. Although the current orientation of buildings and circulation roadway within the campus is still under development, an additional roadway access connection is being considered for either Greenway Circle and/or E 15th Street to meet emergency service access requirements. The intersection of E 19th Street & O’Connell Road will be reconfigured into a stop-controlled T-intersection with O’Connell Road extending to the north.
Many of the vacated improvements currently on site will be removed, including Tank 5 and Tank 6. The bulk warehouse and bag warehouse buildings are planned to remain unchanged due to this development but other options are being discussed at this time. Additional details for the existing site conditions are shown in the image below.

![Existing Conditions Site Map, Lawrence, Kansas](image)

The overall objective of the report is to look at proposed land uses and nearby intersections to determine if additional improvements are needed based on trip generation levels. The report will provide details on planned site improvements, provide traffic generation volumes, use available traffic data to distribute volumes for peak hour analysis, provide a Synchro analysis using performance measures, analyze multi-modal aspects of the facility, and provide details on the proposed roadways and access points.

**Section 1: Specific Development Plan and Land Use**

Land Use of Development: The land use for the site will be converted from the “Former Farmland/Vacant” category to “Institution” category. The site includes portions of two parcels currently owned by the City of Lawrence, Parcel ID 102-04-0-00-00-002.01-0 and Parcel ID
102-04-0-00-02-002.00-0. New improvements to Parcel ID 102-04-0-00-00-002.01-0 will include 3-6 combined-use buildings, bulk storage, fueling station, new roadways, and parking. New improvements to Parcel ID 102-04-0-00-02-002.00-0 will include a roadway connection or other improvements, such as the Household Hazardous Waste (HHW) building, depending on the final building footprint arrangement.

![Land Use Map, Lawrence, Kansas](image)

There will be 3 distinct land uses for the development which include the following:

1. **Office and Maintenance Combined Campus**
   
   (a) This includes several related-use buildings, offices, conference rooms, workshops, garages, storage bays, a refueling pump, and other building elements needed for city operations. Divisions within the Office and Maintenance Campus include the central maintenance garage, construction management engineering division, facility maintenance, forestry, horticulture, inspections, stormwater, streets, traffic division, wastewater collections, and water distribution.

   (b) For trip generation purposes, operating hours are Monday through Friday. It was estimated that 95% of the employees make at least one additional trip throughout the day if not two. Most employees will arrive around 6:30am, leave between
6:45am-7:00am to go to their scheduled field work, and return to the campus around 5:00pm-5:15pm. About 50% of staff will return for lunch around 11:30am-12:00pm. Inspectors leave for the field around 8:00am and return at 5:00pm. Some of the supervisory staff may make 3 or 4 trips throughout the day for meetings. Maintenance operations hours are 7:30am to 3:30pm with cart delivery trucks and maintenance trucks entering and exiting the shop area throughout the day.

(2) Solid Waste Division
(a) This includes trash truck operations.
(b) For trip generation purposes, operation hours are slightly different than Office and Maintenance operations since trash trucks operate Monday through Saturday. About 70% of the collection services operation starts at 6:00am with the other 30% at 7:00am. There is a single “late truck” that starts at 7:30am. Trucks leaving at 6:00am are expected to return back from their route at around 2:00-2:15pm to be clocked out by 2:30pm. Trucks leaving at 7:00am are expected to return back from their route at around 3:00-3:15pm to be clocked out by 3:30pm. The single “late truck” works until 4:00pm. Inclement weather slows down operations as well as when students move out meaning that, on occasion, the 6:00am trucks don’t return until 3:00-3:30pm. Only 3 trucks run on Saturdays with a start time of 6:00am and ending around 12:00pm.

(3) Household Hazardous Waste
(a) This includes household hazardous waste operations as well as a drop-off area for the public. This building will be outside of the fenced-in section of the campus.
(b) For trip generation purposes, the facility is open to the public 8:00am-1:00pm Tuesday, Wednesday, and Thursday. The number of public trips is expected to be 7 per hour.

Land Use of Surrounding Properties: To the north, across the BNSF Railroad rail line, the land use category is Agriculture. To the east, the land use category is Industrial. To the south of the site is vacant which is undeveloped/partially developed. To the west of the site, the land use categories are Vacant on the southside of E 19th Street and Multiple Family Residential on the northside of E 19th Street.

Development Plan: The following Facility Divisions will share space in the new campus:
● CMG – Central Maintenance Garage
  ○ Service and repair for all City-owned equipment
  ○ 73,770 sq ft for Main Building, 8.25 acres for total site requirements
  ○ 17 full-time employees
● CMED – Construction Management Engineering Division
○ Engineering oversight and management for construction projects in the City
○ 8,490 sq ft for Main Building, 2.71 acres for total site requirements
○ 14 full-time employees

● FAC – Facility Maintenance Division
○ Maintenance and operations for 258 City-owned buildings/structures and grounds
○ 33,523 sq ft for Main Building, 4.60 acres for total site requirements
○ 10 full-time employees and 1 part-time employee

● FOR – Forestry Division
○ Protect and maintain street trees
○ 24,665 sq ft for Main Building, 2.70 acres for total site requirements
○ 5 full-time employees and 3 part-time employee

● HOR – Horticulture Division
○ Maintenance of landscaping and natural areas
○ 11,856 sq ft for Main Building, 10.52 acres for total site requirements
○ 5 full-time employees and 5 part-time employee

● HHW – Household Hazardous Waste Division
○ City and County drop off location for household hazardous waste
○ 12,181 sq ft for Main Building, 2.78 acres for total site requirements
○ 1 full-time employee and 4 part-time employees

● INS – Inspections Division
○ Inspection of construction and repair projects
○ 4,713 sq ft for Main Building, 1.93 acres for total site requirements
○ 9 full-time employees

● SWD – Solid Waste Division
○ Collection of trash, recycling, yard waste, bulky items and tires
○ 43,584 sq ft for Main Building, 14.48 acres for total site requirements
○ 80 full-time employees

● STWT – Stormwater Division
○ Stormwater system oversight and management
○ 51,623 sq ft for Main Building, 6.56 acres for total site requirements
○ 10 full-time employees

● STRT – Streets Division
○ Roadway oversight and management
○ 79,626 sq ft for Main Building, 11.93 acres for total site requirements
○ 24 full-time employees

● TRAF – Traffic Division
○ Street signage and intersection traffic signal oversight and management
○ 23,513 sq ft for Main Building, 3.16 acres for total site requirements
○ 6 full-time employees
- **WSWT – Wastewater Collections Division**
  - Sanitary sewer system oversight and management
  - 22,729 sq ft for Main Building, 2.53 acres for total site requirements
  - 10 full-time employees
- **WTDT – Water Distribution Division**
  - Water distribution system oversight and management
  - 58,583 sq ft for Main Building, 10.00 acres for total site requirements
  - 32 full-time employees

For the Office and Maintenance Combined Campus including the Household Hazardous Waste division, the total building square footage is 448,856 sq ft and the total acreage is 82.15 acres. The final building layout is being refined at the time of writing this report. The general concept of the buildings is shown in the image below.
Schematic Building Layout
Section 2: Land Use Shown in the Lawrence/Douglas County Comprehensive Plan

Land Uses in the Lawrence/Douglas County Comprehensive Plan: The land use shown in the Plan 2040 GIS maps show that the site is partially vacant and partially industrial.

Plan 2040 Industrial Map (Purple)

Shown below are the nearby commercial areas and flood areas which will not be impacted by the new development.
There is no conflict between the proposed land use for the new development and the Comprehensive Plan.
Section 3: Functional Classification of the Public Streets Bordering the Site

Surrounding Public Streets and Highway Network: As shown in the Transportation 2040 (T2040) report developed by the Metropolitan Transportation Plan of Lawrence and Douglas County, the functional classification of the surrounding streets is shown in the map below.

Surrounding Roadways include the following:
- E 23rd Street/N 1400 Road - Principal Arterial
- O’Connell Road/E 1600 Road - Collector/Rural Major Collector
- Venture Park Drive - Collector/Rural Major Collector
Section 4: Access to the Development, Internal Circulation, and Truck Turning Movements

Access to the Development: The main access to the development will be an extension of O’Connell Road to the north of 19th Street. North of O’Connell Road & 19th Street will be a security gate entrance. The roadway will provide internal circulation through the site and will be used by vehicles traveling between buildings, vehicle maintenance bays, and workshops. Several options for a back entrance are being considered as an alternative egress for emergency/fire access.

Internal Circulation and Parking: The final parking lot layout and circulation plan is being refined at the time of writing this report. The general concept of vehicle flow is shown in the image below.
The Facility Divisions within the campus will share parking spaces although parking space requirements per division have been calculated separately to ensure parking needs are satisfied. The number of vehicle parking spaces is outlined below:
- CMG – Central Maintenance Garage
  - Staff Parking - 30 spaces
  - ADA Reserved Parking - 1 space
  - Conditioned Vehicle Storage (Warm) - 3,366 sq ft total
    - Pickup - 6 spaces at 10 ft x 20 ft
  - Large Service Bays - 18 spaces at 28 ft x 52 ft
  - Small Service Bays - 12 spaces at 22 ft x 32 ft
  - Tire Service Bay - 1 space at 28 ft x 52 ft
  - Fleet Staging Area - 6 spaces at 20 ft x 45 ft
  - Wash Bay - 1 space at 30 ft x 56 ft
  - Fuel Island - 1 space at 30 ft x 50 ft
  - Trash / Recycling Area - 1 space at 30 ft x 30 ft
- CMED – Construction Management Engineering Division
  - Staff Parking - 23 spaces
  - ADA Reserved Parking - 1 space
  - Exterior Equipment Parking - 10 spaces at 12 ft x 24 ft
- FAC – Facility Maintenance Division
  - Staff Parking - 18 spaces
  - ADA Reserved Parking - 1 space
  - Conditioned Vehicle Storage (Warm) - 26,668 sq ft total
    - Large - 5 spaces at 20 ft x 45 ft
    - Medium - 14 spaces at 12 ft x 24 ft
    - Pickup - 5 spaces at 10 ft x 20 ft
  - Unconditioned Vehicle Storage (Cold) - 8,976 sq ft total
    - Pickup - 16 spaces at 10 ft x 20 ft
  - Trash / Recycling Area - 1 space at 30 ft x 30 ft
- FOR – Forestry Division
  - Staff Parking - 8 spaces
  - ADA Reserved Parking - 1 space
  - Conditioned Vehicle Storage (Warm) - 19,191 sq ft total
    - Large - 5 spaces at 20 ft x 45 ft
    - Medium - 3 spaces at 12 ft x 24 ft
    - Pickup - 8 spaces at 10 ft x 20 ft
  - Unconditioned Vehicle Storage (Cold) - 1,795 sq ft total
    - Pickup - 3 spaces at 10 ft x 20 ft
  - Trash / Recycling Area - 1 space at 30 ft x 30 ft
- HOR – Horticulture Division
  - Staff Parking - 26 spaces
  - ADA Reserved Parking - 1 space
- Conditioned Vehicle Storage (Warm) - 4,825 sq ft total
  - Pickup - 9 spaces at 10 ft x 20 ft
- Unconditioned Vehicle Storage (Cold) - 8,976 sq ft total
  - Pickup - 16 spaces at 10 ft x 20 ft
- Exterior Equipment Parking - 14 spaces at 12 ft x 24 ft
- Trash / Recycling Area - 1 space at 30 ft x 30 ft
- HHW – Household Hazardous Waste Division
  - Staff Parking - 9 spaces
  - ADA Reserved Parking - 2 spaces
  - Visitor Parking - 17 spaces
  - Visitor Drive-thru - 1 space at 15 ft x 15 ft
  - Conditioned Vehicle Storage (Warm) - 561 sq ft total
    - Pickup - 1 spaces at 10 ft x 20 ft
  - Household Hazardous Waste Dumpster Containers - 3 spaces at 8 ft x 13 ft
- INS – Inspections Division
  - Staff Parking - 15 spaces
  - ADA Reserved Parking - 1 space
  - Exterior Equipment Parking - 14 spaces at 12 ft x 24 ft
- SWD – Solid Waste Division
  - Staff Parking - 109 spaces
  - ADA Reserved Parking - 4 spaces
  - Exterior Equipment Parking - 109 spaces at 12 ft x 24 ft
  - Wash Bay - 2 spaces at 30 ft x 56 ft
  - Fuel Island - 1 space at 30 ft x 50 ft
  - Dumpster and Cart Storage Area - 1 space at 160 ft x 300 ft
- STWT – Stormwater Division
  - Staff Parking - 16 spaces
  - ADA Reserved Parking - 1 space
  - Conditioned Vehicle Storage (Warm) - 39,898 sq ft total
    - Large - 13 spaces at 20 ft x 45 ft
    - Medium - 8 spaces at 12 ft x 24 ft
    - Pickup - 2 spaces at 10 ft x 20 ft
  - Unconditioned Vehicle Storage (Cold) - 12,629 sq ft total
    - Medium - 5 spaces at 12 ft x 24 ft
    - Pickup - 16 spaces at 10 ft x 20 ft
  - Exterior Equipment Parking - 13 spaces at 12 ft x 24 ft
  - Wash Bay - 1 space at 30 ft x 56 ft
- STRT – Streets Division
  - Staff Parking - 39 spaces
○ ADA Reserved Parking - 2 spaces
○ Conditioned Vehicle Storage (Warm) - 61,055 sq ft total
  ■ Large - 19 spaces at 20 ft x 45 ft
  ■ Medium - 13 spaces at 12 ft x 24 ft
  ■ Pickup - 4 spaces at 10 ft x 20 ft
○ Unconditioned Vehicle Storage (Cold) - 11,561 sq ft total
  ■ Medium - 3 spaces at 12 ft x 24 ft
  ■ Pickup - 16 spaces at 10 ft x 20 ft
○ Exterior Equipment Parking - 28 spaces at 12 ft x 24 ft
○ Wash Bay - 1 space at 30 ft x 56 ft
○ Fuel Island - 1 space at 30 ft x 50 ft
○ Trash / Recycling Area - 1 space at 30 ft x 30 ft
● TRAF – Traffic Division
  ○ Staff Parking - 10 spaces
  ○ ADA Reserved Parking - 1 space
  ○ Conditioned Vehicle Storage (Warm) - 7,414 sq ft total
    ■ Medium - 6 spaces at 12 ft x 24 ft
    ■ Pickup - 4 spaces at 10 ft x 20 ft
  ○ Exterior Equipment Parking - 6 spaces at 12 ft x 24 ft
● WSWT – Wastewater Collections Division
  ○ Staff Parking - 16 spaces
  ○ ADA Reserved Parking - 1 space
  ○ Conditioned Vehicle Storage (Warm) - 17,126 sq ft total
    ■ Large - 3 spaces at 20 ft x 45 ft
    ■ Medium - 11 spaces at 12 ft x 24 ft
● WTDT – Water Distribution Division
  ○ Staff Parking - 52 spaces
  ○ ADA Reserved Parking - 2 spaces
  ○ Conditioned Vehicle Storage (Warm) - 37,443 sq ft total
    ■ Large - 6 spaces at 20 ft x 45 ft
    ■ Medium - 18 spaces at 12 ft x 24 ft
    ■ Pickup - 13 spaces at 10 ft x 20 ft
  ○ Unconditioned Vehicle Storage (Cold) - 12,118 sq ft total
    ■ Pickup - 22 spaces at 10 ft x 20 ft
  ○ Exterior Equipment Parking - 35 spaces at 12 ft x 24 ft

