# Memorandum
# City of Lawrence
# Public Works

**TO:** Chuck Soules, Public Works Director
**FROM:** Shoeb Uddin, City Engineer
**CC:** Dave Corliss, Debbie Van Saun, Sheila Stogsdill, David Woosley, David Schwartz, Andrew Jenkins, Davonna Morgan, Lisa Pool, Anson Gock
**Date:** July 17, 2007
**RE:** **West 6th Street (US 40) Corridor**
**Traffic Impact Analysis**

This memo is intended to provide a synopsis of the traffic impact analysis for West 6th Street Corridor (bounded by Folks Road, K-10, Overland Drive and Harvard Road). This has been a joint venture between KDOT and the City of Lawrence. Traffic impact analysis was performed by the engineers at KDOT using the VISSIM computer model. The City staff provided KDOT with information and recommendations related to traffic data, road geometry, traffic control measures, e.g. signals, roundabouts etc. and development plans in the corridor.

## Background

The City of Lawrence and KDOT completed a 15 million dollar project in 2005 that consisted of dual through lanes for both east and west bound traffic and provisions for dual left-turn lanes at each intersection between Wakarusa and George Williams Way. All of these intersections will be signalized when warrants are met. These improvements were designed to accommodate the potential future developments in the corridor.

The City of Lawrence requires a Traffic Impact Study with every new development plan. Numerous traffic impact studies have been performed for this corridor during past few years. KDOT performed a Preliminary (or Draft) Corridor Analysis using the VISSIM model in 2005 and the results were wrongly interpreted as final or conclusive while the study was still ongoing. As a result, there have been a lot of diverse and conflicting information, views and opinions out there as to the impact of future development in this corridor. In April, 2007 the City staff took on a project to analyze this problem objectively and address the confusion as to the traffic volume and its impact on Travel Time and Intersection Delay. KDOT became a natural partner in this process. We started out with a meeting with KDOT engineers and planners led by Mr. Jerry Younger, Assistant Secretary of Transportation. Since then, engineers at KDOT and the City of Lawrence have worked together as a team assembling a comprehensive scenario of future development activities and its impact on traffic and safety of public in this corridor. Tasks accomplished are listed below.

1. Assemble a list of all Development Plans (approved by the City) in the corridor, along with Floor Area in square Footage. (See KDOT report)

2. Develop the VISSIM model by inputting all background data related to proposed development, road geometry, traffic control measures, growth rate etc.
3. Determine Traffic Analysis Scenarios and modify Data Input for each scenario.
4. Perform Analysis.
5. Report Results and Make Recommendations.

## Analysis, Results and Recommendation

Traffic Impact analysis is typically performed for current and future scenarios. In this study, 3 scenarios, namely, "Existing plus Committed", "Future –1 (Year 2030)", "Future – 2 (Year 2030), were analyzed.

Results show that for "Existing plus Committed" scenario, the average travel time during peak hour between Folks road and K-10 is approximately 5 minutes and the average delay at each of the intersections in the corridor will range from 10 to 55 seconds, which, generally speaking, is an acceptable operating condition.

For future scenarios, the average travel time during peak hour between Folks road and K-10 will range from 8 to 10 minutes and the average delay at the intersections will range from 10 to 80 seconds. Details about the Analysis Scenarios and the Results are included in the Attachment.

In order to ensure efficient and safe operation of the West 6$^{th}$ Street corridor, the following steps are recommended.

1. Implement all committed improvements in the corridor as well as all improvements recommended in the Traffic Impact Studies associated with the Development Plans.
2. Install a Traffic Signal at K-10 and West 6$^{th}$ street (Need an aggressive plan in the immediate future)
3. Implement all future improvement measures recommended in the numerous Traffic Impact Studies submitted with the Development Plans. (Recommended to be included in the Long Range Planning)
4. Construct an Interchange at K-10 and Bob Billings Parkway (Need Feasibility Study, could possibly be included in the Long Range Planning)
5. Construct a road north of Overland Drive extending from Folks Road to the East and to GWW to the West. (Need Feasibility Study, could possibly be included in the Long Range Planning)

Respectfully submitted,

Shoeb Uddin, P.E.
City Engineer

# ATTACHMENT

## Analysis Scenarios

It was decided that 3 different scenarios, based on traffic volume, road geometry and traffic control measures, would be analyzed.

1. Existing plus Committed
   This scenario includes all existing developments and all development plans within the corridor approved by the City. Road Geometry includes all existing and committed improvements, signals, roundabouts etc. It also includes a traffic signal at the interchange of K-10 and West 6th Street.

2. Future – 1 (2030)
   This scenario involves all developments considered in the previous scenario plus all conceivable developments to the north, to the west of K-10 and growth in the background traffic. This is essentially the "Full Build Out" scenario. Road Geometry includes all features of the previous scenario plus other recommended improvements at various intersections.

3. Future – 2 (2030)
   This scenario is different from Future – 1 with respect to road network. In this scenario, it is assumed that an interchange will be built at the intersection of Bob Billings and K-10 and a road north of Overland Drive will be built extending from Folks to the east to GWW to the west. These additions into the road network could not be added into the model directly as it will make the size of the model too large for analysis. Therefore, these geometric additions were accounted for by applying a reduction in the volume of traffic in the corridor as some traffic will be diverted away due to these geometric additions.

## Results

Existing Plus Committed

- Average travel time during peak hour between Folks Road and K-10 is approximately 5 minutes for both eastbound and westbound traffic.
- Average delay during peak hour at each of the intersections in the corridor will be less than 35 seconds with few exceptions – Intersection of 6th and Folks, the Intersection of Overland and Wakarusa and the Intersection of 6th and K-10, where the average delay is expected to be between 35 and 55 seconds.

Future – 1 (2030)

- Average travel time during peak hour between Folks Road and K-10 is less than 10 minutes for both directions.
- Average delay during peak hour at each of the intersections will be less than 55 seconds with the following exceptions.
  a. Intersection of 6th and Wakarusa, Intersection of Harvard and Wakarusa and Intersection of 6th and K-10: Average delay is expected to be between 55 and 80 seconds.
  b. Intersection of 6th and Folks: Average Delay is more than 80 seconds.

Future – 2 (2030)

- Average travel time during peak hour between Folks Road and K-10 is less than 8 minutes for both directions.

- Average delay during peak hour at each of the intersections will be less than 55 seconds with the following exceptions.
  a. Intersection of Harvard and Wakarusa: Average delay is more than 55 seconds but less than 80 seconds.
  b. Intersection 6th and Folks: Average Delay is more than 80 seconds.

It appears that the intersection of 6th and Folks are experiencing the longest delay. We are closely examining this intersection to verify the accuracy of the traffic volume assigned to this intersection. We are also evaluating various measures to improve the operating condition at this intersection.

**For more in-depth and detailed results related to travel time and intersection delay, please refer to KDOT report.**

## Cut-Through Traffic

VISSIM computer model does not analyze the problem associated with Cut-Through traffic. However, if the travel time between Folks and K-10 ranges from 8 to 10 minutes, the likelihood of cut-through traffic in the surrounding neighborhoods will be greatly diminished. In the future, installation of additional traffic calming measures in the neighborhood streets will further diminish the potential for Cut-Through traffic.

## Traffic Signal at K-10 and 6th Street

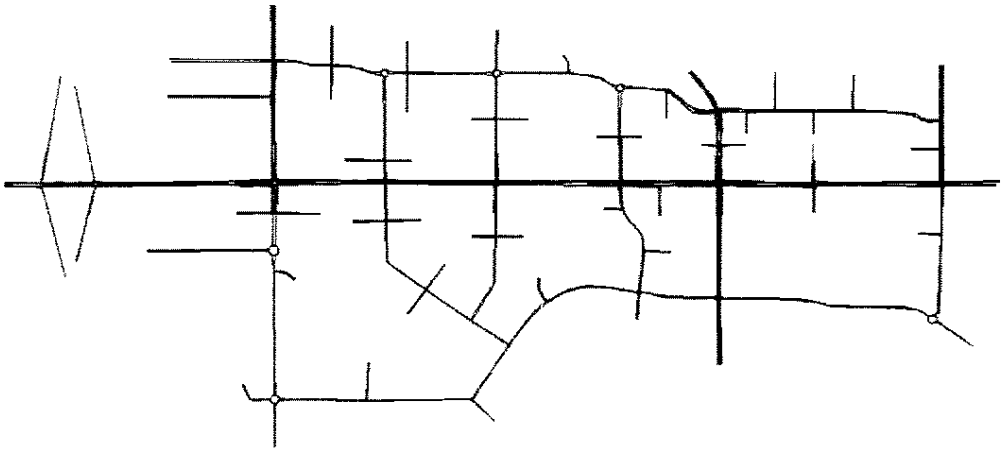
During trial runs, it became evident that the east bound traffic was experiencing excessive delays and long queues at this interchange for the "Existing plus Committed" scenario. Subsequently, all scenarios were analyzed assuming a traffic signal at this location. In the near future, we will work with KDOT to closely examine the operational characteristics of this interchange and establish a timeline for the traffic signal and lane improvements for the south bound off-ramps.

# West Sixth Street Traffic Micro-Simulation

US-40 (6th Street) is an important corridor to the City of Lawrence. It has long served as a western gateway to the City, as it brought traffic in from Topeka. As Lawrence has developed westward, 6th Street has become an important connector of neighborhoods, as well as a path for intercity traffic. Many large developments, of both commercial and residential character, have been built in Northwest Lawrence, with several significant developments still to come. The traffic associated with this growth will require additional capacity, especially at intersections.

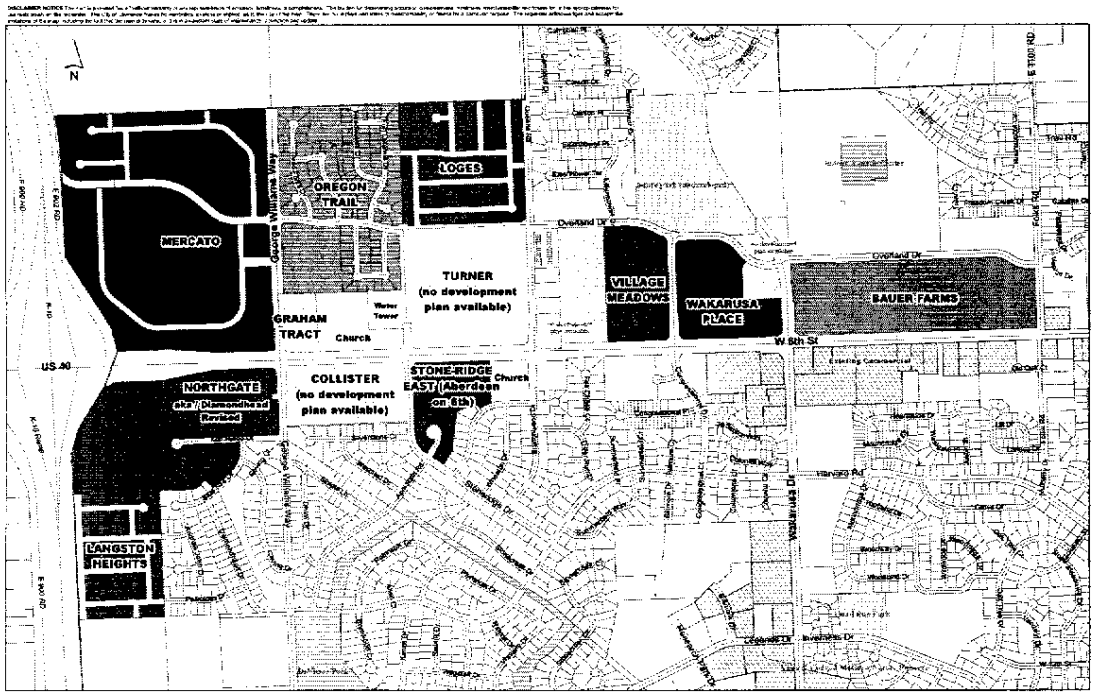
It was for this reason this corridor was examined for a traffic study using VISSIM micro-simulation software. The VISSIM computer model takes data about the roadway system and the traffic mix and simulates individual vehicle behavior, constrained by the same laws of time and space that real drivers face. Much data can be collected about the performance of the streets and signals, but the output is only as good as the trip information that the user codes in. VISSIM also gives you the ability to run the simulation multiple times with vehicles entering the system at different, random intervals each time, so any aberrations can be spotted and the results can be averaged.

The VISSIM model developed by KDOT included 6th Street from west of K-10 to east of Folks Road. The model was bounded by Overland Drive to the north and Harvard Road to the south. The following diagram shows the model area with the above bounds. (The thick, double horizontal line is 6th Street. K-10 Highway itself is not shown, but you can see the ramps of the diamond interchange at the left of the model.



This corridor was previously studied by KDOT in 2005 and was reexamined with new and adjusted traffic data, as well as more refined geometrics and traffic control (roundabouts, signals, stop signs) for the new intersections of the area. Several sources of information were used in this study including the city of Lawrence and its resources, *Bauer Farm Update* and *Wal-Mart Store #5219* traffic impact studies prepared by TranSystems, the *Traffic Analyses for Intersections of 6th Street with Queens Road, Stoneridge Drive, and George Williams Way* prepared for Landplan Engineering, and office resources such as the previous KDOT 6th Street study and the ITE Trip Generation Manual.

Several scenarios were examined for this study. The first scenario used the existing plus development volumes with anticipated geometric improvements. The volumes used were derived from existing counts along with anticipated volumes for the known developments north and south of 6th Street in the study area. These developments are shown below. The ITE Trip Generation Manual, along with the above mentioned studies, was used to determine volumes from these developments. The geometrics of the roadways were based on the traffic impact studies previously mentioned. Signals were placed along 6th Street at K-10 ramps, George Williams Way, Stoneridge, Queens, Congressional, Wakarusa, Champion and Folks. Signals were also placed at GWW at Overland, Wakarusa at Overland and Wakarusa at Harvard. The signals at the K-10 ramps were needed in order to move the SB off-ramp traffic.




The second scenario examined future volumes that were determined using the Traffic Impact Studies along with reasonable growth rates for the background traffic and future land use data. For this scenario, the geometrics were improved according to the Bauer Farm and Wal-Mart Traffic Impact Studies' future lane configurations. Also included in the model were improvements at the K-10 ramp terminals.

The third and final scenario reflected reduced future volumes to account for adjacent road improvements within the immediate region. These improvements include a possible 15th Street interchange with K-10 and a roadway north of Overland. Since these facilities are outside the limits of the simulation model, adjustments to traffic caused by vehicles choosing other paths had to be assumed: A 20% reduction on the entry volumes at the K-10 off-ramps and 6th Street west of K-10, a 10% reduction at 6th Street east of Folks, Folks north of Overland, and Wakarusa south of Harvard. The geometrics of the third scenario are identical to those modeled in the second scenario.

The results from the 6th Street Corridor Study are shown in the following pages. Pages 4-5 show the turning volumes used for the scenarios while pages 6-8 display the Level of Service at each signal for the given scenario.

On page 9 is a summary of the actual volumes reported by VISSIM for specific measurement points along with the desired volumes. The difference between actual and desired is calculated, followed by the percent difference. Given the nature of micro-simulation models, the difference in volumes is expected to vary within a few percent. The points of large difference may indicate areas with capacity restraints. For example, the Existing plus Development results look acceptable while the Future results show problems, especially around 6th and Folks. These results are verified in the simulation, as backup occurs at this intersection.

Travel Time results are shown on pages 10-11. The tables show travel times for the ten listed routes for four different scenarios. Along with travel times, the number of vehicles making each route is shown. It is important to notice, especially with routes 1 and 2, that even though there are higher volume demands on the future scenarios, there are fewer vehicles traveling the desired routes. One reason is that fewer vehicles are able to travel the network due to congestion, especially at 6th and Folks. The graph shows travel times for routes 1 and 2 from the previous page for the three scenarios, broken down by 15-minute intervals.

Pages 12 and 13 show the maximum queue lengths (in feet) at the given intersections along 6th St and the change in queue length between scenarios as shown. This data needs to be interpreted with caution as it represents an average of the longest backup experienced at a given approach from five runs, while a typical queue length is shorter.

Lastly, there are several screenshots for the scenarios as indicated above each screenshot on pages 14-19. The "Future Volumes, Existing + Develop Geometry" screenshots show the excessive backups around the Bauer Farms area and along K-10. Each subsequent scenario demonstrates the effects of its network changes. The screenshots were all taken at 45 minutes into the hour of simulation and at the same locations, so they are comparable.

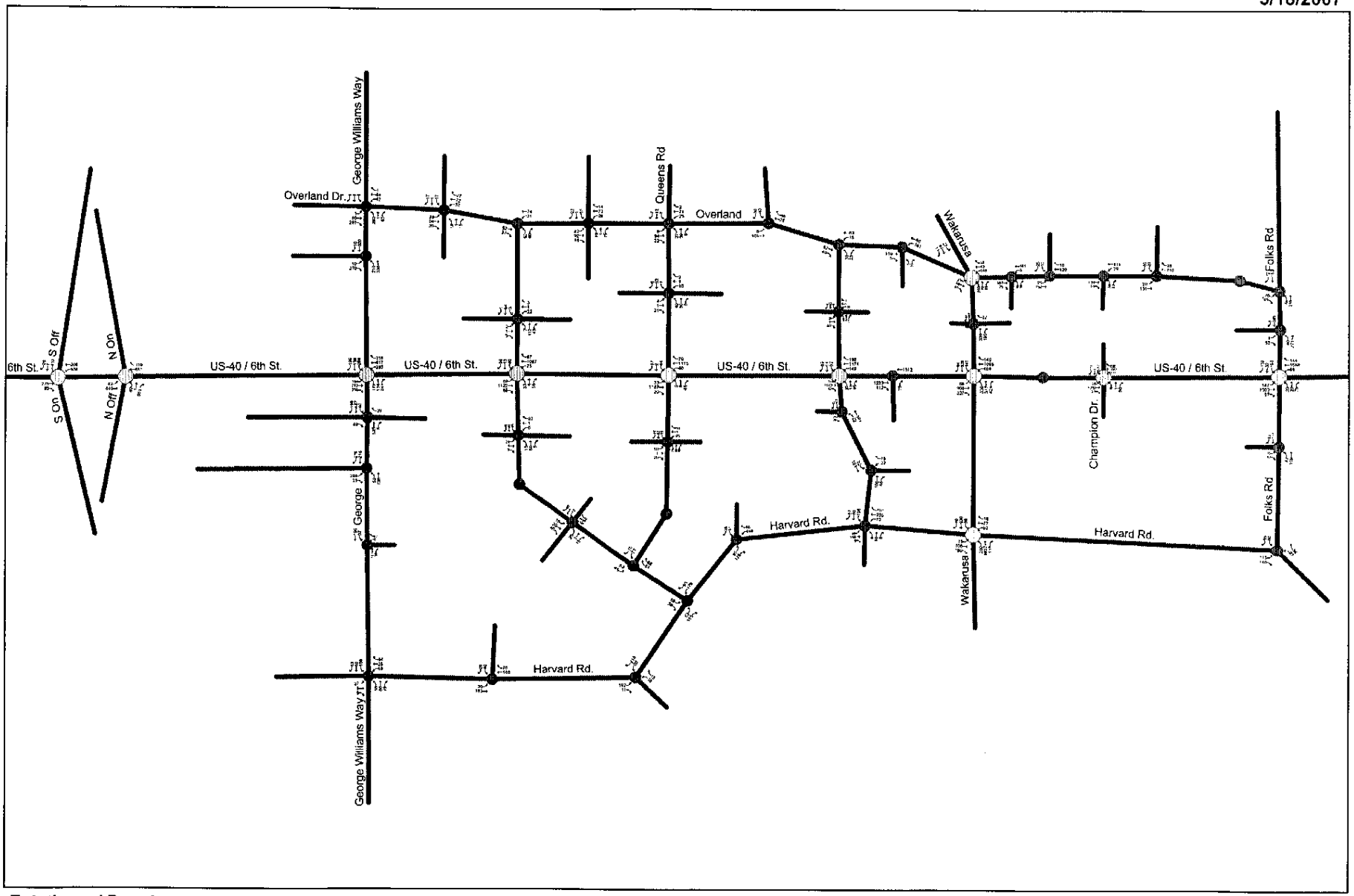
The development in Northwest Lawrence needs to be monitored, as certain areas appear to be approaching capacity, and in cases like 6th & Folks Road, demand exceeds capacity. This corridor will need to serve both local trips and commuter trips for many years, so mobility needs to be preserved while accommodating growth.

# Comprehensive Future Full Development
# US 40 (Folks Road to K-10) Corridor

| Site Name | Commercial | Residential | Total |
|---|---|---|---|
| Mercato | Comm/Ret. – 184,640 SF<br>Comm/non-ret. – 153,060 SF | 18 duplex<br>,75 single family, 1 lot zoned RM24 max 24 units per acre (11.74 acres) | 393 dwelling units |
| Oregon Trail | | 73 duplex, 50 single family, 1 lot zoned RM 12 max 12 units per acre (10.256 acres) | 316 dwelling units |
| Loges | | 69 duplex, 73 single family | 211 dwelling units |
| Northgate/ aka Diamondhead Revised | Comm / Ret. – 188,250 SF | 12-15 units per acre for (18.8 acres) | 225 – 282 dwelling units |
| Stoneridge East (includes Aberdeen on 6th) | | No. of units – 108<br>12 single family | 120 dwelling units |
| Bauer Farms | Comm/ret. – 62,000 SF<br>Office / Bank – 59,400 SF<br>Theater – 41,500 SF | 211 Res. Units<br>8000 SF office | 211 dwelling units |
| Village Meadows | | 310 retirement community units | 310 dwelling units |
| Walmart | 100,000 SF bldg. floor area<br>6,000 SF Garden Center<br>21,500 SF Pad Site | | |
| Langston Heights | | 85 lots, 18 duplex, 67 single | 121 dwelling units |
| Collister Property | | 12-15 units per acre for (18.4 acres) | 221 - 276 dwelling units (using acreage before R/W removed) |
| Turner Property | | 50% 12-15 units per acre (18.5 ac)<br>50% 5-7 units per acre (18.5 ac) | 315 – 407 dwelling units (using acreage before R/W removed) |