Truck Turning Movements: Internal circulation routes will provide sufficient space for truck turning maneuvers. Most large trucks are less than 45 ft although the combination of a truck and trailer could be longer. The following image is a draft layout that provides sufficient turning
space for a Lawrence 49 Pumper Fire Truck. A larger version of this illustration has been included in the appendix.

Potential Layout showing Lawrence 49 Pumper Fire Truck Turning Movements

Section 5: Current Public Street Characteristics Adjacent to the Site

Surrounding Roadways: The following list provides a recap of roadways surrounding the MSO facility.

- E 23rd Street/N 1400 Road - Principal Arterial
  - East of O’Connell Road/E 1600 Road
    - 4 lane divided roadway with a speed limit of 55 mph
  - West of O’Connell Road/E 1600 Road
    - 4 lane divided roadway transition to a 5 lane undivided roadway with a speed limit of 45 mph
• O’Connell Road/E 1600 Road - Collector/Rural Major Collector
  ○ South of Venture Park Drive
    ■ 4 lane divided roadway with a speed limit of 35 mph and bike lanes
  ○ North of Venture Park Drive
    ■ 2 lane divided roadway with a speed limit of 35 mph and bike lanes
• Venture Park Drive - Collector/Rural Major Collector
  ○ 2 lane undivided roadway with a speed limit of 35 mph and bike lanes
• Greenway Circle - Collector/Rural Major Collector
  ○ 2 lane undivided roadway with a speed limit of 35 mph
• Noria Road/E 1750 Road - Minor Arterial
  ○ 2 lane undivided roadway with a speed limit of 45 mph
• E 19th Street - Collector/Rural Major Collector
  ○ 2 lane undivided roadway with a speed limit of 30 mph
• Harper Street - Collector/Rural Major Collector
  ○ 2 lane undivided roadway with a speed limit of 35 mph between 19th Street and 23rd Street, otherwise the speed limit is 30 mph

There are several proposed improvements to surrounding roadways as listed in the T2040 report. The report states that Harper Street, from 15th Street to 19th Street, is planned to be reconstructed. 19th Street, from Harper Street to O’Connell Road, is also planned to be reconstructed in 2021. The reconstruction is necessary due to pavement deterioration and would allow the continuation of bike lanes and sidewalks to match the rest of 19th Street. Future design plans would include curb & gutter, stormwater improvements, and address the current disconnection between O’Connell Road and 19th Street. T2040 lists the intersection of Harper Street & 19th Street as a candidate for a roundabout.

Public feedback from the T2040 report included several comments in regards to 19th Street improvements. Due to concerns that 19th Street will experience more traffic and will be treated like an arterial roadway rather than a collector roadway, many residents and representatives of the 19th Street Neighborhoods Coalition question whether connecting O’Connell Road to 19th Street is necessary. Since 19th Street is currently a “No Outlet” collector, the roadway does not experience thru traffic.
The public feedback centers on the potential level of traffic in conflict with walkability goals and neighborhood safety. This report does not cover any further detail of the future design of 19th Street improvements. If 19th Street is connected to O’Connell Road, some new trips generated by the MSO Facility might utilize 19th Street for emergency vehicle service, trash truck service, or other city vehicles in-service to the neighborhood; Most trips to and from the MSO facility will not utilize 19th Street because the layout of the MSO facility’s main access drive will be an extension of O’Connell Road and vehicles that utilize O’Connell Road will have a quicker travel time to access a majority of Lawrence. Since 19th Street is not on the City’s truck routing map, all trucks will be required to utilize O’Connell Road to get to E 23rd Street.

**Water Conflicts:** The flood map for the selected area is number 20045C0179E, effective on 09/02/2015, showed that the site was located outside of the 500 year flood zone.

**Existing Alternative Transportation Mode Choices:** Currently, there are sidewalks along both sides of O’Connell Road and Venture Park Drive. There is an existing sidewalk segment on the northside of E 19th Street. There are bicycle lanes on O’Connell Road and Venture Park Drive. Transit buses are routed along O’Connell Road and Venture Park Drive (Routes 5 and 15) and along Harper St and 19th Street (Route 1) which serve the area for the new development.
Crash Analysis: The analysis of crash data near the vicinity of the MSO Facility was limited to the previous 5 years, January 2014 to December 2018. During the 5 years, all observed crashes occurred along E 23rd Street/N 1400 Road or Venture Park Drive or at the intersections of K-10/E 23rd Street & O’Connell Road/E 1600 Road and O’Connell Road & Venture Park Drive.
Details of total crashes are summarized in the tables below:

**Table 1. Number of Crashes in Each Year**

<table>
<thead>
<tr>
<th>Year</th>
<th># of Crashes</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>14</td>
<td>12.5%</td>
</tr>
<tr>
<td>2015</td>
<td>33</td>
<td>29.5%</td>
</tr>
<tr>
<td>2016</td>
<td>34</td>
<td>30.4%</td>
</tr>
<tr>
<td>2017</td>
<td>18</td>
<td>16.1%</td>
</tr>
<tr>
<td>2018</td>
<td>13</td>
<td>11.6%</td>
</tr>
<tr>
<td>Grand Total</td>
<td>112</td>
<td>100%</td>
</tr>
<tr>
<td>Location Type</td>
<td># of Crashes</td>
<td>Percentage</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>--------------</td>
<td>------------</td>
</tr>
<tr>
<td>INTERSECTION-ON ROAD</td>
<td>11</td>
<td>9.8%</td>
</tr>
<tr>
<td>INTERSECTION-RELATED-ON ROAD</td>
<td>66</td>
<td>58.9%</td>
</tr>
<tr>
<td>MEDIAN-OFF ROAD</td>
<td>2</td>
<td>1.8%</td>
</tr>
<tr>
<td>NON-INTERSECTION-ON ROAD</td>
<td>31</td>
<td>27.7%</td>
</tr>
<tr>
<td>ROADSIDE-NO SHLDR-OFF ROAD</td>
<td>2</td>
<td>1.8%</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td><strong>112</strong></td>
<td><strong>100.0%</strong></td>
</tr>
</tbody>
</table>

Of the 112 total crashes, 58.9% occurred on a roadway related to the presence of an intersection, 27.7% occurred on a roadway without being related to the presence of an intersection, 9.8% occurred within an intersection, 1.8% occurred off of a roadway within the median, and 1.8% occurred within the roadside.

<table>
<thead>
<tr>
<th>Collision Type</th>
<th># of Crashes</th>
<th>Percentage</th>
<th># of Vehicles</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>WITH ANIMAL</td>
<td>3</td>
<td>2.7%</td>
<td>3</td>
<td>1.3%</td>
</tr>
<tr>
<td>WITH FIXED OBJECT</td>
<td>8</td>
<td>7.1%</td>
<td>9</td>
<td>3.8%</td>
</tr>
<tr>
<td>WITH OTHER MOTOR VEHICLE</td>
<td>99</td>
<td>88.4%</td>
<td>220</td>
<td>94.0%</td>
</tr>
<tr>
<td>WITH PEDESTRIAN</td>
<td>2</td>
<td>1.8%</td>
<td>2</td>
<td>0.9%</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td><strong>112</strong></td>
<td><strong>100.0%</strong></td>
<td><strong>234</strong></td>
<td><strong>100.0%</strong></td>
</tr>
</tbody>
</table>

Of the 112 total crashes, 88.4% occurred with at least one other motor vehicle, 7.1% occurred with fixed objects, 2.7% occurred with animals, and 1.8% occurred with pedestrians.

<table>
<thead>
<tr>
<th>Location Type vs Collision Type</th>
<th>WITH ANIMAL</th>
<th>WITH FIXED OBJECT</th>
<th>WITH OTHER MOTOR VEHICLE</th>
<th>WITH PEDESTRIAN</th>
<th>Grand Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTERSECTION-ON ROAD</td>
<td>1</td>
<td>22</td>
<td></td>
<td></td>
<td>23</td>
</tr>
<tr>
<td>INTERSECTION-RELATED-ON ROAD</td>
<td>1</td>
<td>144</td>
<td></td>
<td></td>
<td>145</td>
</tr>
<tr>
<td>MEDIAN-OFF ROAD</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>NON-INTERSECTION-ON ROAD</td>
<td>3</td>
<td>2</td>
<td>54</td>
<td>2</td>
<td>61</td>
</tr>
<tr>
<td>ROADSIDE-NO SHLDR-OFF ROAD</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td>3</td>
<td>9</td>
<td>220</td>
<td>2</td>
<td>234</td>
</tr>
</tbody>
</table>

The table above illustrates the total number of vehicles when considering location type and collision type. The two pedestrian crashes occurred on the roadway not at an intersection.
Table 5. Number of Crashes per Category | Lighting Conditions

<table>
<thead>
<tr>
<th>Lighting Conditions</th>
<th># of Crashes</th>
<th>Percentage</th>
<th># of Vehicles</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>DARK--NO STREET LIGHTS</td>
<td>3</td>
<td>2.7%</td>
<td>5</td>
<td>2.1%</td>
</tr>
<tr>
<td>DARK--STREET LIGHTS ON</td>
<td>18</td>
<td>16.1%</td>
<td>35</td>
<td>15.0%</td>
</tr>
<tr>
<td>DAWN</td>
<td>4</td>
<td>3.6%</td>
<td>9</td>
<td>3.8%</td>
</tr>
<tr>
<td>DAYLIGHT</td>
<td>84</td>
<td>75.0%</td>
<td>177</td>
<td>75.6%</td>
</tr>
<tr>
<td>DUSK</td>
<td>3</td>
<td>2.7%</td>
<td>8</td>
<td>3.4%</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td><strong>112</strong></td>
<td><strong>100%</strong></td>
<td><strong>234</strong></td>
<td><strong>100.0%</strong></td>
</tr>
</tbody>
</table>

Of the 112 total crashes, 75% occurred during daylight hours, 16.1% occurred during dark with street lights turned on, 2.7% occurred during dark without street lights, 3.6% occurred during dawn, and 2.7% occurred during dusk.

Table 6. Number of Crashes per Category | Weather Conditions

<table>
<thead>
<tr>
<th>Weather Conditions</th>
<th># of Crashes</th>
<th>Percentage</th>
<th># of Vehicles</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOG</td>
<td>2</td>
<td>1.8%</td>
<td>4</td>
<td>1.7%</td>
</tr>
<tr>
<td>FREEZING RAIN</td>
<td>1</td>
<td>0.9%</td>
<td>3</td>
<td>1.3%</td>
</tr>
<tr>
<td>NO ADVERSE CONDITIONS</td>
<td>94</td>
<td>83.9%</td>
<td>196</td>
<td>83.8%</td>
</tr>
<tr>
<td>RAIN, MIST, OR DRIZZLE</td>
<td>14</td>
<td>12.5%</td>
<td>29</td>
<td>12.4%</td>
</tr>
<tr>
<td>SNOW</td>
<td>1</td>
<td>0.9%</td>
<td>2</td>
<td>0.9%</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td><strong>112</strong></td>
<td><strong>100%</strong></td>
<td><strong>234</strong></td>
<td><strong>100.0%</strong></td>
</tr>
</tbody>
</table>

Of the 112 total crashes, 83.9% occurred during no adverse conditions, 12.5% occurred during rain, mist or drizzle, 1.8% occurred during fog, 0.9% occurred during snow, and 0.9% occurred during freezing rain.

Table 7. Number of Crashes per Category | Crash Type

<table>
<thead>
<tr>
<th>Crash Type</th>
<th># of Crashes</th>
<th>Percentage</th>
<th># of Vehicles</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNKNOWN</td>
<td>13</td>
<td>11.6%</td>
<td>14</td>
<td>6.0%</td>
</tr>
<tr>
<td>ANGLE - SIDE IMPACT</td>
<td>10</td>
<td>8.9%</td>
<td>20</td>
<td>8.5%</td>
</tr>
<tr>
<td>HEAD ON</td>
<td>1</td>
<td>0.9%</td>
<td>2</td>
<td>0.9%</td>
</tr>
<tr>
<td>REAR END</td>
<td>83</td>
<td>74.1%</td>
<td>186</td>
<td>79.5%</td>
</tr>
<tr>
<td>SIDESWIPE: SAME DIRECTION</td>
<td>5</td>
<td>4.5%</td>
<td>12</td>
<td>5.1%</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td><strong>112</strong></td>
<td><strong>100%</strong></td>
<td><strong>234</strong></td>
<td><strong>100.0%</strong></td>
</tr>
</tbody>
</table>
Of the 112 total crashes, 74.1% involved a rear end, 8.9% involved an angle-side impact, 4.5% involved a sideswipe in the same direction, 0.9% involved a head on, and 11.6% where left unknown.

Table 8. Severity Distribution per Crash Type

<table>
<thead>
<tr>
<th>Crash Type</th>
<th># of Crashes</th>
<th># of Injury</th>
<th>Percentage</th>
<th># of PDO</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNKNOWN</td>
<td>13</td>
<td>3</td>
<td>23.1%</td>
<td>10</td>
<td>76.9%</td>
</tr>
<tr>
<td>ANGLE - SIDE IMPACT</td>
<td>10</td>
<td>4</td>
<td>40.0%</td>
<td>6</td>
<td>60.0%</td>
</tr>
<tr>
<td>HEAD ON</td>
<td>1</td>
<td>0</td>
<td>0.0%</td>
<td>1</td>
<td>100.0%</td>
</tr>
<tr>
<td>REAR END</td>
<td>83</td>
<td>17</td>
<td>20.5%</td>
<td>66</td>
<td>79.5%</td>
</tr>
<tr>
<td>SIDESWIPE: SAME DIRECTION</td>
<td>5</td>
<td>1</td>
<td>20.0%</td>
<td>4</td>
<td>80.0%</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td><strong>112</strong></td>
<td><strong>25</strong></td>
<td><strong>22.3%</strong></td>
<td><strong>87</strong></td>
<td><strong>77.7%</strong></td>
</tr>
</tbody>
</table>

Most of the collisions are clustered around E 23rd Street/N 1400 Road & O’Connell Road with 74.1% rear end crashes. Of the 25 injury crashes, most were rear end crashes; however, if an angle/side impact crash occurred, the probability of an injury increased. Head on collisions are rare and the only recorded head-on was at a low enough speed so that there were no injuries. Based on the existing traffic crashes and new trips generated by the MSO facility, no improvements of the surrounding roadway network are recommended at this time.

**Section 6: Proposed Access Compared with Design Criteria and Sight Distance Requirements**

For the proposed access locations, the design speed is 35 mph resulting in a required stopping sight distance of 250 ft and an intersection sight distance of 390 ft. Although the layout of the access drives are currently under design consideration, the sight distance requirements given the current layout of the existing roadways is met. The new access drives will be laid out to meet these design constraints.
Section 7: Estimate of Trips Generated by Existing and Proposed Development

Existing Trip Generation: No trips are currently generated by the current land use.

Proposed Trip Generation: Since the City of Lawrence has defined how many employees will be working within each division and when they are expected to arrive and depart throughout the day, the number of trips can be estimated.

<table>
<thead>
<tr>
<th>Trip Generation Summary</th>
<th>TOTAL DIVISIONS</th>
<th>BUILDING FLOOR AREA (sq ft)</th>
<th>TOTAL SITE (acres)</th>
<th>STAFF SUBCATEGORY</th>
<th>OPERATING DAYS OF THE WEEK</th>
<th>APPROX. OPERATING HOURS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office and Maintenance Combined Campus (Staff)</td>
<td>11</td>
<td>393,091</td>
<td>65</td>
<td>Campus-only Staff</td>
<td>MON-FRI</td>
<td>7:00am - 5:00pm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Site Visiting Staff</td>
<td>MON-FRI</td>
<td>6:30am - 5:00pm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Inspectors</td>
<td>MON-FRI</td>
<td>8:00am - 5:00pm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Maintenance Staff</td>
<td>MON-FRI</td>
<td>7:30am - 3:30pm</td>
</tr>
<tr>
<td>Solid Waste Division (Staff)</td>
<td>1</td>
<td>43,584</td>
<td>14</td>
<td>Fleet Round 1</td>
<td>MON-SAT</td>
<td>6:00am - 2:00pm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Fleet Round 2</td>
<td>MON-SAT</td>
<td>7:00am - 3:00pm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Fleet Round 3</td>
<td>MON-SAT</td>
<td>7:30am - 4:00pm</td>
</tr>
<tr>
<td>Household Hazardous Waste (Staff)</td>
<td>1</td>
<td>12,181</td>
<td>3</td>
<td>Campus-only Staff</td>
<td>MON-FRI</td>
<td>6:30am - 5:00pm</td>
</tr>
<tr>
<td>Household Hazardous Waste (Public Drop Off)</td>
<td>1</td>
<td></td>
<td></td>
<td>Public</td>
<td>TUES-THUR</td>
<td>8:00am - 1:00pm</td>
</tr>
</tbody>
</table>
## Trip Generation Summary 2020

<table>
<thead>
<tr>
<th>SUBCATEGORY</th>
<th>NUMBER OF EMPLOYEES (Full and Part Time)</th>
<th>EXPECTED DAILY TRIPS PER STAFF SUBCATEGORY (Veh / Day / Employee)</th>
<th>ESTIMATED DAILY TRIPS (Veh / Day)</th>
<th>A.M. PEAK HOUR, 7-9am (Veh / Hour)</th>
<th>P.M. PEAK HOUR, 4-6pm (Veh / Hour)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office and Maintenance Combined Campus (Staff)</td>
<td>8 Employees</td>
<td>2</td>
<td>16</td>
<td>8 IN</td>
<td>8 OUT</td>
</tr>
<tr>
<td></td>
<td>117 Employees</td>
<td>6</td>
<td>702</td>
<td>117 IN</td>
<td>117 OUT</td>
</tr>
<tr>
<td></td>
<td>9 Employees</td>
<td>8</td>
<td>72</td>
<td>9 IN</td>
<td>9 OUT</td>
</tr>
<tr>
<td></td>
<td>17 Employees</td>
<td>2</td>
<td>34</td>
<td>17 IN</td>
<td>17 OUT</td>
</tr>
<tr>
<td>Solid Waste Division (Staff)</td>
<td>56 Employees</td>
<td>2</td>
<td>112</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>23 Employees</td>
<td>2</td>
<td>46</td>
<td>23 IN</td>
<td>23 OUT</td>
</tr>
<tr>
<td></td>
<td>1 Employee</td>
<td>2</td>
<td>2</td>
<td>1 IN</td>
<td>1 OUT</td>
</tr>
<tr>
<td>Household Hazardous Waste (Staff)</td>
<td>5 Employees</td>
<td>2</td>
<td>10</td>
<td>5 IN</td>
<td>5 OUT</td>
</tr>
<tr>
<td>Household Hazardous Waste (Public Drop Off)</td>
<td></td>
<td></td>
<td>35</td>
<td>7 IN</td>
<td>7 OUT</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>236</strong> Employees</td>
<td><strong>1029</strong></td>
<td></td>
<td><strong>187</strong> IN</td>
<td><strong>157</strong> OUT</td>
</tr>
</tbody>
</table>

### Verification of Trip Generation Rates and Design Hour Volume Data

To verify the trips produced by the proposed development, trip generation volumes were compared utilizing the land use types categorized by the Institute of Transportation Engineer’s Trip Generation Guidelines, 10th Edition. “Government Office Complex” (ITE Code 733) and “Utility” (ITE Code 170) were the ITE Land Use categories used to compare against the expected trips for the campus. The estimated number of trips were based on the number of employees. Copies of the applicable ITE Trip Generation Manual pages are included in the appendix. The following tables show the parameters for measurement units, total trip generation rates for peak hour traffic volumes, and corresponding total vehicles for peak hour traffic at the site.
ITE Traffic Generation Parameters Comparison Chart

<table>
<thead>
<tr>
<th>ITE Category</th>
<th>Government Office Complex (ITE Code 733)</th>
<th>Utility (ITE Code 170)</th>
<th>Expected Trips (Based on City-Provided Data)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weekday Total</td>
<td>13.29</td>
<td>4.11</td>
<td>4.36</td>
</tr>
<tr>
<td>Weekday In</td>
<td>50%</td>
<td>50%</td>
<td>50%</td>
</tr>
<tr>
<td>Weekday Out</td>
<td>50%</td>
<td>50%</td>
<td>50%</td>
</tr>
</tbody>
</table>

**Peak Hour of Adjacent Street Traffic, One Hour**

<table>
<thead>
<tr>
<th></th>
<th>AM Peak Total</th>
<th>AM Peak In</th>
<th>AM Peak Out</th>
<th>PM Peak Total</th>
<th>PM Peak In</th>
<th>PM Peak Out</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.83</td>
<td>89%</td>
<td>11%</td>
<td>1.10</td>
<td>31%</td>
<td>69%</td>
</tr>
<tr>
<td></td>
<td>0.70</td>
<td>81%</td>
<td>19%</td>
<td>0.76</td>
<td>15%</td>
<td>85%</td>
</tr>
</tbody>
</table>

ITE Traffic Generation Volumes Comparison Chart

<table>
<thead>
<tr>
<th>ITE Category</th>
<th>Government Office Complex (ITE Code 733)</th>
<th>Utility (ITE Code 170)</th>
<th>Expected Trips (Based on City-Provided Data)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Units</td>
<td>Employee</td>
<td>Employee</td>
<td>Employee</td>
</tr>
<tr>
<td>Expected Units</td>
<td>236</td>
<td>236</td>
<td>236</td>
</tr>
<tr>
<td>Weekday Total</td>
<td>3,136</td>
<td>970</td>
<td>1,029</td>
</tr>
<tr>
<td>Weekday In</td>
<td>1,568</td>
<td>485</td>
<td>514.5</td>
</tr>
<tr>
<td>Weekday Out</td>
<td>1,568</td>
<td>485</td>
<td>514.5</td>
</tr>
<tr>
<td>AM Peak Total</td>
<td>196</td>
<td>165</td>
<td>344</td>
</tr>
<tr>
<td>AM Peak In</td>
<td>174</td>
<td>134</td>
<td>187</td>
</tr>
<tr>
<td>AM Peak Out</td>
<td>22</td>
<td>31</td>
<td>157</td>
</tr>
<tr>
<td>PM Peak Total</td>
<td>260</td>
<td>179</td>
<td>284</td>
</tr>
<tr>
<td>PM Peak In</td>
<td>80</td>
<td>27</td>
<td>127</td>
</tr>
<tr>
<td>PM Peak Out</td>
<td>179</td>
<td>152</td>
<td>157</td>
</tr>
</tbody>
</table>

The expected trips most closely resemble trip generation parameters for the Utility category with only a slight increase in volume (6% difference).

**Reductions for Pass-By and Diverted-Link Trips**: The land-use is not applicable to pass-by trip generation. No diverted-link analysis was done for this analysis.
Section 8: Traffic Data

Existing Traffic Volumes: Traffic count data was provided at the intersection of E 23rd Street/N 1400 Road & O’Connell Road/E 1600 Road on Tuesday, December 3, 2019. Although this study occurred during the COVID-19 pandemic, which caused a drastic change in traffic volumes, the data used for the analysis was taken December 3rd, 2019 well before the event. Counts were taken over a 24-hour period and were recorded in 15 minutes intervals. Recorded vehicle classifications included the following: light vehicles (motorcycles, cars, and light goods vehicles), buses and single-unit trucks, articulated trucks, bikes on the crosswalk, and pedestrians on the crosswalk. Inclement weather conditions or national holiday traffic did not impact the traffic counts.

The combined daily traffic through the intersection was 20,475 vpd. There are 1,037 vpd currently using O’Connell Road/E 1600 Road to the north of E 23rd Street/N 1400 Road. With the new trips from the MSO facility, the daily trips are expected to grow to about 2,000 vpd.

For the AM Peak, between 7:45AM - 8:45 AM, all trips headed toward the new development came from the west or south meaning that existing commuters entering the Venture Park area from the east are not likely to use O’Connell Road. On O’Connell Road/E 1600 Road to the north of E 23rd Street/N 1400 Road, there were 45 trips headed northbound and 47 trips headed southbound. The AM peak hour factor was 0.938.

For the PM Peak, between 4:45PM - 5:45 PM, there were not many vehicles headed toward the new development using O’Connell Road. On O’Connell Road/E 1600 Road to the north of E 23rd Street/N 1400 Road, there were 18 trips headed northbound and 65 trips headed southbound. The PM peak hour factor was 0.953.