**Map - Existing w/ Development Volumes**

**5/18/2007**




**Existing w/ Development Baseline**
**%user_name%**

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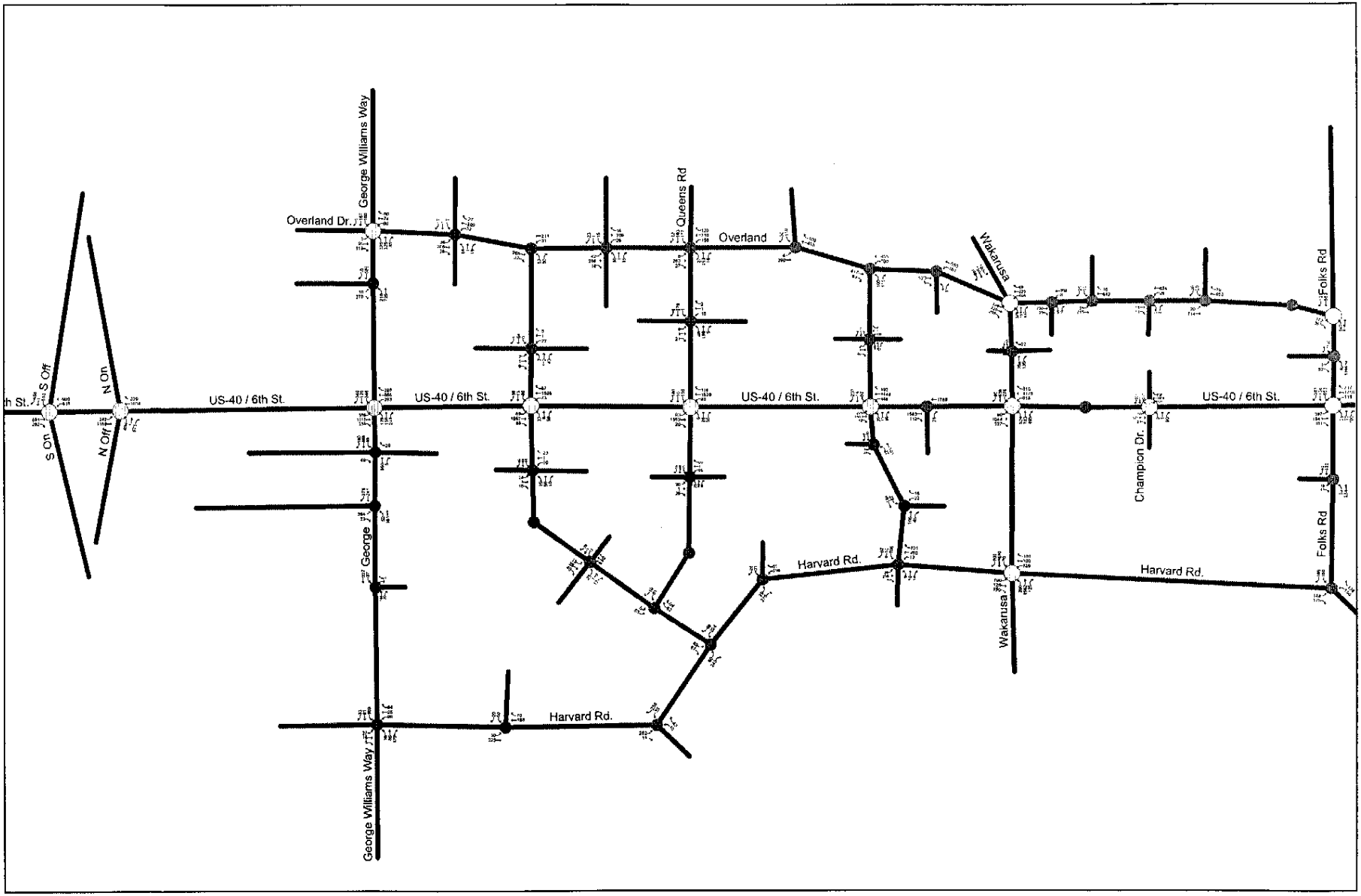
**Map - Future**
**Volumes**

**6/27/2007**




**Future Future**
**%user_name%**

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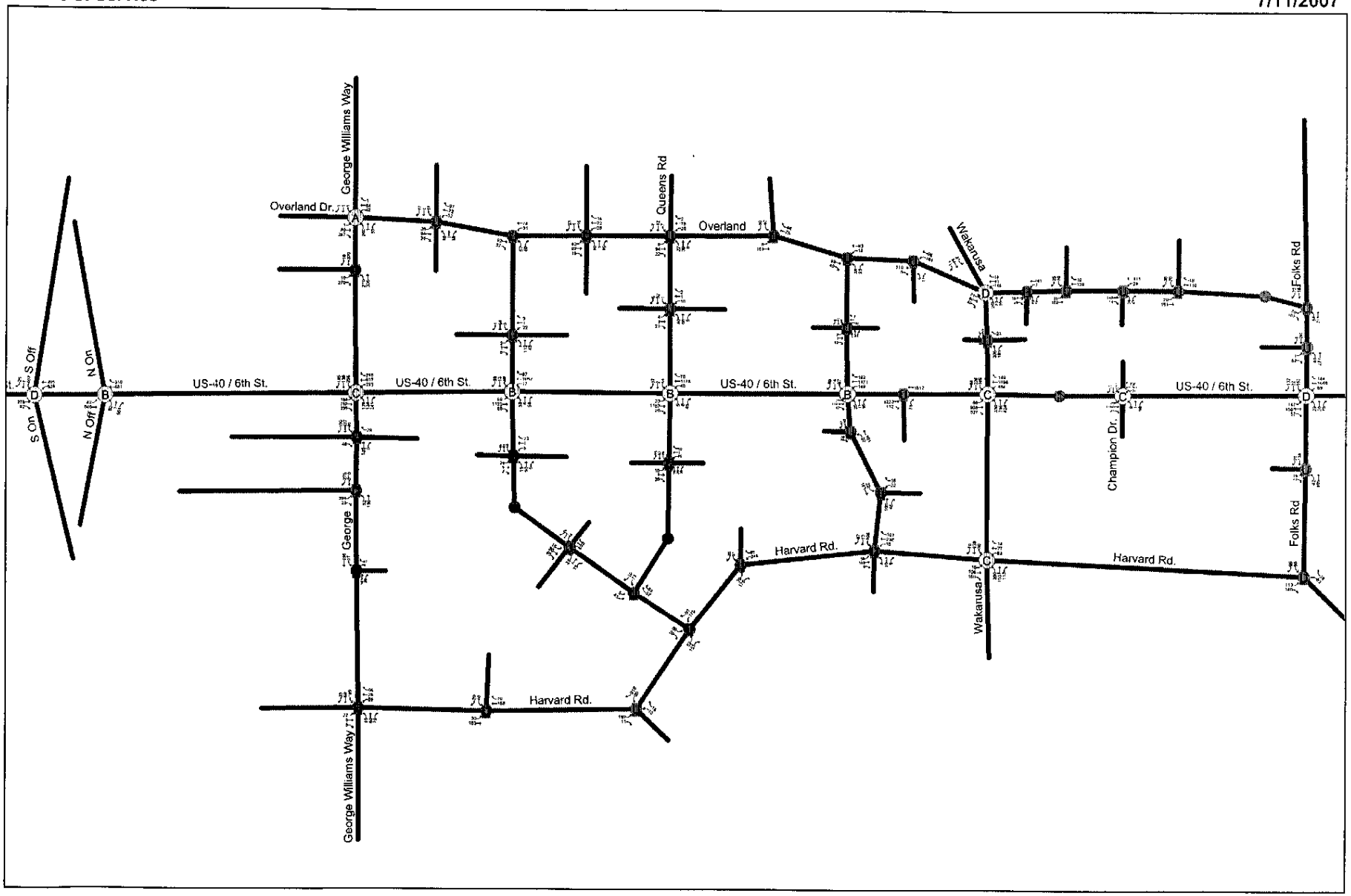
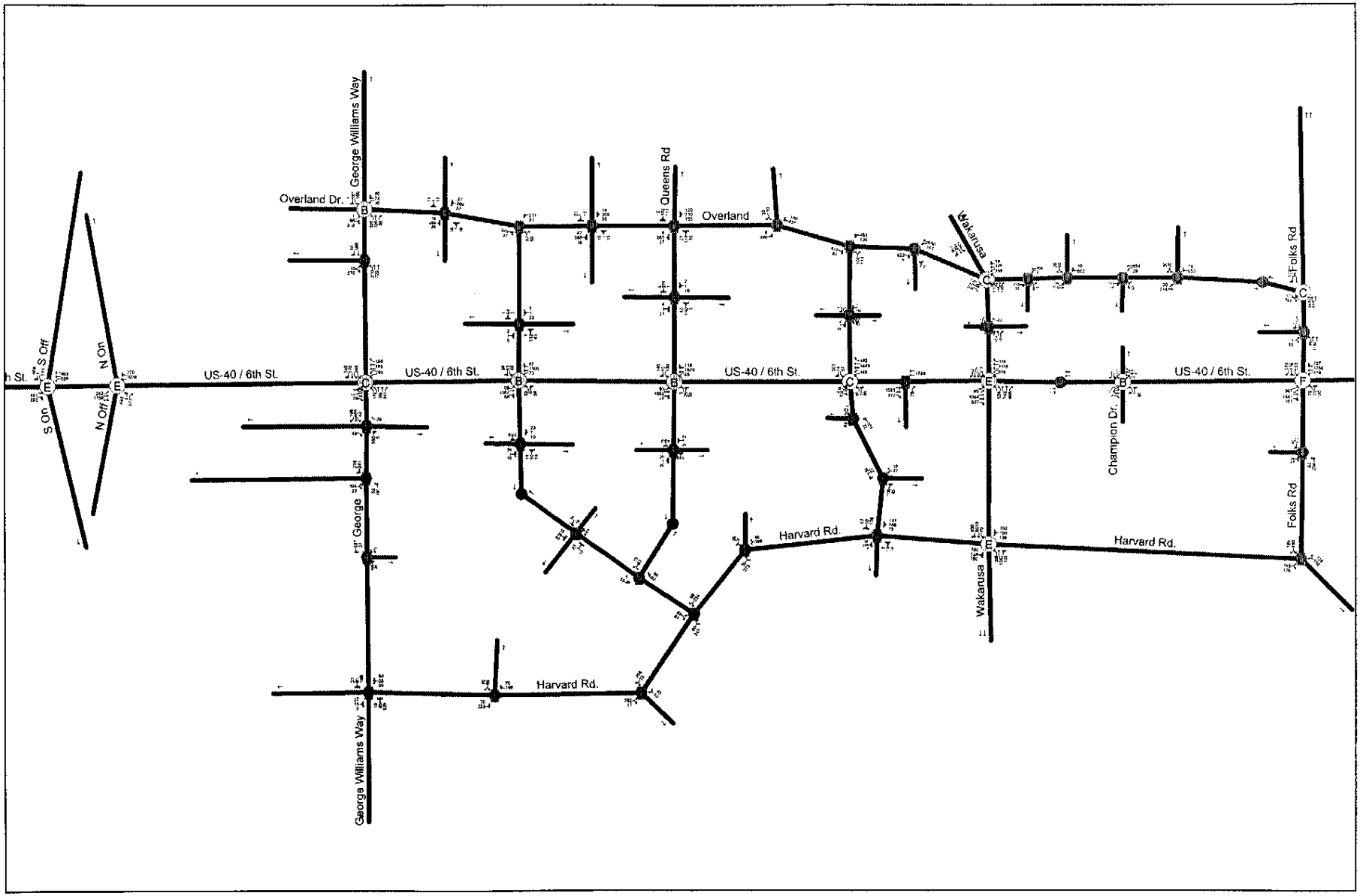
**Map - Existing w/ Development**
**Levels of Service**