The following tables summarize the daily traffic volumes and AM and PM peak hour traffic volumes:
## Daily Total, E 23rd Street & O’Connell Road Turning Movement Counts

|       | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Existing | 307 | 8583 | 774 | 398 | 8357 | 17  | 826 | 85  | 482 | 19  | 112 | 515 |

**[N] 1600 Rd**
- Total: 1037
- In: 646
- Out: 391

**[W] 23rd St**
- Total: 19379
- In: 9664
- Out: 9715

**In: 1393**
- Out: 1282
- Total: 2675

**[S] 1600 Rd**
- Total: 17859
- In: 8772
- Out: 9087

---

Lawrence Field Operations Facility - Traffic Study, July 2, 2020
<table>
<thead>
<tr>
<th></th>
<th>EBL</th>
<th>EBT</th>
<th>EBR</th>
<th>WBL</th>
<th>WBT</th>
<th>WBR</th>
<th>NBL</th>
<th>NBT</th>
<th>NBR</th>
<th>SBL</th>
<th>SBT</th>
<th>SBR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing</td>
<td>30</td>
<td>593</td>
<td>45</td>
<td>9</td>
<td>552</td>
<td>0</td>
<td>92</td>
<td>15</td>
<td>54</td>
<td>3</td>
<td>3</td>
<td>41</td>
</tr>
</tbody>
</table>

AM Peak Hour, E 23rd Street & O’Connell Road Turning Movement Counts

[N] 1600 Rd
Total: 92
In: 47 Out: 45

[W] 23rd St
Total: 1353
In: 689 Out: 665

[S] 1600 Rd
Out: 56 In: 161
Total: 217

Lawrence Field Operations Facility - Traffic Study, July 2, 2020 Page 30
### PM Peak Hour, E 23rd Street & O’Connell Road Turning Movement Counts

<table>
<thead>
<tr>
<th></th>
<th>EBL</th>
<th>EBT</th>
<th>EBR</th>
<th>WBL</th>
<th>WBT</th>
<th>WBR</th>
<th>NBL</th>
<th>NBT</th>
<th>NBR</th>
<th>SBL</th>
<th>SBT</th>
<th>SBR</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Existing</strong></td>
<td>12</td>
<td>769</td>
<td>94</td>
<td>69</td>
<td>723</td>
<td>4</td>
<td>53</td>
<td>3</td>
<td>31</td>
<td>2</td>
<td>16</td>
<td>47</td>
</tr>
</tbody>
</table>
Average Daily Traffic Volumes: An estimate of the average daily traffic on the connecting roadway segments between each intersection is given below:

Based on Dec 3rd, 2019 traffic counts
1. E 23rd Street/N 1400 Road (East of O’Connell Road/E 1600 Road)  ADT = 17,859 vpd
2. E 23rd Street/N 1400 Road (West of O’Connell Road/E 1600 Road)  ADT = 19,409 vpd
3. O’Connell Road/E 1600 Road (South of E 23rd Street/N 1400 Road)  ADT =  2,675 vpd
4. O’Connell Road/E 1600 Road (North of E 23rd Street/N 1400 Road)  ADT =  1,037 vpd
   a. Expected ADT post-development construction  ADT =  2,000 vpd

Based on 2016 KDOT traffic counts
5. Harper Street (South of E 19th Street)  ADT =  5,460 vpd
6. E 19th Street (West of Harper Street)  ADT =  3,840 vpd
7. Noria Road/E 1750 Road (North of Greenway Circle)  ADT =  4,435 vpd
Buses and Single-unit Trucks: For Buses and Single-unit Trucks, there were a total of 646 vehicles for the 24 hour period making up 3.2% of total traffic. For the daily total, the highest percentage per movement were EBL and NBL. On O’Connell Road/E 1600 Road to the north of E 23rd Street/N 1400 Road, there were 114 Bus and Single-unit Truck trips making up 11% of the total traffic on the roadway. The tables below show the amount of Buses and Single-unit Trucks per movement:

<table>
<thead>
<tr>
<th></th>
<th>Daily Total, E 23rd Street &amp; O’Connell Road Turning Movement Counts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EBL</td>
</tr>
<tr>
<td>Existing</td>
<td>50</td>
</tr>
<tr>
<td>Percentage %</td>
<td>17.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>AM Peak Hour, E 23rd Street &amp; O’Connell Road Turning Movement Counts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EBL</td>
</tr>
<tr>
<td>Existing</td>
<td>3</td>
</tr>
<tr>
<td>Percentage %</td>
<td>10.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>PM Peak Hour, E 23rd Street &amp; O’Connell Road Turning Movement Counts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EBL</td>
</tr>
<tr>
<td>Existing</td>
<td>3</td>
</tr>
<tr>
<td>Percentage %</td>
<td>27.3</td>
</tr>
</tbody>
</table>
Articulated Trucks: For Articulated Trucks, there were a total of 198 vehicles for the 24 hour period making up 1.0% of total traffic. For the daily total, the highest percentage per movement were SBL and EBL. On O’Connell Road/E 1600 Road to the north of E 23rd Street/N 1400 Road, there were 27 Articulated Truck trips making up 2.6% of the total traffic on the roadway. The tables below show the amount of Articulated Trucks per movement:

<table>
<thead>
<tr>
<th></th>
<th>Daily Total, E 23rd Street &amp; O’Connell Road Turning Movement Counts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EBL</td>
</tr>
<tr>
<td>Existing</td>
<td>15</td>
</tr>
<tr>
<td>Percentage %</td>
<td>5.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>AM Peak Hour, E 23rd Street &amp; O’Connell Road Turning Movement Counts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EBL</td>
</tr>
<tr>
<td>Existing</td>
<td>0</td>
</tr>
<tr>
<td>Percentage %</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>PM Peak Hour, E 23rd Street &amp; O’Connell Road Turning Movement Counts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EBL</td>
</tr>
<tr>
<td>Existing</td>
<td>2</td>
</tr>
<tr>
<td>Percentage %</td>
<td>18.2</td>
</tr>
</tbody>
</table>

Bikes on the Crosswalk: There was only one bicyclist observed on December 3rd.

Pedestrians on the Crosswalk: 8 total pedestrians were observed on December 3rd with 5 crossing the east leg and 3 crossing the south leg of the intersection.

Trip Distribution: Trip distribution patterns were determined based on a gravity model using the peak hour counts around the development’s surrounding origins and destinations. Directional percentages were applied along entry and exit paths so that trips could be distributed proportionally and are shown in the following figures.
The trip distribution pattern also considered how many trips generated by the development would travel along 19th Street if 19th Street was connected to O'Connell Road. A previous Traffic Impact Study for Venture Park listed up to 30% of trips generated by the Venture Park
commercial zone to be routed along 19th Street; however, the trip distribution in that report included a lot of unknown assumptions for the area. Based on the MSO facility’s land uses and 19th Street not being listed as a truck route, it was determined that a refined representation of potential trip distribution was needed.

The method used to refine the probable trip distribution pattern along 19th Street was the catchment area method. By identifying a catchment area that would likely use 19th Street compared to O’Connell Road, a general percentage of expected vehicles was estimated. The catchment area was evaluated using a shortest travel time method which is not necessarily aligned with the shortest path. Beyond this estimated catchment boundary, trips to and from the MSO facility will be more likely to be routed to and from the site with a strong preference for arterials due to higher speed limits. This means that, outside the boundary, a collector street such as 19th Street would not have a high probability of becoming a main thoroughfare for MSO facility generated trips. With an approximate catchment area of 2.4 sq miles out of the total 34.26 square miles in the City of Lawrence, this could mean about 7% of new vehicle trips would be likely to use 19th Street. To be conservative in the estimation, it was assumed that 10% of all new trips generated by the MSO facility would utilize 19th Street compared to O’Connell Road.

Estimated Catchment Area for Vehicles using 19th Street to Access the MSO Facility

Using the conservative estimate that 10% of the newly generated trips would utilize 19th Street, the trip distribution patterns were adjusted as follows:
Using these trip distribution percentages, the number of vehicles during the peak hours were added to existing traffic volume patterns.
AM Peak Hour, E 23rd Street & O’Connell Road Turning Movement Counts

<table>
<thead>
<tr>
<th></th>
<th>EBL</th>
<th>EBT</th>
<th>EBR</th>
<th>WBL</th>
<th>WBT</th>
<th>WBR</th>
<th>NBL</th>
<th>NBT</th>
<th>NBR</th>
<th>SBL</th>
<th>SBT</th>
<th>SBR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing</td>
<td>30</td>
<td>593</td>
<td>45</td>
<td>9</td>
<td>552</td>
<td>0</td>
<td>92</td>
<td>15</td>
<td>54</td>
<td>3</td>
<td>3</td>
<td>41</td>
</tr>
<tr>
<td>Trip Generated</td>
<td>78</td>
<td></td>
<td></td>
<td></td>
<td>66</td>
<td></td>
<td>19</td>
<td></td>
<td>64</td>
<td></td>
<td>5</td>
<td>67</td>
</tr>
<tr>
<td>Total</td>
<td>108</td>
<td>593</td>
<td>45</td>
<td>9</td>
<td>552</td>
<td>66</td>
<td>92</td>
<td>34</td>
<td>54</td>
<td>67</td>
<td>8</td>
<td>108</td>
</tr>
</tbody>
</table>

Lawrence Field Operations Facility - Traffic Study, July 2, 2020
Determining the Growth Rate: The U.S. Census Bureau reported that the Lawrence population in 2000 was 80,098 while the population in 2015 was 94,104. This is an increase in growth of 17.5%. Based on the available census data, the average annual growth rate of Lawrence was calculated to be 1.08% which represented a constant linear growth derived from the following equation:

\[
\text{Constant % Growth (2000 to 2015)} = (\text{End Year vpd} / \text{Beginning Year vpd}) ^ {\frac{1}{\text{End Year-Beginning Year}}} - 1
\]

\[
= (94,104 / 80,098)^{\frac{1}{2015-2000}} - 1
\]

\[
= 1.08\% \text{ per year}
\]

Because the area is expected to grow slightly in traffic volume due to the proposed development and other possible developments, a 1.08% annual constant percent growth rate was used to project the increase in traffic volume twenty years into the future.
**Growth Factor**: The growth factor constant was determined as follows:

\[
\text{Growth Factor Constant} = (1 + \text{Constant \% Growth Rate})^\text{Projected Years} \\
= (1 + 0.0108)^{20} \\
= 1.24, \text{ for 20 years growth at 1.1\%}
\]

**Projected Traffic Volumes**: The 1.24 growth factor was applied to the existing traffic volumes but not the trips generated by the new development or existing developments. The number of trips attracted to the site will not increase or decrease with time, but would increase or decrease if the number of employees was altered.

In the case of the MSO facility, the campus will be constructed to accommodate a growth in city staff to align with the growth of Lawrence over the next 50 years; therefore, the increase of employees needs to be accounted for within the traffic volumes. Since traffic studies typically analyze traffic patterns projected by only two decades to remain relatively accurate, the number of employees at the facility at the 20 year mark post construction needs to be determined.

Based on data provided by city estimates, the future projected estimated staff includes 355 full-time and 21 part-time personnel at the 50 year mark. The increase in the number of employees at the 20 year mark would be about 40\% of the expected increase in employees by the 50 year mark. Therefore, at the 20 year mark, there would be 276 full-time and 16 part-time personnel. Based on these new employee totals, the trip generation table has been updated for the future projected growth in 20 years.
<table>
<thead>
<tr>
<th>SUBCATEGORY</th>
<th>NUMBER OF EMPLOYEES</th>
<th>EXPECTED DAILY TRIPS PER STAFF SUBCATEGORY (Veh / Day / Employee)</th>
<th>ESTIMATED DAILY TRIPS (Veh / Day)</th>
<th>A.M. PEAK HOUR, 7-9am (Veh / Hour)</th>
<th>P.M. PEAK HOUR, 4-6pm (Veh / Hour)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office and Maintenance Combined Campus (Staff)</td>
<td>9 Employees</td>
<td>2</td>
<td>18</td>
<td>9 IN 9 OUT</td>
<td>9 IN 9 OUT</td>
</tr>
<tr>
<td></td>
<td>147 Employees</td>
<td>6</td>
<td>882</td>
<td>147 IN 147 OUT</td>
<td>147 IN 147 OUT</td>
</tr>
<tr>
<td></td>
<td>11 Employees</td>
<td>8</td>
<td>88</td>
<td>11 IN 11 OUT</td>
<td>11 IN 11 OUT</td>
</tr>
<tr>
<td></td>
<td>20 Employees</td>
<td>2</td>
<td>40</td>
<td>20 IN 20 OUT</td>
<td>20 IN 20 OUT</td>
</tr>
<tr>
<td>Solid Waste Division (Staff)</td>
<td>69 Employees</td>
<td>2</td>
<td>138</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>29 Employees</td>
<td>2</td>
<td>58</td>
<td>29 IN 29 OUT</td>
<td>29 IN 29 OUT</td>
</tr>
<tr>
<td></td>
<td>1 Employee</td>
<td>2</td>
<td>2</td>
<td>1 IN 1 OUT</td>
<td>1 IN 1 OUT</td>
</tr>
<tr>
<td>Household Hazardous Waste (Staff)</td>
<td>6 Employees</td>
<td>2</td>
<td>12</td>
<td>6 IN 6 OUT</td>
<td>6 IN 6 OUT</td>
</tr>
<tr>
<td>Household Hazardous Waste (Public Drop Off)</td>
<td></td>
<td></td>
<td>35</td>
<td>9 IN 9 OUT</td>
<td>9 IN 9 OUT</td>
</tr>
<tr>
<td>Total</td>
<td>292 Employees</td>
<td></td>
<td>1273</td>
<td>232 IN 197 OUT</td>
<td>159 IN 194 OUT</td>
</tr>
</tbody>
</table>