**7/11/2007**



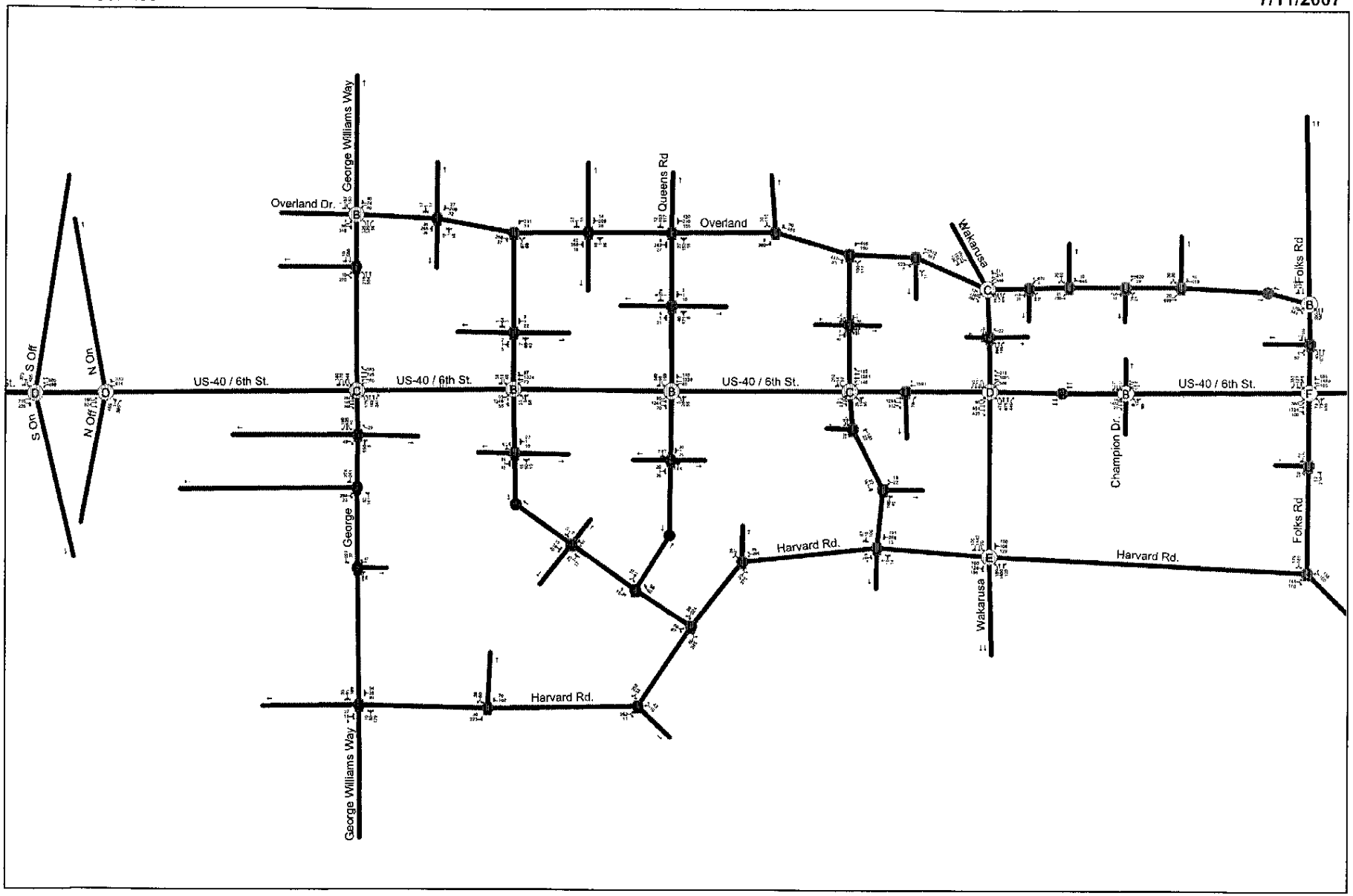
**Map - Future with Improved Geometry**
**Levels of Service**

**7/11/2007**



**Map - Future with Reduced Volumes**
**Levels of Service**

**7/11/2007**



**Travel times for the following routes:**

| | | |
|---|---|---|
| No. 1 (EB ): from link 156 at 146.7 ft to link 189 at 605.8 ftDistance 12775.8 ft | From K-10 SB offramp to east of Folks on 6th St. |
| No. 2 (WB ): from link 190 at 269.3 ft to link 175 at 1076.7 ftDistance 12734.7 ft | From east of Folks on 6th west to K-10 SB onramp. |
| No. 3 (Folks2GWWS ): from link 190 at 264.0 ft to link 6110002 at 88.0 ftDistance 11352.6 ft | From Folks east of 6th St to GWW at Harvard Rd via 6th St. |
| No. 4 (Folks2GWWN ): from link 190 at 262.9 ft to link 137 at 207.1 ftDistance 10077.4 ft | From Folks east of 6th St to GWW at Overland Dr via 6th St. |
| No. 5 (Folks2GWWOD ): from link 1000125 at 10.8 ft to link 57 at 34.4 ftDistance 8925.3 ft | From Folks east of 6th St to GWW at Overland Dr via Overland Dr. |
| No. 6 (Folks2GWWHV ): from link 1000131 at 11.5 ft to link 6110005 at 298.8 ftDistance 10203.9 | From Folks east of 6th St to GWW at Harvard Rd Dr via Harvard Rd. |
| No. 7 (SGWW2Folks ): from link 6110003 at 49.0 ft to link 189 at 605.7 ftDistance 11276.3 ft | From GWW at Harvard to 6th St east of Folks via 6th St. |
| No. 8 (NGWW2Folks ): from link 133 at 75.6 ft to link 189 at 604.8 ftDistance 10137.4 ft | From GWW at Overland Dr to 6th St east of Folks via 6th St. |
| No. 9 (GWW2FolksOD ): from link 6030024 at 113.0 ft to link 189 at 604.7 ftDistance 9599.6 ft | From GWW at Overland Dr to 6th St east of Folks via Overland Dr. |
| No. 10 (GWW2FolksHV ): from link 6110004 at 23.2 ft to link 189 at 604.7 ftDistance 10637.1 ft | From GWW at Harvard to 6th St east of Folks via Harvard Rd. |

**Existing plus Development and Committed Roadway, Sig K-10**

| | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Trav | #Veh | Trav | #Veh | Trav | #Veh | Trav | #Veh | Trav | #Veh | Trav | #Veh | Trav | #Veh | Trav | #Veh | Trav | #Veh | Trav | #Veh |
| 5:00 - 5:15 | 05:09.44 | 23.6 | 05:26.36 | 40 | 05:12.94 | 6.6 | 03:48.30 | 15 | 0 | 0 | 05:16.38 | 3.2 | 04:30.16 | 6 | 04:14.38 | 12.8 | 05:10.72 | 2.4 | 05:37.58 | 3.8 |
| 5:15 - 5:30 | 05:12.36 | 26.2 | 05:34.08 | 43.8 | 05:08.44 | 10 | 04:06.84 | 15.4 | 0 | 0 | 05:39.42 | 1.5 | 04:22.14 | 4.2 | 03:54.68 | 16.6 | 05:06.88 | 3.8 | 06:00.12 | 5 |
| 5:30 - 5:45 | 05:21.42 | 26.4 | 05:38.08 | 41.8 | 05:07.28 | 8.4 | 04:15.10 | 16.6 | 0 | 0 | 05:46.40 | 1.25 | 04:46.78 | 7.2 | 04:04.98 | 12.6 | 05:20.46 | 4.2 | 05:36.80 | 5.4 |
| 5:45 - 6:00 | 05:11.00 | 26 | 05:35.80 | 40.8 | 05:15.92 | 7.2 | 04:03.58 | 18.4 | 0 | 0 | 05:44.90 | 2 | 04:42.22 | 6 | 04:12.02 | 14.4 | 05:26.23 | 4.5 | 05:32.06 | 3.8 |

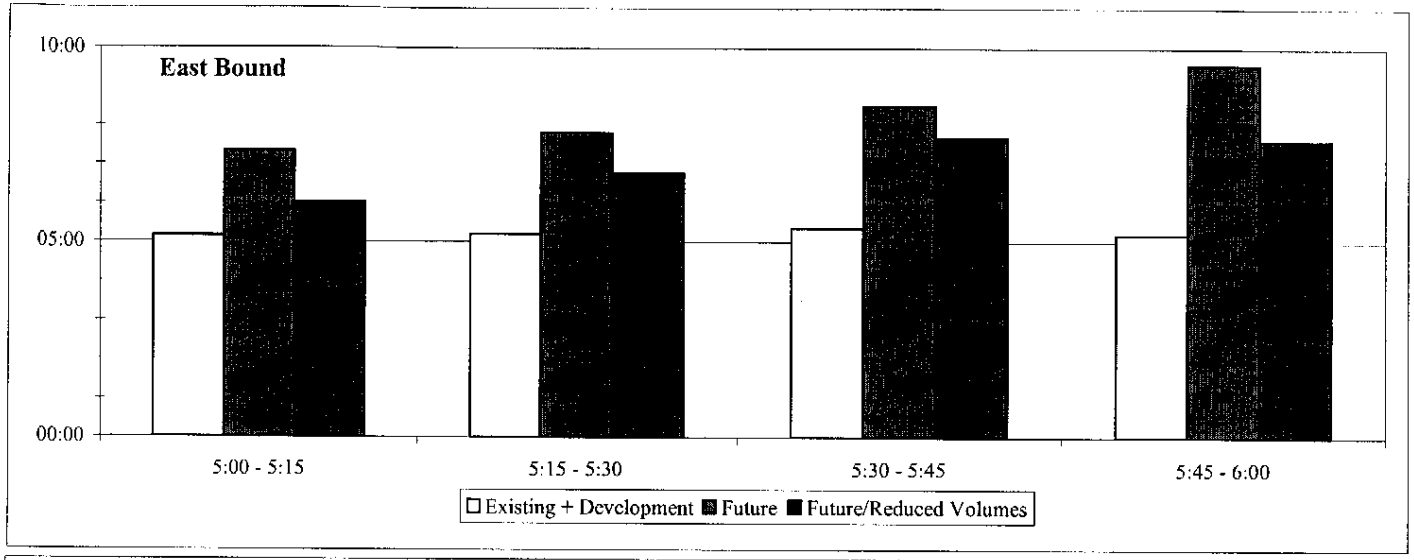
**Future Improved Geometry per Bauer Farms Study and Improved K-10 West Ramp and LTs on 6th**

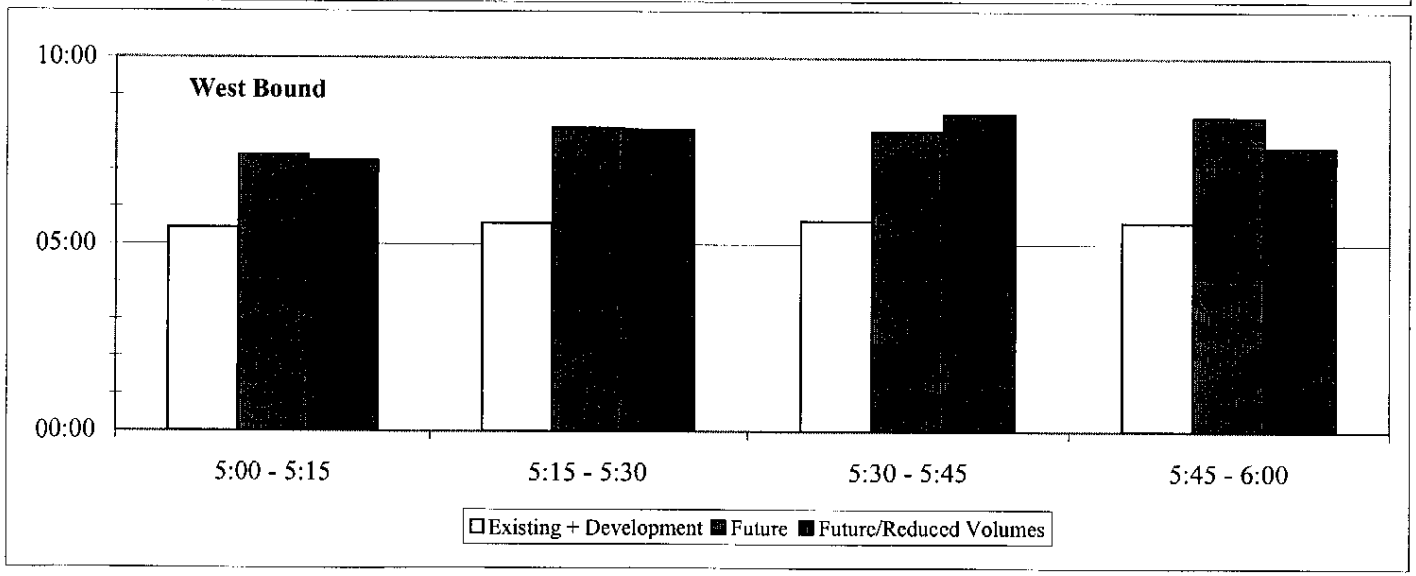
| | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Trav | #Veh | Trav | #Veh | Trav | #Veh | Trav | #Veh | Trav | #Veh | Trav | #Veh | Trav | #Veh | Trav | #Veh | Trav | #Veh | Trav | #Veh |
| 5:00 - 5:15 | 07:19.76 | 17.2 | 07:23.76 | 9.8 | 06:11.14 | 6.2 | 05:22.34 | 21.4 | 04:39.10 | 3.25 | 05:27.62 | 1.25 | 05:23.74 | 4.6 | 04:29.10 | 16.4 | 06:11.52 | 8.4 | 06:01.94 | 4.6 |
| 5:15 - 5:30 | 07:48.58 | 25.6 | 08:07.32 | 12.6 | 06:32.26 | 6.8 | 05:40.88 | 24.8 | 05:00.30 | 6.2 | 06:40.68 | 2.8 | 05:04.24 | 3.6 | 04:49.74 | 14 | 08:03.28 | 9 | 08:13.54 | 5.4 |
| 5:30 - 5:45 | 08:30.08 | 21.8 | 08:02.56 | 8.8 | 06:43.74 | 6.6 | 05:46.18 | 19.8 | 05:47.05 | 4.25 | 06:19.50 | 2.8 | 07:32.15 | 4.75 | 06:18.48 | 17.2 | 09:37.86 | 8 | 07:35.40 | 5 |
| 5:45 - 6:00 | 09:34.84 | 26.8 | 08:25.54 | 7 | 07:10.12 | 4.4 | 05:53.58 | 26.4 | 06:46.24 | 3.6 | 05:46.58 | 2.8 | 07:29.24 | 5.4 | 08:09.80 | 20.6 | 10:35.16 | 11.8 | 09:29.36 | 4.2 |

**Future Improved Geometry per Bauer Farms Study and Improved K-10 West Ramp and LTs on 6th, Reduced Volumes**

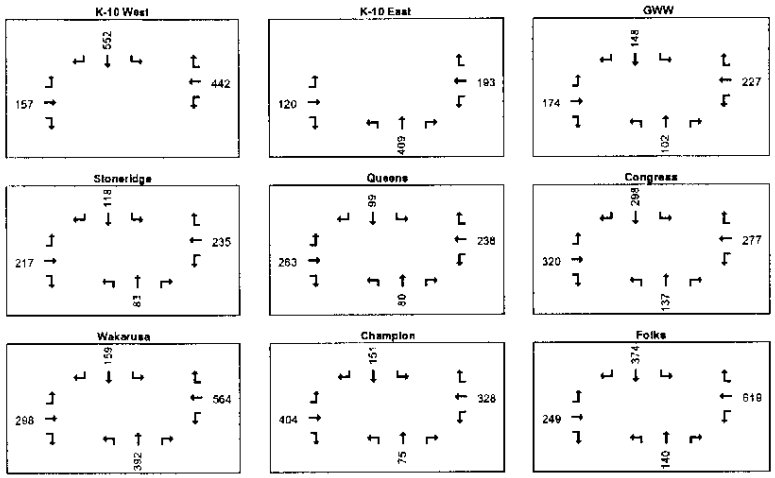
| | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Trav | #Veh | Trav | #Veh | Trav | #Veh | Trav | #Veh | Trav | #Veh | Trav | #Veh | Trav | #Veh | Trav | #Veh | Trav | #Veh | Trav | #Veh |
| 5:00 - 5:15 | 06:00.84 | 18.4 | 07:14.92 | 7.2 | 05:54.60 | 5.6 | 05:02.70 | 20.4 | 04:13.93 | 3 | 05:32.56 | 2.2 | 04:46.28 | 5 | 04:17.32 | 22 | 05:42.02 | 9.2 | 05:47.60 | 4.2 |
| 5:15 - 5:30 | 06:46.78 | 18 | 08:04.66 | 11.2 | 06:33.10 | 8.2 | 05:33.92 | 25 | 04:20.46 | 4.4 | 05:44.34 | 2.2 | 04:39.80 | 2.6 | 04:55.98 | 17.6 | 06:15.30 | 10.6 | 07:43.50 | 6.8 |
| 5:30 - 5:45 | 07:41.14 | 17.8 | 08:30.34 | 8.8 | 06:40.96 | 9.4 | 05:39.12 | 22.6 | 04:11.18 | 4.8 | 06:26.66 | 2.4 | 05:32.90 | 6 | 05:36.04 | 20.6 | 07:07.48 | 9.8 | 07:35.28 | 5.6 |
| 5:45 - 6:00 | 07:36.96 | 18.4 | 07:37.22 | 10.2 | 06:45.34 | 6 | 05:35.28 | 25.4 | 04:44.18 | 4 | 06:01.75 | 4 | 06:02.86 | 5.4 | 05:42.46 | 18.2 | 07:38.96 | 7.2 | 07:34.70 | 4.2 |

Travel times along 6th Street from K-10 to Folks.

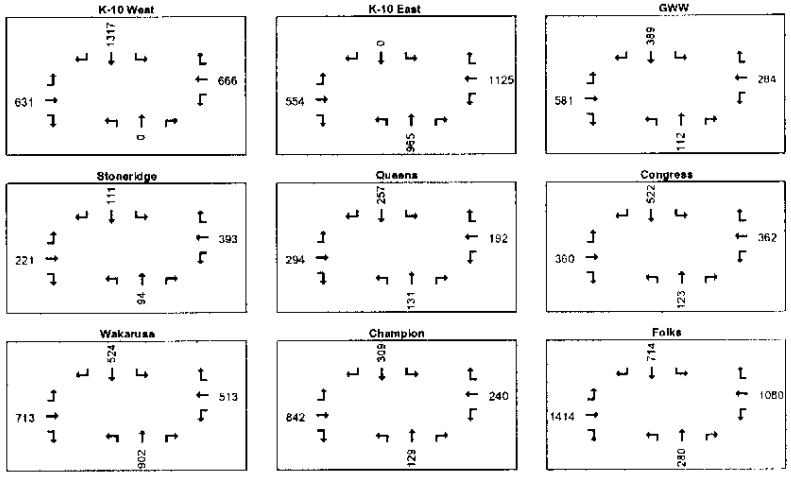


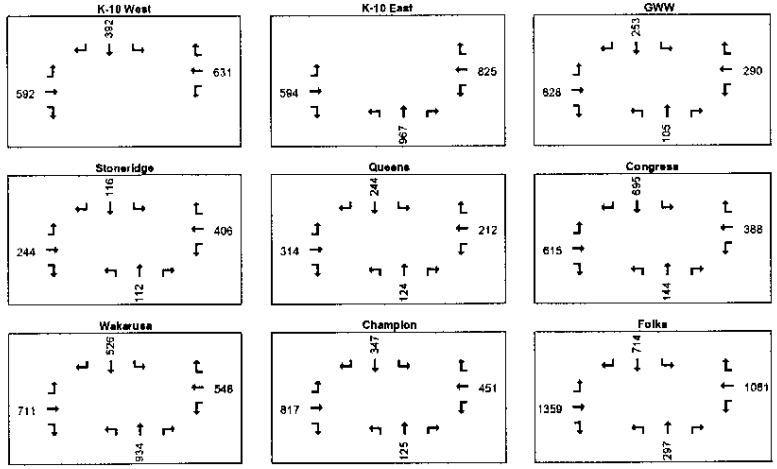
Averaged Max Queue Length in feet over 5 Runs Along 6th Street, Existing plus Development Volumes



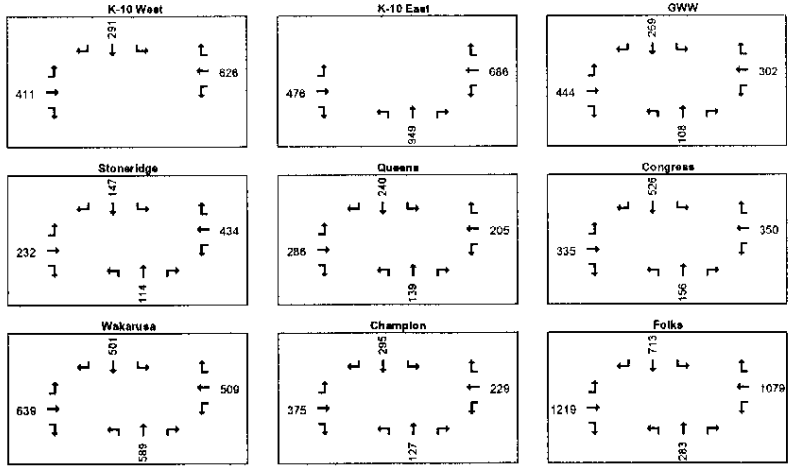

Averaged Max Queue Length in feet over 5 Runs Along 6th Street, Future Improved with Bauer Farms Improvements



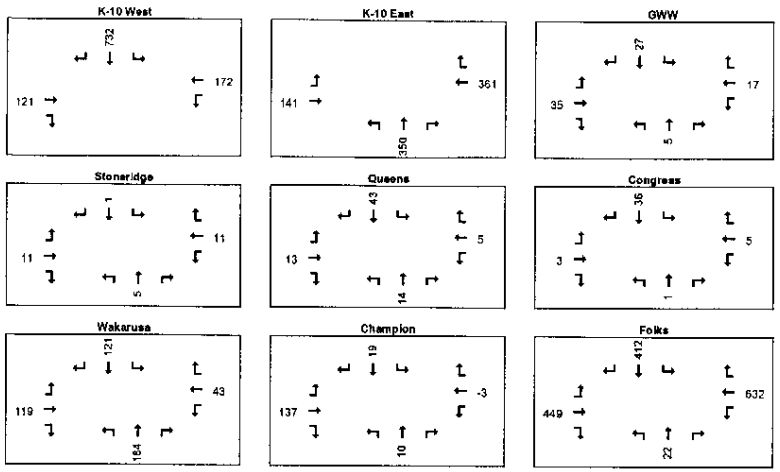

Averaged Max Queue Length in feet over 5 Runs Along 6th Street, Future Improved Bauer and K-10



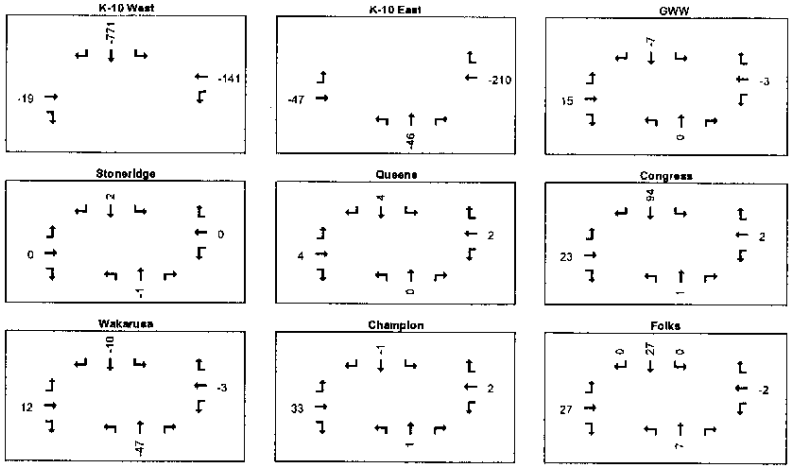

Averaged Max Queue Length in feet over 5 Runs Along 6th Street, Future Improved with Reduced Volumes