These trips were then distributed using the same distribution pattern.
### AM Peak Hour, E 23rd Street & O’Connell Road Turning Movement Counts

<table>
<thead>
<tr>
<th></th>
<th>EBL</th>
<th>EBT</th>
<th>EBR</th>
<th>WBL</th>
<th>WBT</th>
<th>WBR</th>
<th>NBL</th>
<th>NBT</th>
<th>NBR</th>
<th>SBL</th>
<th>SBT</th>
<th>SBR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing</td>
<td>30</td>
<td>593</td>
<td>45</td>
<td>9</td>
<td>552</td>
<td>0</td>
<td>92</td>
<td>15</td>
<td>54</td>
<td>3</td>
<td>3</td>
<td>41</td>
</tr>
<tr>
<td>Trip Generated</td>
<td>78</td>
<td></td>
<td></td>
<td>66</td>
<td></td>
<td>19</td>
<td></td>
<td></td>
<td></td>
<td>64</td>
<td>5</td>
<td>67</td>
</tr>
<tr>
<td>Total</td>
<td>108</td>
<td>593</td>
<td>45</td>
<td>9</td>
<td>552</td>
<td>66</td>
<td>92</td>
<td>34</td>
<td>54</td>
<td>8</td>
<td>108</td>
<td></td>
</tr>
<tr>
<td>Future = Existing *1.24 Growth Factor</td>
<td>37</td>
<td>735</td>
<td>56</td>
<td>11</td>
<td>684</td>
<td>0</td>
<td>114</td>
<td>19</td>
<td>67</td>
<td>4</td>
<td>4</td>
<td>51</td>
</tr>
<tr>
<td>Future Trip Gen.</td>
<td>97</td>
<td></td>
<td></td>
<td>81</td>
<td></td>
<td>23</td>
<td></td>
<td></td>
<td></td>
<td>80</td>
<td>7</td>
<td>85</td>
</tr>
<tr>
<td>Future Total</td>
<td>134</td>
<td>735</td>
<td>56</td>
<td>11</td>
<td>684</td>
<td>81</td>
<td>114</td>
<td>42</td>
<td>67</td>
<td>84</td>
<td>11</td>
<td>136</td>
</tr>
</tbody>
</table>
Using these traffic volumes, a Synchro analysis was performed to identify any necessary changes to the intersection.
Section 9: Synchro Analysis of Performance Measures

Creating Synchro Scenarios: Using the traffic counts and the ITE trip generation volumes, six Synchro models were created for the traffic conditions surrounding the site.

- Scenario 1 - Existing street/pre-development conditions, Weekday AM Peak Traffic 2020
- Scenario 2 - Existing street/pre-development conditions, Weekday PM Peak Traffic 2020
- Scenario 3 - Proposed street/after-development conditions, Weekday AM Peak Traffic 2020
- Scenario 4 - Proposed street/after-development conditions, Weekday PM Peak Traffic 2020
- Scenario 5 - Proposed street/after-development conditions, Weekday AM Peak Traffic 2040
- Scenario 6 - Proposed street/after-development conditions, Weekday PM Peak Traffic 2040

Capacity and Level of Service Analysis: Three performance measures commonly used for Traffic Impact Studies are vehicle delay, level-of-service (LOS), and queue length. Vehicle delay is the average delay, in seconds, experienced by one vehicle passing through the intersection. The quality of traffic operation at an intersection is defined through level-of-service (LOS) which consists of assignments of ‘A’ for free-flowing conditions through ‘F’ for congested conditions. The procedures and methodology for determining the LOS are outlined in the Highway Capacity Manual (HCM 2010), produced by Transportation Research Board. LOS ‘A’ through ‘C’ is considered acceptable. For intersections, no individual lane should be below LOS D. The 95th percentile queue length is the overall length of a string of stopped vehicles. Note that the queue is reported in the left\thru\right order. The results of the Synchro models are in the tables below.
### Scenarios 1 & 2 Synchro Results (Existing)

<table>
<thead>
<tr>
<th>Performance Measures</th>
<th>AM 2020</th>
<th>PM 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>E 23rd Street &amp; O’Connell Road</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delay, s</td>
<td>21.7</td>
<td>26.3</td>
</tr>
<tr>
<td>LOS</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>NB Delay, s</td>
<td>10.6</td>
<td>12.1</td>
</tr>
<tr>
<td>L/T+R</td>
<td>12.7/7.8</td>
<td>14.6/8.3</td>
</tr>
<tr>
<td>NB LOS</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>L/T+R</td>
<td>B/A</td>
<td>B/A</td>
</tr>
<tr>
<td>NB Queue, ft</td>
<td>56/35</td>
<td>37/22</td>
</tr>
<tr>
<td>EB Delay, s</td>
<td>22.0</td>
<td>32.1</td>
</tr>
<tr>
<td>L/T/R</td>
<td>34.3/23.0/0.1</td>
<td>34.8/35.8/1.5</td>
</tr>
<tr>
<td>EB LOS</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>L/T/R</td>
<td>C/C/A</td>
<td>C/D/A</td>
</tr>
<tr>
<td>EB Queue, ft</td>
<td>40/194/0</td>
<td>22/291/13</td>
</tr>
<tr>
<td>SB Delay, s</td>
<td>2.2</td>
<td>6.0</td>
</tr>
<tr>
<td>L/T/R</td>
<td>12.7/20.3/0.2</td>
<td>13.5/21.6/0.3</td>
</tr>
<tr>
<td>SB LOS</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>L/T/R</td>
<td>B/C/A</td>
<td>B/C/A</td>
</tr>
<tr>
<td>SB Queue, ft</td>
<td>6/7/0</td>
<td>4/21/0</td>
</tr>
<tr>
<td>WB Delay, s</td>
<td>26.2</td>
<td>23.1</td>
</tr>
<tr>
<td>L/T/R</td>
<td>33.0/26.1/0</td>
<td>45.8/21.0/0.0</td>
</tr>
<tr>
<td>WB LOS</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>L/T/R</td>
<td>C/C/A</td>
<td>D/C/A</td>
</tr>
<tr>
<td>WB Queue, ft</td>
<td>19/182/0</td>
<td>85/243/0</td>
</tr>
</tbody>
</table>

Existing traffic conditions were evaluated for the intersection of E 23rd Street & O’Connell Road. For AM peak hour traffic, the delay at the intersection was 21.7 sec on average with an overall LOS C. Each of the approaches and turning movements have a LOS C or better. EB and WB left-turns experienced the most delay compared to the other movements; however, this is likely due to the left-turns active before the other movements meaning a left-turning vehicle arriving just after the green phase for left-turns has to wait out nearly a whole cycle length. For PM peak hour traffic, the delay at the intersection was 26.3 sec on average with an overall LOS C. Each of the approaches have a LOS C or better while only EBT and WBL turning movements are at LOS D. Overall, the traffic signal is operating well under current demand and capacity levels. Queue lengths did not exceed the turn lane capacity for any movement.
Scenarios 3 & 4 Synchro Results (Proposed street/after-development conditions 2020)

<table>
<thead>
<tr>
<th>Performance Measures</th>
<th>AM 2020</th>
<th>PM 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>E 23rd Street &amp; O’Connell Road</td>
<td></td>
</tr>
<tr>
<td>Delay, s</td>
<td>21.8</td>
<td>28.9</td>
</tr>
<tr>
<td>LOS</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>NB Delay, s</td>
<td>13.6</td>
<td>13.0</td>
</tr>
<tr>
<td>L/T+R</td>
<td>15.3/11.8</td>
<td>14.8/10.6</td>
</tr>
<tr>
<td>NB LOS</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>L/T+R</td>
<td>B/B</td>
<td>B/B</td>
</tr>
<tr>
<td>NB Queue, ft</td>
<td>57/47</td>
<td>37/26</td>
</tr>
<tr>
<td>EB Delay, s</td>
<td>23.5</td>
<td>33.3</td>
</tr>
<tr>
<td>L/T/R</td>
<td>53.2/19.9/0.1</td>
<td>49.2/35.8/1.5</td>
</tr>
<tr>
<td>EB LOS</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>L/T/R</td>
<td>D/B/A</td>
<td>D/D/A</td>
</tr>
<tr>
<td>EB Queue, ft</td>
<td>135/192/0</td>
<td>87/291/13</td>
</tr>
<tr>
<td>SB Delay, s</td>
<td>6.7</td>
<td>7.4</td>
</tr>
<tr>
<td>L/T/R</td>
<td>14.8/21.2/0.6</td>
<td>15.0/21.7/0.7</td>
</tr>
<tr>
<td>SB LOS</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>L/T/R</td>
<td>B/C/A</td>
<td>B/C/A</td>
</tr>
<tr>
<td>SB Queue, ft</td>
<td>44/14/0</td>
<td>42/22/0</td>
</tr>
<tr>
<td>WB Delay, s</td>
<td>26.6</td>
<td>30.7</td>
</tr>
<tr>
<td>L/T/R</td>
<td>34.2/29.6/0.2</td>
<td>45.8/31.5/0.2</td>
</tr>
<tr>
<td>WB LOS</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>L/T/R</td>
<td>C/C/A</td>
<td>D/C/A</td>
</tr>
<tr>
<td>WB Queue, ft</td>
<td>19/183/1</td>
<td>85/247/0</td>
</tr>
</tbody>
</table>

Existing traffic conditions plus trips generated by the new development were evaluated for the intersection of E 23rd Street & O’Connell Road. For AM peak hour traffic, the delay at the intersection was 21.8 sec on average with an overall LOS C. This is 0.1 sec more than the existing traffic conditions without the new development trips. Each of the approaches and turning movements have a LOS C or better except EB left-turns. EB left-turns experienced the most delay compared to the other movements since there will be an influx of city employees coming from the east to head to the facility. For PM peak hour traffic, the delay at the intersection was 28.9 sec on average with an overall LOS C. This is 2.6 sec more than the existing traffic conditions without the new development trips. Each of the approaches have a LOS C or better while only EBL, EBT, and WBL turning movements are at LOS D. Given the additional traffic volumes, the traffic signal is operating well under expected demand and capacity levels. Based on the number of turning vehicles in the AM and PM, dual left-turn lanes are not justified. Queue lengths did not exceed the turn lane capacity for any movement.
### Scenarios 5 & 6 Synchro Results (Proposed street/after-development conditions 2040)

<table>
<thead>
<tr>
<th>Performance Measures</th>
<th>AM 2040</th>
<th>PM 2040</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>E 23rd Street &amp; O’Connell Road</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delay, s</td>
<td>25.6</td>
<td>32.6</td>
</tr>
<tr>
<td>LOS</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>NB Delay, s</td>
<td>14.6</td>
<td>14.8</td>
</tr>
<tr>
<td>L/T+R</td>
<td>16.9/12.2</td>
<td>17.3/11.4</td>
</tr>
<tr>
<td>NB LOS</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>L/T+R</td>
<td>B/B</td>
<td>B/B</td>
</tr>
<tr>
<td>NB Queue, ft</td>
<td>69/55</td>
<td>49/32</td>
</tr>
<tr>
<td>EB Delay, s</td>
<td>26.3</td>
<td>37.2</td>
</tr>
<tr>
<td>L/T/R</td>
<td>70.7/20.2/0.1</td>
<td>64.2/39.1/2.9</td>
</tr>
<tr>
<td>EB LOS</td>
<td>C</td>
<td>D</td>
</tr>
<tr>
<td>L/T/R</td>
<td>E/C/A</td>
<td>E/D/A</td>
</tr>
<tr>
<td>EB Queue, ft</td>
<td>166/252/0</td>
<td>122/395/25</td>
</tr>
<tr>
<td>SB Delay, s</td>
<td>7.6</td>
<td>9.3</td>
</tr>
<tr>
<td>L/T/R</td>
<td>15.9/21.7/1.4</td>
<td>17.7/24.1/2.0</td>
</tr>
<tr>
<td>SB LOS</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>L/T/R</td>
<td>B/C/A</td>
<td>B/C/A</td>
</tr>
<tr>
<td>SB Queue, ft</td>
<td>53/17/5</td>
<td>57/29/12</td>
</tr>
<tr>
<td>WB Delay, s</td>
<td>33.4</td>
<td>34.6</td>
</tr>
<tr>
<td>L/T/R</td>
<td>34.8/37.1/1.1</td>
<td>65.8/34.2/0.5</td>
</tr>
<tr>
<td>WB LOS</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>L/T/R</td>
<td>C/D/A</td>
<td>E/C/A</td>
</tr>
<tr>
<td>WB Queue, ft</td>
<td>21/257/8</td>
<td>125/358/4</td>
</tr>
</tbody>
</table>

Future traffic conditions plus trips generated by the new development were evaluated for the intersection of E 23rd Street & O’Connell Road. For AM peak hour traffic, the delay at the intersection was 25.6 sec on average with an overall LOS C. This is 3.8 sec more than the existing 2020 traffic conditions with the new development trips. Each of the approaches and turning movements have a LOS C or better except EBL and WBT. For PM peak hour traffic, the delay at the intersection was 32.6 sec on average with an overall LOS C. This is 3.7 sec more than the existing 2020 traffic conditions with the new development trips. Each of the approaches have a LOS C or better except the eastbound approach with a LOS D. The only turning movements with a LOS C or worse are EBL at LOS E, EBT at LOS D, and WBL at LOS E. The traffic signal is operating well under expected demand and capacity levels. Based on the number of turning vehicles in the AM and PM, dual left-turn lanes are still not justified. Queue lengths did not exceed the turn lane capacity for any movement.
Section 10: Near-term Impact of Development

The roadways surrounding the planned MSO Facility have the capacity to handle the newly generated trips. The intersection of E 23rd Street & O’Connell Road does not require improvements to handle the new trips since the traffic volumes do not justify dual left-turn lanes and the queue lengths do not exceed the turn lane capacity for any movement.