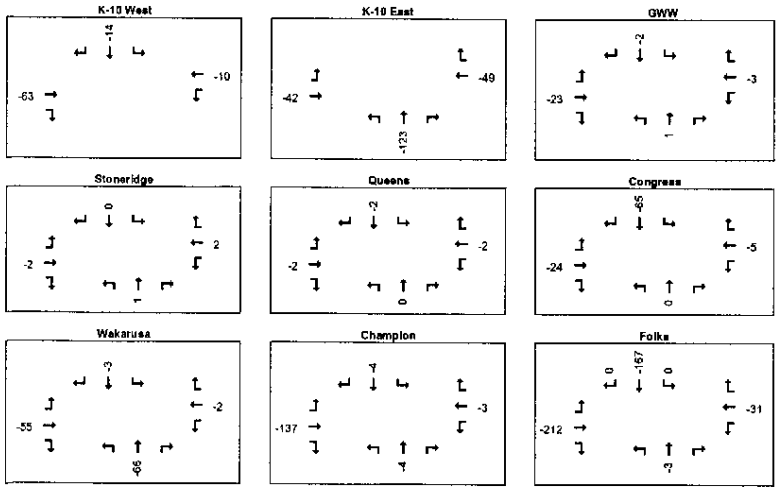
Added Max Queue Length in feet over 5 Runs Along 6th Street, Future Improved Bauer Farms - ExistDev



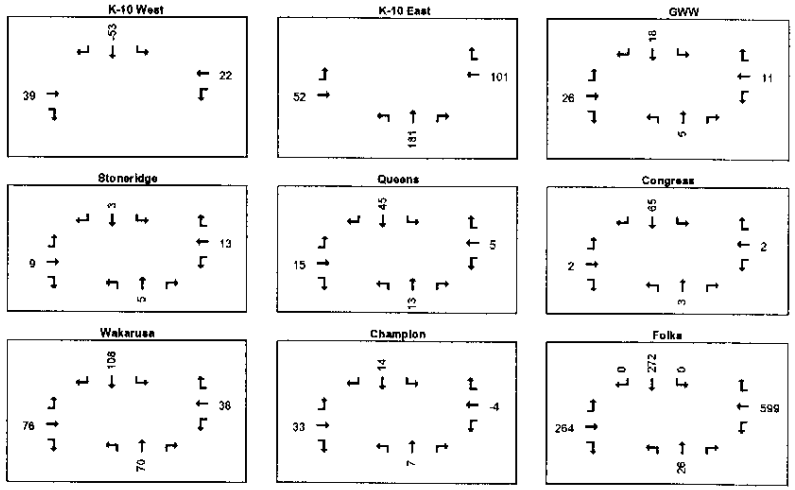

Lost Max Queue Length In feet over 5 Runs Along 6th Street, Future Improved Bauer and K-10 - Future Improved Bauer



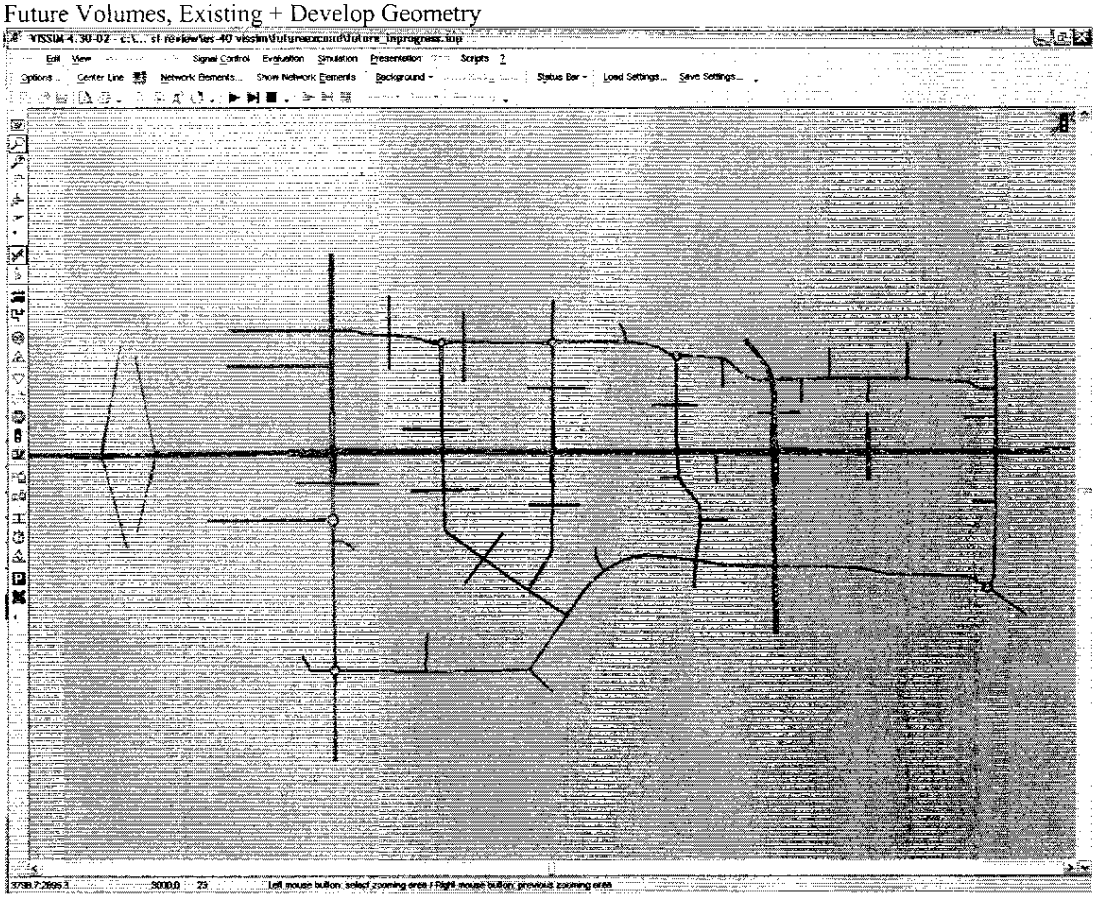

Lost Max Queue Length In feet over 5 Runs Along 6th Street, Future Reduced - Future Improved Bauer and K-10



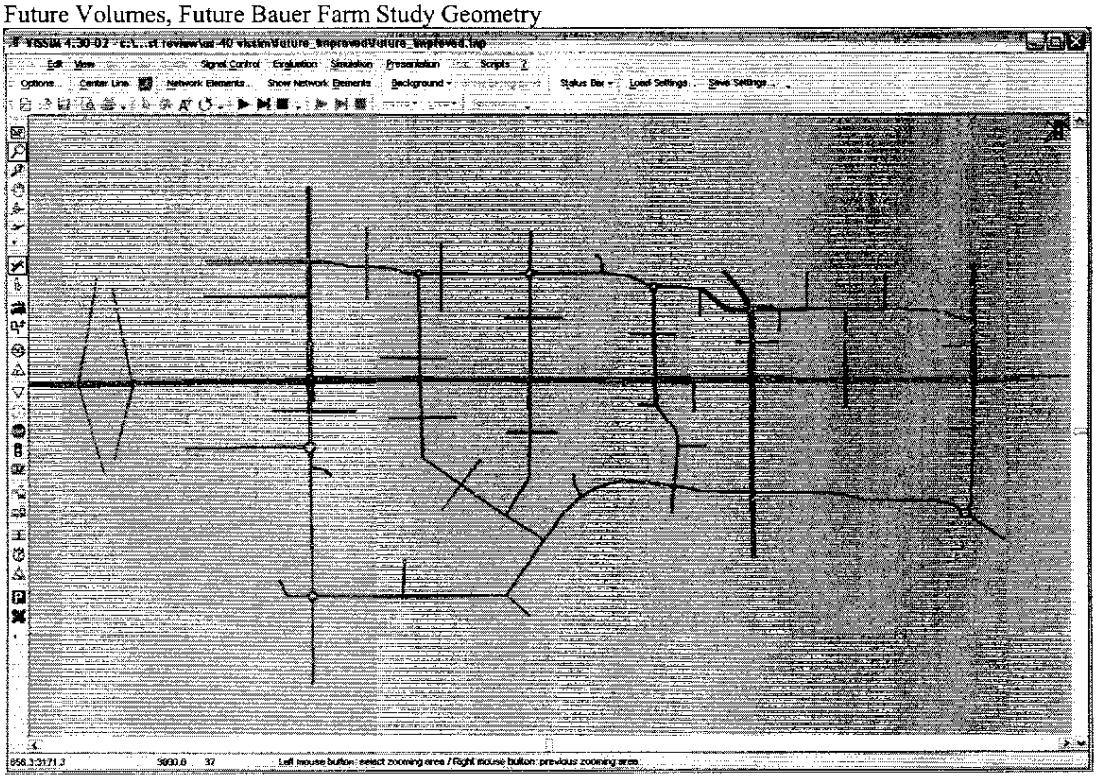

Added Max Queue Length In feet over 5 Runs Along 6th Street, Future Reduced - Existing + Development



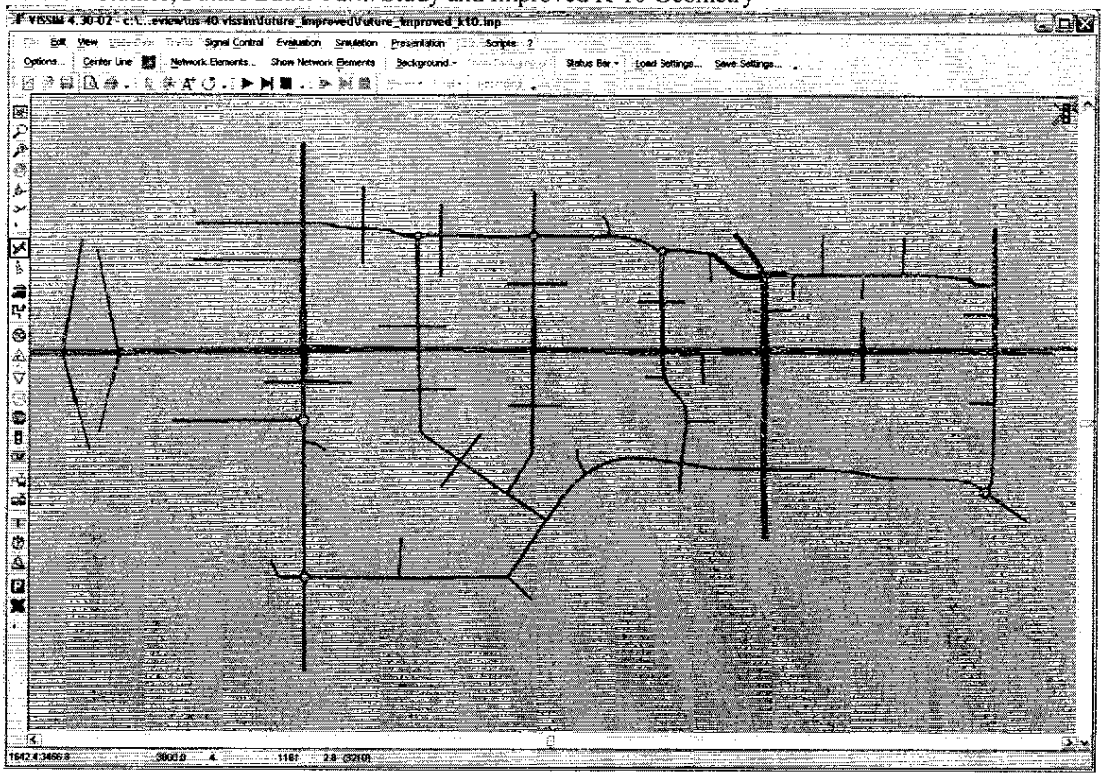
Future Volumes, Existing + Develop Geometry