Since 19th Street is planned to be connected to O’Connell Road in 2021, some city vehicles would utilize 19th Street with an estimate of up to 10% of newly generated trips by the MSO facility. This means an additional 16 westbound vehicles and 19 eastbound vehicles during the AM peak hour and an additional 16 westbound vehicles and 13 eastbound vehicles during the PM peak hour between Harper Street and O’Connell Road. Although the neighborhood association has raised concerns about thru traffic utilizing 19th Street, the MSO Facility land-uses would not cause a high enough volume to cause congestion or walkability issues along 19th Street and 19th Street will not be utilized as a truck route.

Section 11: Impact of Development with Existing Traffic Projected 20 Years

For the projected traffic volumes, no changes are required to handle traffic volumes as a result of the MSO Facility. For 2040 traffic volumes, the intersection of E 23rd Street & O’Connell Road does not require dual left-turn lanes or extended turn lane capacity for any movement.
Section 12: Summary and Recommendations

Summary: This traffic study covered the impact of the field operations campus in the City of Lawrence, Kansas. The 168 acre site will include several large buildings and will host a staff of 223 people. The total daily trips for the facility is expected to be 1,029 with 187 entering and 157 leaving during the AM peak hour and with 127 entering and 157 leaving during the PM peak hour. These traffic volumes account for the personnel making multiple site trips to and from the facility throughout the day.

New roadway connections will be constructed connecting to public streets with the major access point connecting to the intersection of E 19th Street & O’Connell Road. Although the current orientation of buildings within the campus is still under development, the site will be contained within a secure fence with only the Household Hazardous Waste located on the outside as a public drop off location. The intersection of E 19th Street & O’Connell Road will be reconfigured into a stop-controlled T-intersection with O’Connell Road extended to the north. The intersection of E 23rd Street & O’Connell Road does not require improvements to handle the new trips. If 19th Street is connected to O’Connell Road, an estimated 10% of newly generated trips might utilize 19th Street. Between Harper Street and O’Connell Road, trip distribution results included an additional 16 westbound vehicles and 19 eastbound vehicles during the AM peak hour and an additional 16 westbound vehicles and 13 eastbound vehicles during the PM peak hour. In general, O’Connell Road and the surrounding roadway network was constructed with the capacity to handle development in the area. The trips generated by the MSO facility do not justify additional roadway improvements besides the necessary changes needed for access to the site.

Recommendations:

- Construct the access roadways for the development and ensure trucks can maneuver through the circulating parking areas and fuel areas without issues.
- Ensure sight distance requirements are consistent with AASHTO requirements during finalization of the facility layout.
- If 19th Street is connected to O’Connell Road, reconsider the routing for transit buses through the area.
- Install a street light at the intersection of 19th Street & O’Connell Road to aid in nighttime visibility.
Government Office Complex
(733)

Vehicle Trip Ends vs: Employees
On a: Weekday

Setting/Location: General Urban/Suburban
Number of Studies: 1
Avg. Num. of Employees: 173
Directional Distribution: 50% entering, 50% exiting

Vehicle Trip Generation per Employee

<table>
<thead>
<tr>
<th>Average Rate</th>
<th>Range of Rates</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>13.29</td>
<td>13.29 - 13.29</td>
<td>*</td>
</tr>
</tbody>
</table>

Data Plot and Equation

Caution – Small Sample Size

Fitted Curve Equation: Not Given

R²= ****
Government Office Complex
(733)

Vehicle Trip Ends vs: Employees
On a: Weekday,
Peak Hour of Adjacent Street Traffic,
One Hour Between 7 and 9 a.m.
Setting/Location: General Urban/Suburban
Number of Studies: 1
Avg. Num. of Employees: 173
Directional Distribution: 89% entering, 11% exiting

Vehicle Trip Generation per Employee
Average Rate: 0.83
Range of Rates: 0.83 - 0.83

Data Plot and Equation
Caution – Small Sample Size

Study Site
Fitted Curve Equation: Not Given

Average Rate
R² = ****
Government Office Complex
(733)

Vehicle Trip Ends vs: Employees
On a: Weekday,
    Peak Hour of Adjacent Street Traffic,
    One Hour Between 4 and 6 p.m.
Setting/Location: General Urban/Suburban
Number of Studies: 1
Avg. Num. of Employees: 173
Directional Distribution: 31% entering, 69% exiting

Vehicle Trip Generation per Employee

<table>
<thead>
<tr>
<th>Average Rate</th>
<th>Range of Rates</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.10</td>
<td>1.10 - 1.10</td>
<td></td>
</tr>
</tbody>
</table>

Data Plot and Equation

Caution – Small Sample Size

![Data Plot](image)

- **Study Site**
- **Average Rate**
- **Fitted Curve Equation: Not Given**
- **R² = ****
Utility
(170)

Vehicle Trip Ends vs: Employees
On a: Weekday

Setting/Location: General Urban/Suburban
Number of Studies: 14
Avg. Num. of Employees: 41
Directional Distribution: 50% entering, 50% exiting

Vehicle Trip Generation per Employee

<table>
<thead>
<tr>
<th>Average Rate</th>
<th>Range of Rates</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.11</td>
<td>0.80 - 22.00</td>
<td>1.99</td>
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</tbody>
</table>

Data Plot and Equation

![Data Plot]

Fitted Curve Equation: \( T = 4.01(X) + 3.97 \)
\[ R^2 = 0.81 \]
Vehicle Trip Ends vs: Employees
On a: Weekday,
Peak Hour of Adjacent Street Traffic,
One Hour Between 7 and 9 a.m.
Setting/Location: General Urban/Suburban
Number of Studies: 14
Avg. Num. of Employees: 45
Directional Distribution: 81% entering, 19% exiting

Vehicle Trip Generation per Employee

<table>
<thead>
<tr>
<th>Average Rate</th>
<th>Range of Rates</th>
<th>Standard Deviation</th>
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<td>0.70</td>
<td>0.18 - 2.00</td>
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Data Plot and Equation

Fitted Curve Equation: \( \ln(T) = 0.81 \ln(X) + 0.37 \)

\( R^2 = 0.92 \)
Utility
(170)

Vehicle Trip Ends vs: Employees
On a: Weekday,
Peak Hour of Adjacent Street Traffic,
One Hour Between 4 and 6 p.m.

Setting/Location: General Urban/Suburban
Number of Studies: 15
Avg. Num. of Employees: 83
Directional Distribution: 15% entering, 85% exiting

Vehicle Trip Generation per Employee

<table>
<thead>
<tr>
<th>Average Rate</th>
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<th>Standard Deviation</th>
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<td>0.76</td>
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Data Plot and Equation

Fitted Curve Equation: \( T = 0.81(X) - 3.71 \)
\( R^2 = 0.99 \)
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</tr>
</tbody>
</table>

**App Ped** indicates the number of applications for pedestrian access.

---

**Notable Dates:****

- **2019-12-03:** 12:00AM - 2:00AM
- **2019-12-12:** 12:00AM - 2:00AM
- **2020-01-01:** 12:00AM - 2:00AM
- **2020-02-14:** 12:00AM - 2:00AM
- **2020-03-17:** 12:00AM - 2:00AM
- **2020-04-01:** 12:00AM - 2:00AM
- **2020-05-02:** 12:00AM - 2:00AM
- **2020-06-07:** 12:00AM - 2:00AM
- **2020-07-04:** 12:00AM - 2:00AM
- **2020-08-08:** 12:00AM - 2:00AM
- **2020-09-06:** 12:00AM - 2:00AM
- **2020-10-12:** 12:00AM - 2:00AM
- **2020-11-06:** 12:00AM - 2:00AM
- **2020-12-08:** 12:00AM - 2:00AM

---

*E 23rd Street & E 1600 Road - TMC*

*Provided by: Gewalt Hamilton Associates Inc.*

*625 Forest Edge Drive, Vernon Hills, IL, 60061, US*
E 23rd Street & E 1600 Road - TMC
Tue Dec 3, 2019
Full Length (12 AM-12 AM (+1))
All Classes (Lights, Articulated Trucks, Buses and Single-Unit Trucks, Pedestrians, Bicycles on Crosswalk)
All Movements
ID: 731785, Location: 38.942698, -95.204907

Total: 2675
Out: 1282
In: 1393

[东] 1600 Rd
Total: 1037
In: 646
Out: 391

[西] 23rd St
Total: 19379
Out: 9715
In: 9664

[S] 1600 Rd

Provided by: Gewalt Hamilton Associates Inc.
625 Forest Edge Drive, Vernon Hills, IL, 60061, US
<table>
<thead>
<tr>
<th>Leg Direction</th>
<th>1600 Rd Southbound</th>
<th>23rd St Westbound</th>
<th>1600 Rd Northbound</th>
<th>23rd St Eastbound</th>
<th>Int</th>
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<tbody>
<tr>
<td>2019-12-03 7:45AM</td>
<td>6</td>
<td>1</td>
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<td>8</td>
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<tr>
<td>8:00AM</td>
<td>16</td>
<td>1</td>
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<td>0</td>
<td>17</td>
</tr>
<tr>
<td>8:15AM</td>
<td>10</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>8:30AM</td>
<td>9</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>41</td>
<td>3</td>
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<tr>
<td><strong>% Approach</strong></td>
<td>87.2%</td>
<td>6.4%</td>
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<tr>
<td><strong>% Total</strong></td>
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<tr>
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<td>85.1%</td>
</tr>
<tr>
<td><strong>% Articulated Trucks</strong></td>
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<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td><strong>% Articulated Trucks</strong></td>
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<td><strong>Buses and Single-Unit Trucks</strong></td>
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<td>7</td>
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<tr>
<td><strong>Pedestrians</strong></td>
<td>-</td>
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<td>0</td>
</tr>
<tr>
<td><strong>Bicycles on Crosswalk</strong></td>
<td>-</td>
<td>-</td>
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<td>0</td>
</tr>
<tr>
<td><strong>% Bicycles on Crosswalk</strong></td>
<td>-</td>
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</tr>
</tbody>
</table>
E 23rd Street & E 1600 Road - TMC

Tue Dec 3, 2019

AM Peak (Dec 03 2019 7:45AM - 8:45 AM)
All Classes (Lights, Articulated Trucks, Buses and Single-Unit Trucks, Pedestrians, Bicycles on Crosswalk)

All Movements

ID: 731785, Location: 38.942698, -95.204907

Provided by: Gewalt Hamilton Associates Inc.
625 Forest Edge Drive, Vernon Hills, IL, 60061, US

[N] 1600 Rd
Total: 92
In: 47    Out: 45

[W] 23rd St
Total: 1353
In: 668    Out: 685

[S] 1600 Rd
Out: 56    In: 161
Total: 217

[E] 23rd St
Out: 651
Total: 1212
In: 561

Total: 1353

5 of 9
<table>
<thead>
<tr>
<th>Leg Direction</th>
<th>1600 Rd Southbound</th>
<th>23rd St Westbound</th>
<th>1600 Rd Northbound</th>
<th>23rd St Eastbound</th>
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</thead>
<tbody>
<tr>
<td><strong>Time</strong></td>
<td></td>
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<tr>
<td>2019-12-03 12:00PM</td>
<td>9</td>
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<td>12:15PM</td>
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</tr>
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<td>12:30PM</td>
<td>8</td>
<td>3</td>
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<td>12</td>
</tr>
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<td>12:45PM</td>
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</tr>
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<td>PHF</td>
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<td>186.5%</td>
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<td>100%</td>
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</tr>
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<td>% Articulated Trucks</td>
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<td>0%</td>
<td>1.9%</td>
</tr>
<tr>
<td>% Buses and Single-Unit Trucks</td>
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<td>6%</td>
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<tr>
<td>% Pedestrians</td>
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<td>-</td>
</tr>
<tr>
<td>% Bicycles on Crosswalk</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, T: Thru, U: U-Turn*
E 23rd Street & E 1600 Road - TMC
Tue Dec 3, 2019
Midday Peak (Dec 03 2019 12PM - 1 PM)
All Classes (Lights, Articulated Trucks, Buses and Single-Unit Trucks, Pedestrians, Bicycles on Crosswalk)
All Movements
ID: 731785, Location: 38.942698, -95.204907

<table>
<thead>
<tr>
<th>[N] 1600 Rd</th>
<th>Total: 73</th>
<th>In: 52</th>
<th>Out: 21</th>
</tr>
</thead>
<tbody>
<tr>
<td>[W] 23rd St</td>
<td>Total: 1080</td>
<td>In: 560</td>
<td>Out: 520</td>
</tr>
<tr>
<td>[S] 1600 Rd</td>
<td>Total: 949</td>
<td>In: 441</td>
<td>Out: 508</td>
</tr>
<tr>
<td>[E] 23rd St</td>
<td>Total: 158</td>
<td>In: 77</td>
<td>Out: 81</td>
</tr>
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</table>