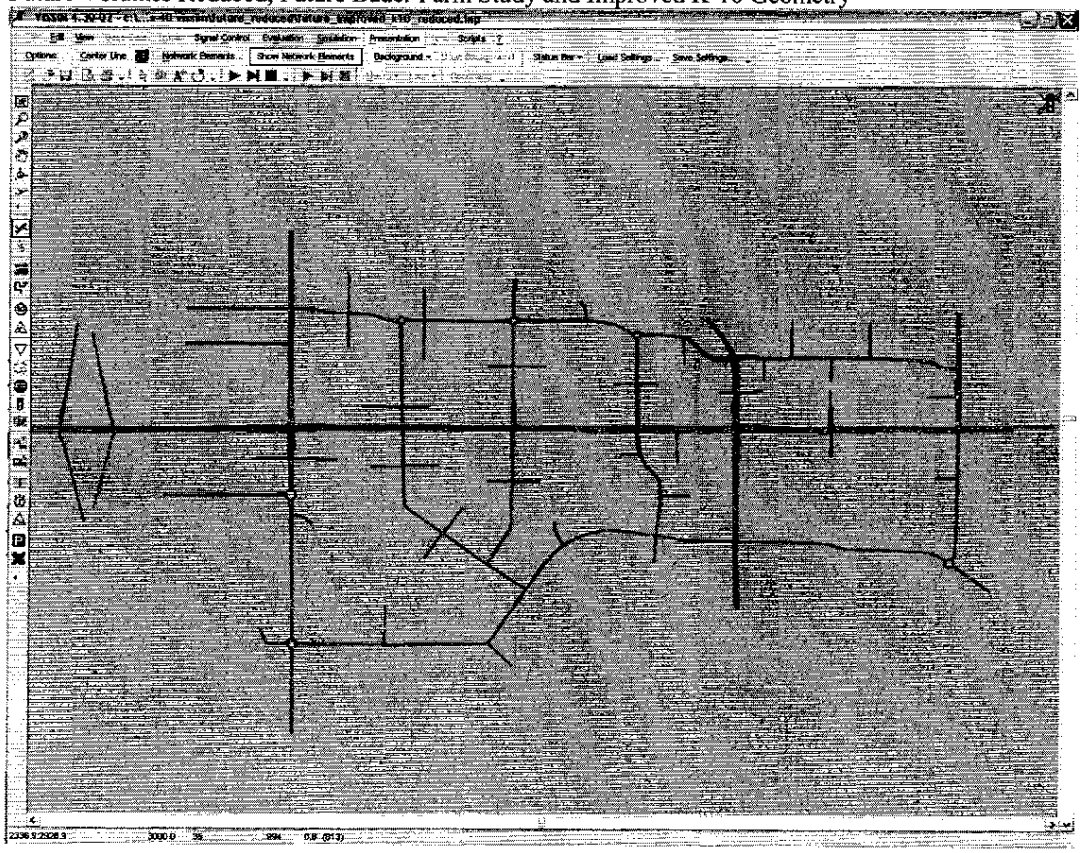
Future Volumes, Future Bauer Farm Study Geometry



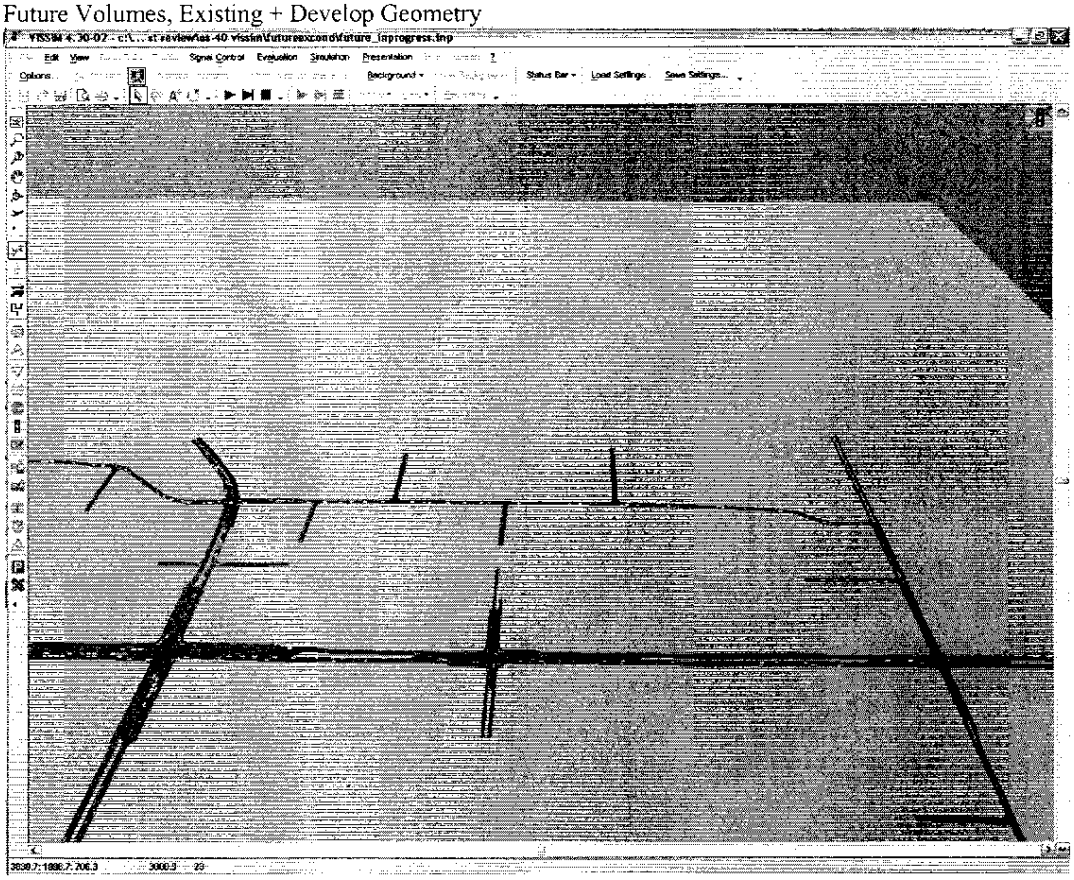
Future Volumes, Future Bauer Farm Study and Improved K-10 Geometry



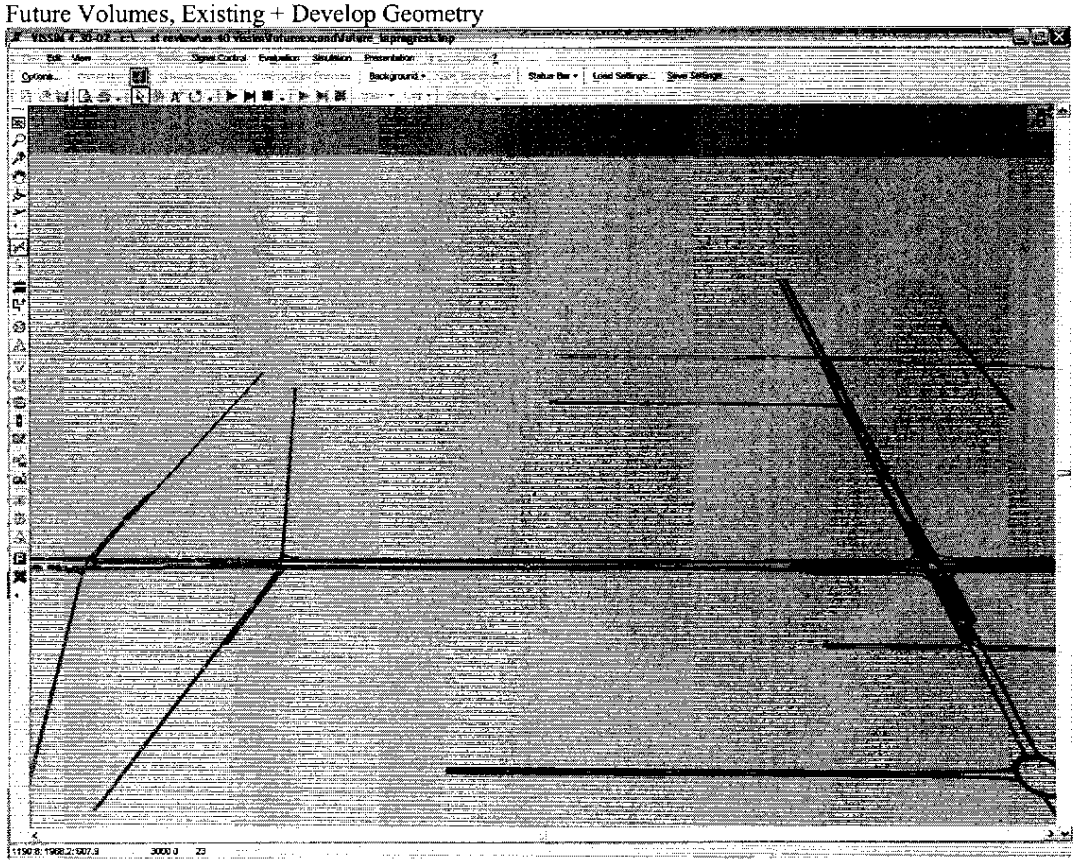
Future Volumes Reduced, Future Bauer Farm Study and Improved K-10 Geometry



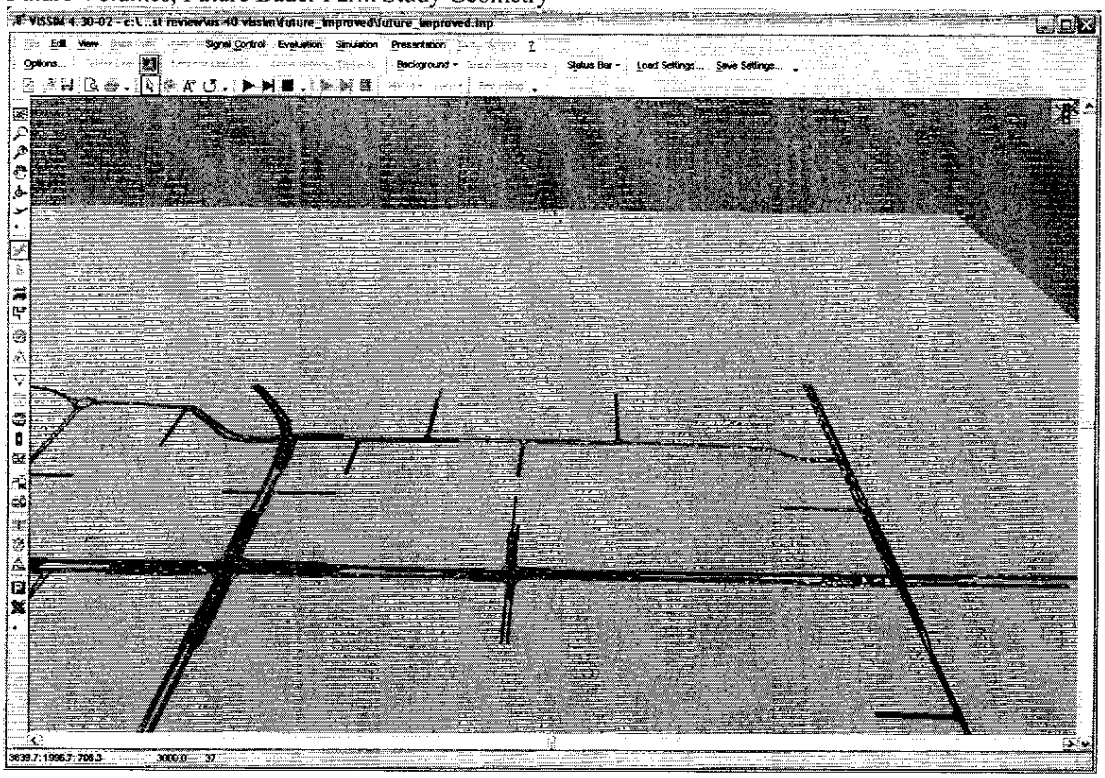
Future Volumes, Existing + Develop Geometry



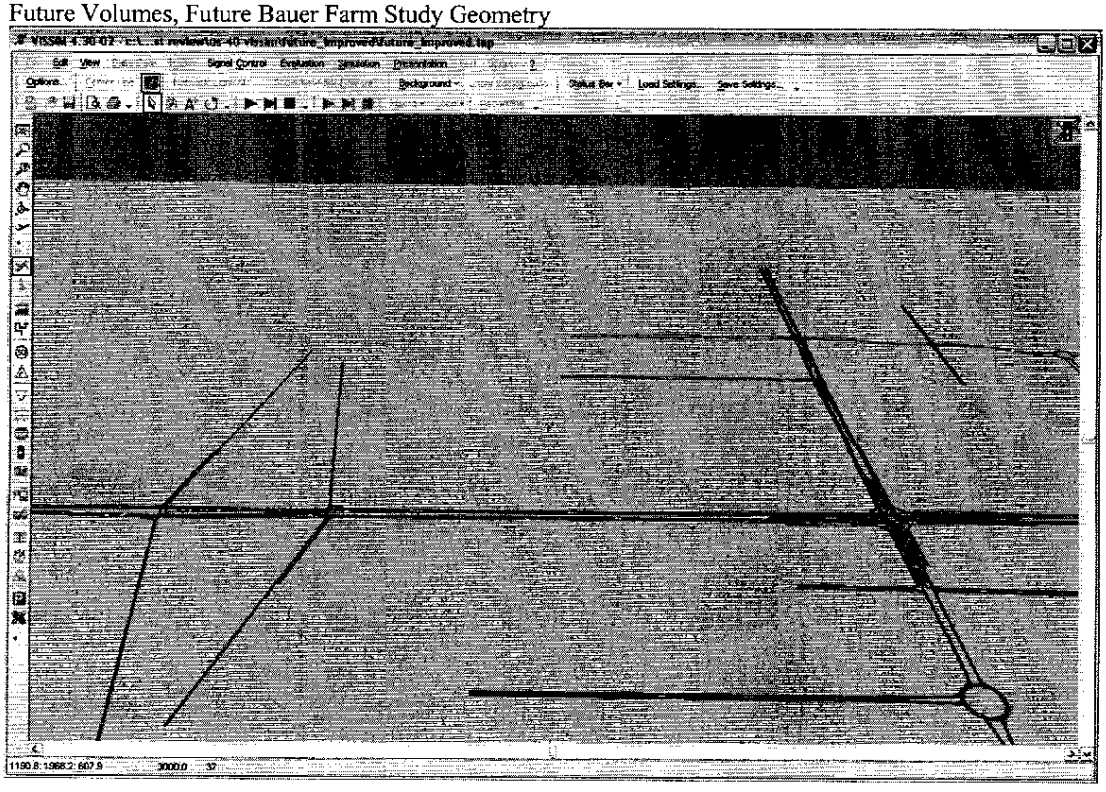
Future Volumes, Existing + Develop Geometry



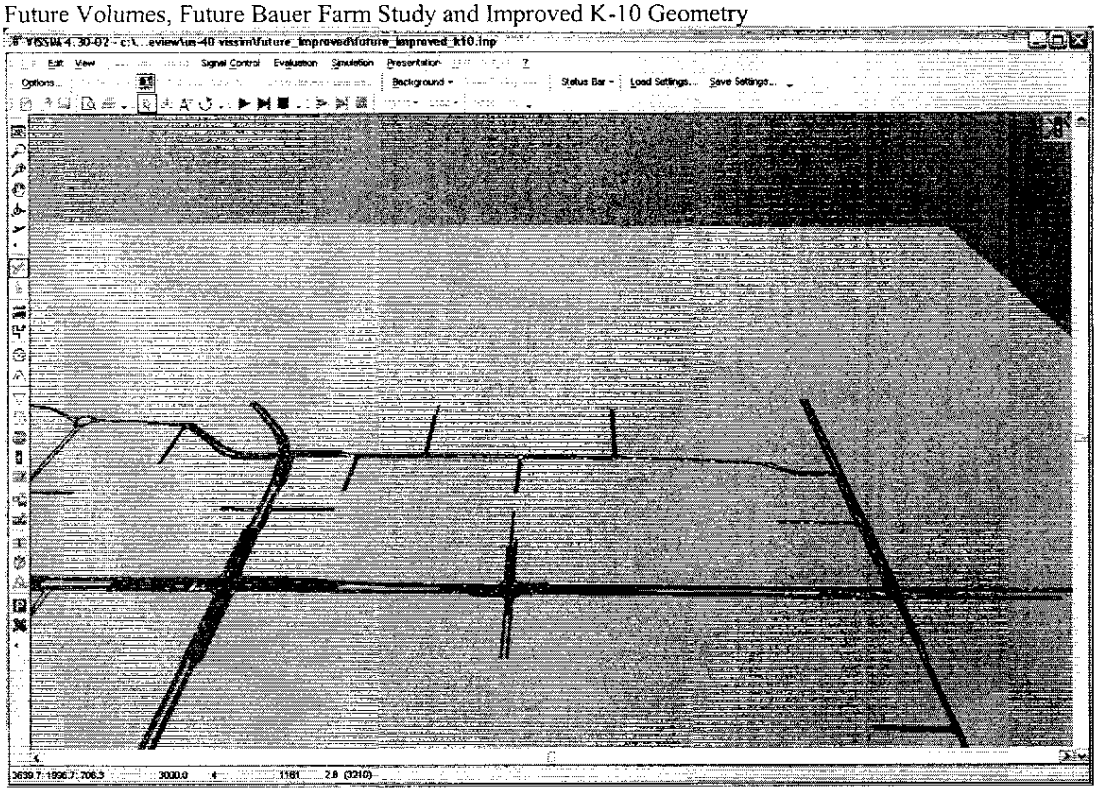
Future Volumes, Future Bauer Farm Study Geometry



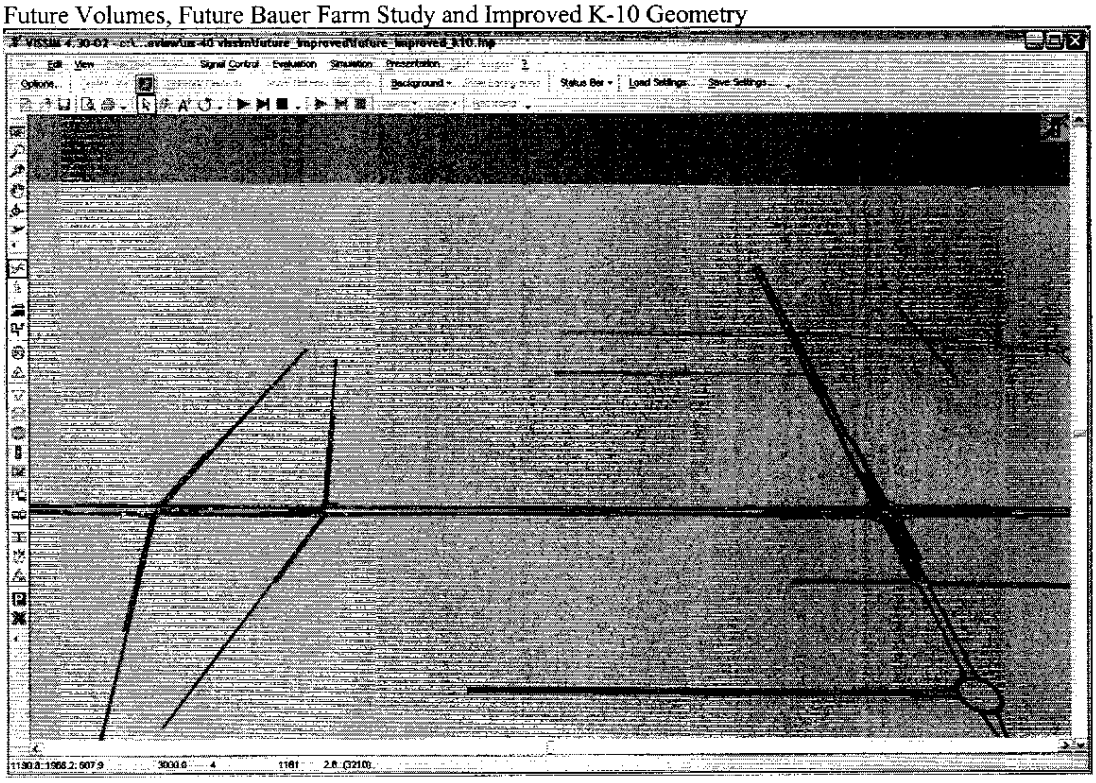
Future Volumes, Future Bauer Farm Study Geometry



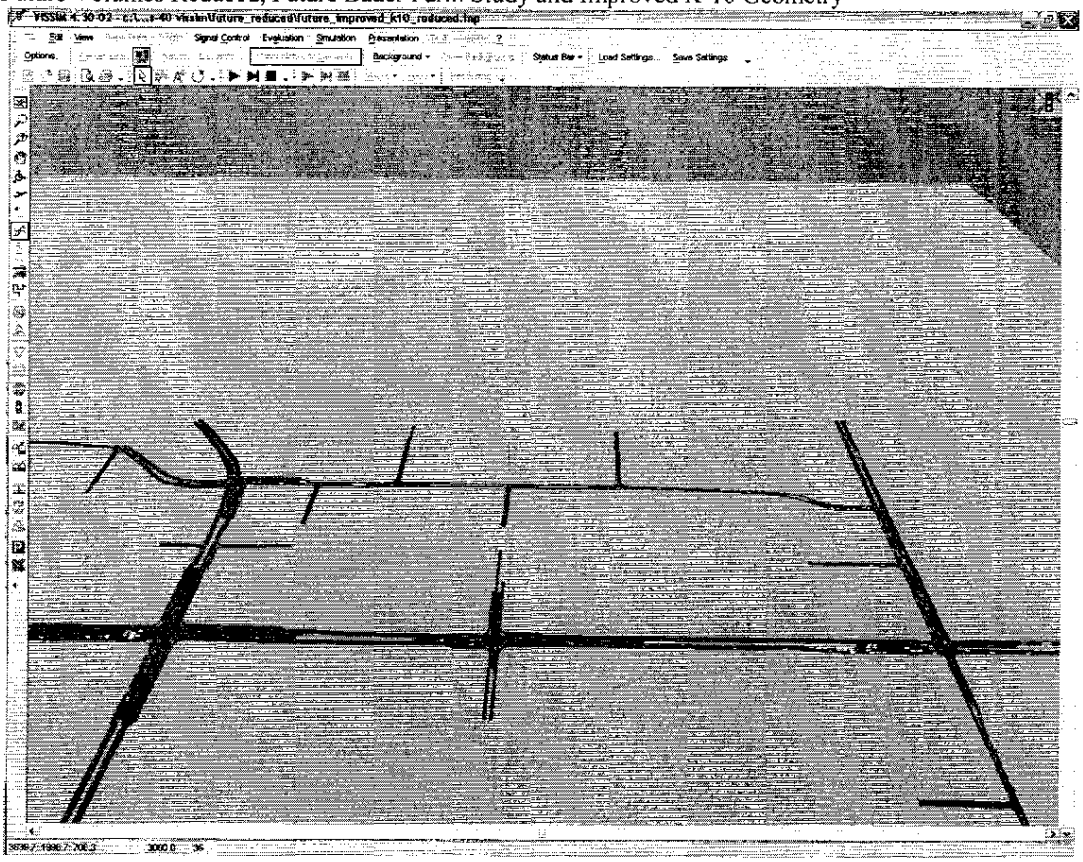
Future Volumes, Future Bauer Farm Study and Improved K-10 Geometry



Future Volumes, Future Bauer Farm Study and Improved K-10 Geometry



Future Volumes Reduced, Future Bauer Farm Study and Improved K-10 Geometry



Future Volumes Reduced, Future Bauer Farm Study and Improved K-10 Geometry