Provided by: Gewalt Hamilton Associates Inc.
625 Forest Edge Drive, Vernon Hills, IL, 60061, US
**E 23rd Street & E 1600 Road - TMC**

Tue Dec 3, 2019

PM Peak (Dec 03 2019 4:45PM - 5:45 PM) - Overall Peak Hour

**All Classes (Lights, Articulated Trucks, Buses and Single-Unit Trucks, Pedestrians, Bicycles on Crosswalk)**

**All Movements**

ID: 731785, Location: 38.942698, -95.204907

### Table: Movement Details

<table>
<thead>
<tr>
<th>Time</th>
<th>Leg</th>
<th>Southbound</th>
<th>Westbound</th>
<th>Northbound</th>
<th>Eastbound</th>
</tr>
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<tbody>
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<td>5:15PM</td>
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<td>5:30PM</td>
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| Total    | 47 | 16 | 2 | 0 | 65 | 0 | 4 | 723 | 69 | 0 | 796 | 0 | 31 | 3 | 53 | 0 | 87 | 0 | 94 | 769 | 11 | 1 | 875 | 0 | 1823 |

**Percent Approach**

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*Pedestrians and Bicycles on Crosswalk: L: Left, R: Right, T: Thru, U: U-Turn*
E 23rd Street & E 1600 Road - TMC
Tue Dec 3, 2019
PM Peak (Dec 03 2019 4:45PM - 5:45 PM) - Overall Peak Hour
All Classes (Lights, Articulated Trucks, Buses and Single-Unit Trucks, Pedestrians, Bicycles on Crosswalk)
All Movements
ID: 731785, Location: 38.942698, -95.204907

[W] 23rd St
Total: 1699
In: 875
Out: 824

[N] 1600 Rd
Total: 83
In: 65
Out: 18

[S] 1600 Rd
Out: 179
In: 87
Total: 266

[<] 23rd St
Total: 1598
In: 796
Out: 802

[<] 1600 Rd
Total: 1699
In: 875
Out: 824

Provided by: Gewalt Hamilton Associates Inc.
625 Forest Edge Drive, Vernon Hills, IL, 60061, US
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**Summary:**

- **Date:** Various dates from 10/15/2015 to 12/18/2015
- **On_Road:** Various numbers from 1 to 501079
- **Dist:** Various numbers from 1 to 5
- **UOM:** Various numbers from 5 to 501079
- **Dir:** Various numbers from 1 to 5
- **Accident_K:** Various numbers from 10 to 501079
- **Seq:** Various numbers from 0 to 501079
- **X_Coordinate:** Various numbers from 85.20513 to -95.20515
- **Y_Coordinate:** Various numbers from 38.94265 to -95.20515
- **Total_Acc:** Various numbers from 0 to 501079
- **Fatal_Acc:** Various numbers from 0 to 501079
- **Injury_Acc:** Various numbers from 0 to 501079
- **PDO_Acc:** Various numbers from 0 to 501079
- **F_of_Death:** Various numbers from 0 to 501079
- **F_of_Injure:** Various numbers from 0 to 501079
- **Type:** Various values including REAR END, SIDE IMPACT, INTERSECTION-RELATED-ON ROADWAY, NON-INTERSECTION-ON ROADWAY, MEDIAN-OFF ROADWAY
- **Condition:** Various values including NO ADVERSE CONDITIONS, RAIN, MIST OR DRIZZLE, DARK--STREET LIGHTS ON, DAYLIGHT
- **Lat_Dot:** Various numbers from 0 to 501079
- **Lon_Dot:** Various numbers from 0 to 501079

**Additional Notes:**

- The data includes various types of accidents and weather conditions.
- The coordinates range from X: 85.20513 to -95.20515 and Y: 38.94265 to -95.20515.
- The data spans a period from October 15, 2015, to December 18, 2015.
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Accident Details:
- **Date**: The date the accident occurred.
- **Location**: The specific location of the accident.
- **Accident Class**: The type of accident (e.g., Angle - Side Impact, Rear End).
- **Curb** indicates a fixed object accident involving a curb.
- **Time**: The time of day during which the accident occurred.
- **Light Conditions**: The lighting conditions during the accident.
- **Latitude** and **Longitude**: Geographic coordinates of the accident location.
### Lanes, Volumes, Timings

**3: E 1600 Road/O’Connell Road & E 23rd Street/N 1400 Road**  

#### Baseline Synchro 10 Report

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Baseline Synchro 10 Report

Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR
--- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | ---
Spillback Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0
Storage Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0
Reduced v/c Ratio | 0.20 | 0.50 | 0.06 | 0.07 | 0.52 | 0.16 | 0.10 | 0.01 | 0.01 | 0.07

Intersection Summary
Area Type: Other
Cycle Length: 75
Actuated Cycle Length: 62.4
Natural Cycle: 75
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.66
Intersection Signal Delay: 21.7
Intersection LOS: C
Intersection Capacity Utilization 47.5%
ICU Level of Service A
Analysis Period (min) 15
90th %ile Actuated Cycle: 75
70th %ile Actuated Cycle: 75
50th %ile Actuated Cycle: 60.5
30th %ile Actuated Cycle: 58.8
10th %ile Actuated Cycle: 42.5

Splits and Phases:

11.5 s 26 s 11.5 s 26 s
12 s 25.5 s 12 s 25.5 s

3: E 1600 Road/O’Connell Road & E 23rd Street/N 1400 Road
### Lanes, Volumes, Timings

#### 3: E 1600 Road/O'Connell Road & E 23rd Street/N 1400 Road

**05/22/2020**

#### Lane Group Lane Configurations

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<td>94</td>
<td>69</td>
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</table>

#### Shared Lane Traffic (%)

| Lane Group Flow (vph) | 13 | 809 | 99 | 73 | 761 | 4 | 56 | 3 | 33 | 2 | 17 | 49 |
| Enter Blocked Intersection | No | No | No | No | No | No | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Right | Left | Left | Right | Left | Left | Right | Left | Right | Left |
| Median Width(ft) | 30 | 36 | 12 | 12 |
| Link Offset(ft) | 0 | 0 | 0 | 0 |
| Crosswalk Width(ft) | 16 | 16 | 16 | 16 |

#### Two way Left Turn Lane

<p>| Headway Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Turning Speed (mph) | 15 | 9 | 15 | 9 | 15 | 9 | 15 | 9 |
| Number of Detectors | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 1 |
| Detector Template | Left | Thru | Right | Left | Thru | Right | Left | Thru | Right | Left | Thru | Right |
| Leading Detector (ft) | 20 | 100 | 20 | 100 | 20 | 100 | 20 | 100 | 20 | 100 | 20 |
| Trailing Detector (ft) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Detector 1 Position(ft) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Detector 1 Size(ft) | 20 | 6 | 20 | 20 | 6 | 20 | 6 | 20 |
| Detector 1 Type | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex |
| Detector 1 Channel | | | | | | | | |
| Detector 1 Extend (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Queue (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Delay (s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 2 Position(ft) | 94 | 94 | 94 | 94 |
| Detector 2 Size(ft) | 6 | 6 | 6 | 6 |
| Detector 2 Type | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex |
| Detector 2 Channel | | | | |
| Detector 2 Extend (s) | 0.0 | 0.0 | 0.0 | 0.0 |
| Turn Type | Prot | NA | pt+ov | Prot | NA | pt+ov | pm+pt | NA | pm+pt | NA | Prot |
| Protected Phases | 7 | 4 | 45 | 3 | 8 | 81 | 5 | 2 | 1 | 6 | 6 |
| Permitted Phases | 2 | 6 |</p>
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Lanes, Volumes, Timings
3: E 1600 Road/O'Connell Road & E 23rd Street/N 1400 Road

Lane Group

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Intersection Summary

Area Type: Other
Cycle Length: 75
Actuated Cycle Length: 69.2
Natural Cycle: 75
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.85
Intersection Signal Delay: 26.3
Intersection LOS: C
Intersection Capacity Utilization 51.3%
Analysis Period (min) 15
90th %ile Actuated Cycle: 75
70th %ile Actuated Cycle: 75
50th %ile Actuated Cycle: 75
30th %ile Actuated Cycle: 75
10th %ile Actuated Cycle: 45.8
# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: E 1600 Road/O'Connell Road & E 23rd Street/N 1400 Road

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## Lanes, Volumes, Timings

**3: E 1600 Road/O’Connell Road & E 23rd Street/N 1400 Road**

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### Baseline Synchro 10 Report

**3: E 1600 Road/O’Connell Road & E 23rd Street/N 1400 Road**

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### Intersection Summary

**Area Type:** Other  
**Cycle Length:** 75  
**Actuated Cycle Length:** 67.9  
**Natural Cycle:** 75  
**Control Type:** Semi Act-Uncoord  
**Maximum v/c Ratio:** 0.69  
**Intersection Signal Delay:** 21.8  
**Intersection LOS:** C  
**Intersection Capacity Utilization:** 49.3%  
**ICU Level of Service:** A  
**Analysis Period (min):** 15  
**90th %ile Actuated Cycle:** 75  
**70th %ile Actuated Cycle:** 75  
**50th %ile Actuated Cycle:** 74.7  
**30th %ile Actuated Cycle:** 71.6  
**10th %ile Actuated Cycle:** 43  

> # 95th percentile volume exceeds capacity, queue may be longer.  
> Queue shown is maximum after two cycles.

#### Splits and Phases:

| Splits and Phases: 3: E 1600 Road/O'Connell Road & E 23rd Street/N 1400 Road |
|---|---|---|---|---|
| EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Spillback Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Storage Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Reduced v/c Ratio | 0.65 | 0.45 | 0.05 | 0.07 | 0.58 | 0.10 | 0.19 | 0.17 | 0.15 | 0.02 | 0.18 |
### Lane Configurations

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<th>EBR</th>
<th>WBL</th>
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<td>67</td>
<td>19</td>
<td>117</td>
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</table>

### Shared Lane Traffic (%)

| Lane Group Flow (vph) | 71  | 809 | 99  | 73  | 761 | 57  | 56  | 41  | 0   | 67  | 19  | 117 |
| Enter Blocked Intersection | No | No | No | No | No | No | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Right | Left | Left | Right | Left | Left | Right | Left | Left | Right |
| Median Width(ft) | 30  | 30  | 36  | 12  |     |     |     |     |     |     |     |     |
| Link Offset(ft) | 0   | 0   | 0   |     |     |     |     |     |     |     |     |     |
| Crosswalk Width(ft) | 16 | 16 | 16  | 16  |     |     |     |     |     |     |     |     |

### Two way Left Turn Lane

| Headway Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Turning Speed (mph) | 15  | 9  | 15  | 9  | 15  | 9  | 15  | 9  | 15  | 9  | 15  | 9  |
| Number of Detectors | 1   | 2  | 1   | 2   | 1   | 2   | 1   | 2   | 1   | 2   | 1   | 2   |
| Detector Template | Left | Thru | Right | Left | Thru | Right | Left | Thru | Right | Left | Thru | Right |
| Leading Detector (ft) | 20  | 100 | 20  | 100 | 20  | 100 | 20  | 100 | 20  | 100 | 20  | 100 |
| Trailing Detector (ft) | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   |
| Detector 1 Position(ft) | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   |
| Detector 1 Size(ft) | 20  | 6   | 20  | 6   | 20  | 6   | 20  | 6   | 20  | 6   | 20  | 6   |
| Detector 2 Position(ft) | 94  | 94  |     | 94  |     | 94  |     | 94  |     | 94  |     | 94  |
| Detector 2 Size(ft) | 6   | 6   | 6   | 6   |     |     |     |     |     |     |     |     |
| Detector 1 Type | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex |
| Detector 1 Channel |     |     |     |     |     |     |     |     |     |     |     |     |
| Detector 1 Extend(s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Queue(s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Delay(s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 2 Position(ft) | 94  | 94  |     | 94  |     | 94  |     | 94  |     | 94  |     | 94  |
| Detector 2 Size(ft) | 6   | 6   | 6   | 6   |     |     |     |     |     |     |     |     |
| Detector 2 Type | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex | Cl+Ex |
| Detector 2 Channel |     |     |     |     |     |     |     |     |     |     |     |     |
| Detector 2 Extend(s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Turn Type | Prot | NA | pt+ov | Prot | NA | pt+ov | pm+pt | NA | pm+pt | NA | Prot | NA |
| Protected Phases | 7   | 4   | 45  | 3   | 8   | 81  | 5   | 2   | 1   | 6   | 6   |     |
| Permitted Phases | 2   | 6   |     |     |     |     |     |     |     |     |     |     |

**Baseline Synchro 10 Report**
Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR
---|---|---|---|---|---|---|---|---|---|---|---|---|
Detector Phase | 7 | 4 | 4 | 5 | 3 | 8 | 8 | 1 | 5 | 2 | 1 | 6 | 6

Switch Phase

- **Minimum Initial (s)**: 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0
- **Minimum Split (s)**: 11.5 25.0 11.5 25.0 11.5 25.3 11.5 25.3 25.0
- **Total Split (s)**: 11.7 26.0 12.2 26.5 11.5 25.3 11.5 25.3 25.3
- **Total Split (%)**: 15.6% 34.7% 16.3% 35.3% 15.3% 33.7% 15.3% 33.7% 33.7%
- **Maximum Green (s)**: 5.2 19.5 5.7 20.0 5.0 18.8 5.0 18.8 18.8
- **Yellow Time (s)**: 4.0 4.0 4.0 4.0 4.0 4.0 4.0 4.0 4.0
- **All-Red Time (s)**: 2.5 2.5 2.5 2.5 2.5 2.5 2.5 2.5 2.5
- **Lost Time Adjust (s)**: 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
- **Total Lost Time (s)**: 6.5 6.5 6.5 6.5 6.5 6.5 6.5 6.5 6.5

Lead/Lag

- **Lead/Lag Optimize?** Yes Yes Yes Yes Yes Yes Yes Yes Yes
- **Vehicle Extension (s)**: 3.0 3.0 3.0 3.0 3.0 3.0 3.0 3.0 3.0
- **Recall Mode** None None None None None Max Max Max Max Max
- **Walk Time (s)**: 7.0 7.0 7.0 7.0 7.0
- **Flash Don't Walk (s)**: 11.0 11.0 11.0 11.0 11.0
- **Pedestrian Calls (#/hr)**: 0 0 0 0 0

**Act Effct Green (s)**

- 5.4 18.6 30.6 5.9 19.0 31.0 23.2 19.6 23.2 19.6
- 0.08 0.27 0.44 0.09 0.27 0.45 0.34 0.28 0.34 0.28
- 0.51 0.85 0.13 0.49 0.78 0.07 0.11 0.08 0.14 0.04 0.19

**Control Delay**

- 49.2 35.8 1.5 45.8 31.5 0.2 14.8 10.6 15.0 21.7 0.7

**Queue Delay**

- 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0

**Total Delay**

- 49.2 35.8 1.5 45.8 31.5 0.2 14.8 10.6 15.0 21.7 0.7

**LOS**

- D D A D C A B B B C A

**Approach Delay**

- 33.3 30.7 13.0 7.4

**Approach LOS**

- C C B A

**90th %ile Green (s)**

- 5.2 19.5 5.7 20.0 5.0 18.8 5.0 18.8 18.8

**90th %ile Term Code**

- Max Max Max Max MaxR MaxR MaxR MaxR MaxR

**70th %ile Green (s)**

- 5.2 19.5 5.7 20.0 5.0 18.8 5.0 18.8 18.8

**70th %ile Term Code**

- Max Max Max Max MaxR MaxR MaxR MaxR

**50th %ile Green (s)**

- 5.2 19.5 5.7 20.0 5.0 18.8 5.0 18.8 18.8

**50th %ile Term Code**

- Max Max Max Max MaxR MaxR MaxR MaxR

**30th %ile Green (s)**

- 5.2 19.5 5.7 20.0 5.0 18.8 5.0 18.8 18.8

**30th %ile Term Code**

- Max Max Max Max MaxR MaxR MaxR MaxR

**10th %ile Green (s)**

- 0.0 14.0 0.0 14.0 0.0 18.8 0.0 18.8 18.8

**10th %ile Term Code**

- Skip Gap Skip Hold Skip MaxR Skip MaxR MaxR

**Stops (vph)**

- 59 660 5 64 619 0 36 15 41 16 0

**Fuel Used (gal)**

- 2 24 1 4 39 2 1 0 1 0 1

**CO Emissions (g/hr)**

- 157 1644 89 282 2744 121 54 32 71 24 63

**NOx Emissions (g/hr)**

- 31 320 17 55 534 24 11 6 14 5 12

**VOC Emissions (g/hr)**

- 36 381 21 65 636 28 13 7 16 6 15

**Dilemma Vehicles (#)**

- 0 51 0 0 50 0 0 3 0 1 0

**Queue Length 50th (ft)**

- 33 190 0 34 173 0 16 3 19 7 0

**Queue Length 95th (ft)**

- #87 #291 13 #85 #247 0 37 26 42 22 0

**Internal Link Dist (ft)**

- 1864 4966 831 1020

**Turn Bay Length (ft)**

- 750 550 700 1000 145 270

**Base Capacity (vph)**

- 138 1037 774 151 1063 784 494 486 487 526 619

**Starvation Cap Reductn**

- 0 0 0 0 0 0 0 0 0 0 0
### Lane Group

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<tr>
<th>Lane Group</th>
<th>EBL</th>
<th>EBT</th>
<th>EBR</th>
<th>WBL</th>
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### Intersection Summary

- **Area Type:** Other
- **Cycle Length:** 75
- **Actuated Cycle Length:** 69.2
- **Natural Cycle:** 75
- **Control Type:** Semi Act-Uncoord
- **Maximum v/c Ratio:** 0.85
- **Intersection Signal Delay:** 28.9
- **Intersection LOS:** C
- **Intersection Capacity Utilization:** 51.9%
- **ICU Level of Service:** A
- **Analysis Period (min):** 15
- **90th %ile Actuated Cycle:** 75
- **70th %ile Actuated Cycle:** 75
- **50th %ile Actuated Cycle:** 75
- **30th %ile Actuated Cycle:** 75
- **10th %ile Actuated Cycle:** 45.8

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

### Splits and Phases

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## Lanes, Volumes, Timings

3: E 1600 Road/O’Connell Road & E 23rd Street/N 1400 Road

### Lanes, Volumes, Timings

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<th>Lane Group</th>
<th>EBL</th>
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<th>EBR</th>
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### Lane Configurations

| Lane Group | Flow (vph) | 143 | 782 | 60 | 12 | 728 | 86 | 121 | 45 | 71 | 89 | 12 | 145 |
|------------|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Enter Blocked Intersection | No | No | No | No | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Right | Left | Left | Right | Left | Left | Right |
| Median Width(ft) | 30 | 36 | 12 | 12 |
| Link Offset(ft) | 0 | 0 | 0 | 0 |
| Crosswalk Width(ft) | 16 | 16 | 16 | 16 |

### Shared Lane Traffic (%)

| Lane Group Flow (vph) | 143 | 782 | 60 | 12 | 728 | 86 | 121 | 45 | 71 | 89 | 12 | 145 |
| Enter Blocked Intersection | No | No | No | No | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Right | Left | Right | Left | Right |
| Median Width(ft) | 30 | 36 | 12 | 12 |
| Link Offset(ft) | 0 | 0 | 0 | 0 |
| Crosswalk Width(ft) | 16 | 16 | 16 | 16 |

### Two way Left Turn Lane

| Headway Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Turning Speed (mph) | 15 | 9 | 15 | 9 | 15 | 9 | 15 | 9 |
| Number of Detectors | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 1 |
| Detector Template | Left | Thru | Right | Left | Thru | Right | Left | Thru | Right |
| Leading Detector (ft) | 20 | 100 | 20 | 20 | 100 | 20 | 20 | 100 |
| Trailing Detector (ft) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Detector 1 Position(ft) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Detector 1 Size(ft) | 20 | 6 | 20 | 20 | 6 | 20 | 20 | 6 |
| Detector 1 Type | Ci+Ex | Ci+Ex | Ci+Ex | Ci+Ex | Ci+Ex | Ci+Ex | Ci+Ex | Ci+Ex | Ci+Ex |
| Detector 1 Extend(s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Queue(s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 1 Delay(s) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Detector 2 Position(ft) | 94 | 94 | 94 | 94 |
| Detector 2 Size(ft) | 6 | 6 | 6 | 6 |
| Detector 2 Type | Ci+Ex | Ci+Ex | Ci+Ex | Ci+Ex |
| Detector 2 Extend(s) | 0.0 | 0.0 | 0.0 | 0.0 |
| Turn Type | Prot | NA | pt+ov | Prot | NA | pt+ov | pm+pt | NA | pm+pt | NA | Prot |
| Protected Phases | 7 | 4 | 4 | 5 | 3 | 8 | 8 | 1 | 5 | 2 | 1 | 6 | 6 |
| Permitted Phases | 2 | 6 |
### Lanes, Volumes, Timings

#### 3: E 1600 Road/O'Connell Road & E 23rd Street/N 1400 Road

**05/22/2020**

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Lane Group

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Intersection Summary

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Analysis Period (min) 15

90th %ile Actuated Cycle: 75
70th %ile Actuated Cycle: 75
50th %ile Actuated Cycle: 75
30th %ile Actuated Cycle: 75
10th %ile Actuated Cycle: 58.6

# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: E 1600 Road/O'Connell Road & E 23rd Street/N 1400 Road

11.5 s 25 s 11.5 s 27 s
11.5 s 25 s 13.5 s 25 s

Baseline Synchro 10 Report Page 3
### Lanes, Volumes, Timings

*3: E 1600 Road/O’Connell Road & E 23rd Street/N 1400 Road*

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<tr>
<td>Turn Type</td>
<td>Prot</td>
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<td>pt+ov</td>
<td>Prot</td>
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<td>pt+ov</td>
<td>pm+pt</td>
<td>NA</td>
<td>pm+pt</td>
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<td>8</td>
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<td>5</td>
<td>2</td>
<td>1</td>
<td>6</td>
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<td>Permitted Phases</td>
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</tr>
</tbody>
</table>
### Lane Group Details

#### Detector Phase
- **EBL**: 7
- **EBT**: 4
- **EBR**: 4
- **WBL**: 5
- **WBT**: 8
- **WBR**: 1
- **NBL**: 5
- **NBT**: 2
- **NBR**: 1
- **SBL**: 6
- **SBT**: 6
- **SBR**: 6

#### Switch Phase
- **Minimum Initial (s)**: 5.0
- **Minimum Split (s)**: 11.5
- **Total Split (s)**: 12.0
- **Total Split (%)**: 15.0%
- **Maximum Green (s)**: 5.5
- **Yellow Time (s)**: 4.0
- **All-Red Time (s)**: 2.5
- **Lost Time Adjust (s)**: 0.0
- **Total Lost Time (s)**: 6.5
- **Lead/Lag Optimize?**: Yes
- **Vehicle Extension (s)**: 3.0
- **Recall Mode**: None
- **Walk Time (s)**: 7.0
- **Flash Don’t Walk (s)**: 11.0
- **Pedestrian Calls (#/hr)**: 0
- **Act Effct Green (s)**: 5.7
- **Actuated g/C Ratio**: 0.08
- **v/c Ratio**: 0.68
- **Control Delay**: 64.2
- **Queue Delay**: 0.0
- **Total Delay**: 64.2
- **LOS**: E

#### Approach Details
- **Approach Delay**: 37.2
- **90th %ile Green (s)**: 5.5
- **90th %ile Term Code**: Max
- **70th %ile Green (s)**: 5.5
- **70th %ile Term Code**: Max
- **50th %ile Green (s)**: 5.5
- **50th %ile Term Code**: Max
- **30th %ile Green (s)**: 5.5
- **30th %ile Term Code**: Max
- **10th %ile Green (s)**: 0.0
- **10th %ile Term Code**: Skip
- **Stops (vph)**: 69
- **Fuel Used(gal)**: 3
- **CO Emissions (g/hr)**: 211
- **NOx Emissions (g/hr)**: 41
- **VOC Emissions (g/hr)**: 49
- **Dilemma Vehicles (#)**: 0
- **Queue Length 50th (ft)**: 46
- **Queue Length 95th (ft)**: 122
- **Internal Link Dist (ft)**: 1864
- **Turn Bay Length (ft)**: 750
- **Base Capacity (vph)**: 134
- **Starvation Cap Reductn**: 0

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This report provides detailed traffic analysis for the intersection of E 1600 Road/O’Connell Road & E 23rd Street/N 1400 Road as of 05/22/2020. The data includes critical timing and performance metrics such as lane group detection, switch phase parameters, and traffic flow characteristics, offering a comprehensive view of the intersection’s operational status and potential areas for improvement.
**Intersection Summary**

<table>
<thead>
<tr>
<th>Lane Group</th>
<th>EBL</th>
<th>EBT</th>
<th>EBR</th>
<th>WBL</th>
<th>WBT</th>
<th>WBR</th>
<th>NBL</th>
<th>NBT</th>
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<th>SBL</th>
<th>SBT</th>
<th>SBR</th>
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<tbody>
<tr>
<td>Spillback Cap Reductn</td>
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<tr>
<td>Storage Cap Reductn</td>
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<tr>
<td>Reduced v/c Ratio</td>
<td>0.68</td>
<td>0.87</td>
<td>0.16</td>
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<td>0.19</td>
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</tr>
</tbody>
</table>

**Intersection Signal Delay**: 32.6  
**Intersection LOS**: C  
**Intersection Capacity Utilization**: 58.4%  
**ICU Level of Service**: B  

**Analysis Period (min)**: 15  
90th %ile Actuated Cycle: 80  
70th %ile Actuated Cycle: 80  
50th %ile Actuated Cycle: 80  
30th %ile Actuated Cycle: 80  
10th %ile Actuated Cycle: 52.5  

# 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.

**Splits and Phases**: 3: E 1600 Road/O'Connell Road & E 23rd Street/N 1400 Road
TRACT 'E'
FORMER FARMLAND PROPERTY
ZONED "UR"
FORMER WATER TANK LOCATION
BH-2
BH-3
BH-4
BH-5
BH-6
BH-1
CMG75,000 sq ft
15,000 sq ft
FAC40,000 sq ft
FOR/ HOR.53,551 sq ft
SWD 50,400 sq ft
7 PACK 212,858 sq ft
HHW
BULK MATERIAL BINS
FUEL BULK MATERIAL BINS
BULK MATERIAL BINS
BULK MATERIAL BINS
VEHICLE TURNING MOVEMENTS
FIELD OPERATION FACILITY
LAWRENCE, KANSAS