ORIGINAL TO GENERAL FILES

D.O.T. 66

DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA

INTERDEPARTMENT CORRESPONDENCE

FILE P. I. No. 0007402, Chatham County
CSSTP-0007-00(402)
Widening and Reconstruction of Gwinnett Street

OFFICE Preconstruction

DATE June 1, 2006

FROM for Margaret B. Pirkle, P.E., Assistant Director of Preconstruction

TO SEE DISTRIBUTION

SUBJECT APPROVED PROJECT CONCEPT REPORT

Attached for your files is the approval for subject project.

MBP/cj

Attachment

DISTRIBUTION:

Brian Summers
Harvey Keepler
Ken Thompson
Jamie Simpson
Michael Henry
Keith Golden
Joe Palladi (file copy)
Paul Liles
Babs Abubakari
Glenn Durrence
BOARD MEMBER

D.O.T. 66

DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA

INTERDEPARTMENT CORRESPONDENCE

FILE: P. I. No. 0007402, Chatham County
CSSTP-0007-00(402)
Widening and Reconstruction of Gwinnett Street

OFFICE Preconstruction

DATE May 16, 2006

FROM Margaret B. Pirkle, P.E., Assistant Director of Preconstruction

TO David E. Studstill, Jr., P.E., Chief Engineer

SUBJECT PROJECT CONCEPT REPORT

This project is the widening and reconstruction of 0.4 miles of Gwinnett Street in the city of Savannah. The project begins 375' west of Stiles Avenue and continues east to I-16/West Boundary Street. Gwinnett Street is a minor urban arterial facilitating the movement of east-west traffic between residential portions of West Savannah and Garden City to the west and Savannah's downtown and historic district to the east. The city of Savannah is currently planning significant development on several large tracts of land located adjacent to Gwinnett Street between Stiles Avenue and I-16/West Boundary Street. The 50 acre development will include a new city office complex, a 12,000 seat arena, a 7,500 seat baseball stadium, a 4,000 seat amphitheater, a 250 room hotel complex, several parking lots, and a 750 space parking deck. The purpose of this project is to improve the capacity of Gwinnett Street to accommodate the expected increase in traffic associated with the planned development.

The proposed construction will consist of adding two additional lanes and a 20' raised median. The widening will be accomplished on the south side of the existing lanes. The section will include 30" curb and gutter and 5' sidewalks on both sides of the road separated from the curb by a 2' grass strip. The project will also include the replacement of an existing 32' bridge over the Springfield Canal with a new wider bridge to accommodate the new lanes. Traffic will be maintained during construction.

Environmental concerns include requiring a Categorical Exclusion be prepared; a public hearing open house is required; time saving procedures are not appropriate.

The estimated costs for this project are:

	PROPOSED	APPROVED	FUNDING	PROG DATE
Construction (includes E&C and inflation)	$2,926,000	$1,326,000	L230	2008
Right-of-Way & Utilities*	Local	Local		

P. I. No. 0007402, Chatham
May 16, 2006

*The city of Savannah signed PMA for PE and utilities; construction and right-of-way to be done by future agreements.

I recommend this project concept be approved.

MBP:JDQ/cj

Attachment

CONCUR _____
Buddy Gratton, P.E., Director of Preconstruction

APPROVE _____
David E. Studstill, Jr., P.E., Chief Engineer

NOTICE OF LOCATION AND DESIGN APPROVAL

Project No. CSSTP-0007-00(402)
P. I. NUMBER 0007402

Notice is hereby given in compliance with Georgia Code 22-2-109 that the Georgia Department of Transportation has approved the Location and Design of this project.

Date of Location Approval: **June 1, 2006**

The project consists of widening and improvements of Gwinnett Street, located in Chatham County, Savannah, GA. The proposed construction will consist of adding two additional lanes and a 20 ft. raised median. The project will include curb and gutter with sidewalks on both sides of the roadway with 2 ft. grass strip separations. The project will also include the replacement of an existing bridge over Springfield Canal with a wider bridge structure to accommodate the new lanes.

Drawings or maps or plats of the proposed project, as approved, are on file and are available for public inspection at the Georgia Department of Transportation:

Donnie Williams
GDOT
Donnie.Williams@dot.state.ga.us
630 West Boundary Street
Savannah GA 31402
Phone: 912-651-2144

Any interested party may obtain a copy of the drawings or maps or plats or portions thereof by paying a nominal fee and requesting in writing to:

Tony Collins
GDOT
Tony.Collins@dot.state.ga.us
P.O. Box 610
Jesup GA 31598
Phone: 912-427-5715

Any written request or communication in reference to this project or notice SHOULD include the Project and P. I. Numbers as noted at the top of this notice.

DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA

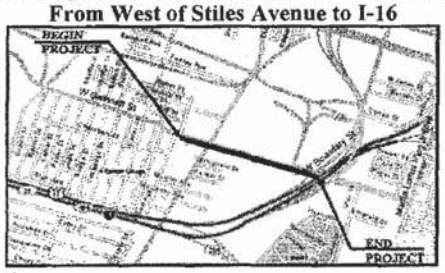
~~Office of Road and Airport Design~~
DISTRICT 5

Project Concept Report

Project Number: CSSTP-0007-00(402)
County: Chatham
P. I. Number: 0007402

Federal Route Number: N/A State Route Number: N/A

Widening and Reconstruction of Gwinnett Street
From West of Stiles Avenue to I-16



Recommendation for approval:

DATE 5/9/06 _____
Project Manager

DATE _____ _____
~~State Road & Airport Design Engineer~~

The concept as presented herein and submitted for approval is consistent with that which is included in the Regional Transportation Program (RTP) and the State Transportation Improvement Program (STIP).

DATE _____ _____
State Transportation Planning Administrator

DATE _____ _____
State Financial Management Administrator

DATE _____ _____
State Environmental/Location Engineer

DATE _____ _____
State Traffic Safety and Design Engineer

DATE 5/9/06 _____
District Engineer

DATE _____ _____
Project Review Engineer

DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA

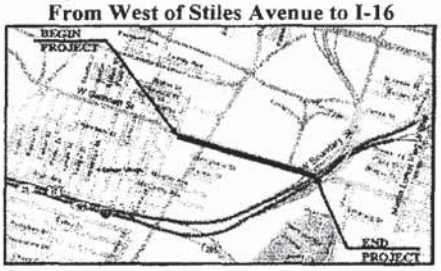
~~Office of Road and Airport Design~~
DISTRICT 5

Project Concept Report

Project Number: CSSTP-0007-00(402)
County: Chatham
P. I. Number: 0007402

Federal Route Number: N/A State Route Number: N/A

Widening and Reconstruction of Gwinnett Street
From West of Stiles Avenue to I-16



Recommendation for approval:

DATE 5/9/06 _____
Project Manager

DATE _____ _____
~~State Road & Airport Design Engineer~~

The concept as presented herein and submitted for approval is consistent with that which is included in the Regional Transportation Program (RTP) and the State Transportation Improvement Program (STIP).

DATE 5/16/06 _____
State Transportation Planning Administrator

DATE _____ _____
State Financial Management Administrator

DATE _____ _____
State Environmental/Location Engineer

DATE _____ _____
State Traffic Safety and Design Engineer

DATE 5/9/06 _____
District Engineer

DATE _____ _____
Project Review Engineer

DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA

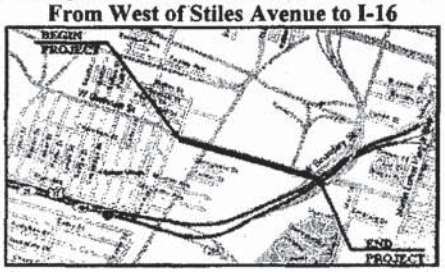
~~Office of Road and Airport Design~~
DISTRICT 5

Project Concept Report

Project Number: CSSTP-0007-00(402)
County: Chatham
P. I. Number: 0007402

Federal Route Number: N/A State Route Number: N/A

Widening and Reconstruction of Gwinnett Street
From West of Stiles Avenue to I-16



Recommendation for approval:

DATE 5/9/06 _____
Project Manager

DATE _____ _____
~~State Road & Airport Design Engineer~~

The concept as presented herein and submitted for approval is consistent with that which is included in the Regional Transportation Program (RTP) and the State Transportation Improvement Program (STIP).

DATE _____ _____
State Transportation Planning Administrator

DATE 5-12-06 _____
State Financial Management Administrator

DATE _____ _____
State Environmental/Location Engineer

DATE _____ _____
State Traffic Safety and Design Engineer

DATE 5/9/06 _____
District Engineer

DATE _____ _____
Project Review Engineer

DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA

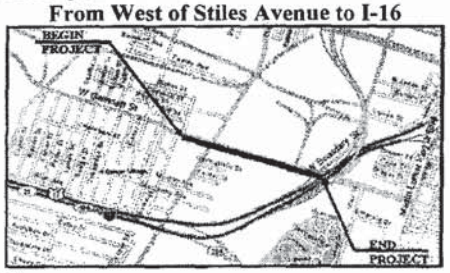
~~Office of Road and Airport Design~~
DISTRICT 5

Project Concept Report

Project Number: CSSTP-0007-00(402)
County: Chatham
P. I. Number: 0007402

Federal Route Number: N/A State Route Number: N/A

Widening and Reconstruction of Gwinnett Street
From West of Stiles Avenue to I-16



Recommendation for approval:

DATE 5/9/06 _____
Project Manager

DATE _____ _____
~~State Road & Airport Design Engineer~~

The concept as presented herein and submitted for approval is consistent with that which is included in the Regional Transportation Program (RTP) and the State Transportation Improvement Program (STIP).

DATE _____ _____
State Transportation Planning Administrator

DATE _____ _____
State Financial Management Administrator

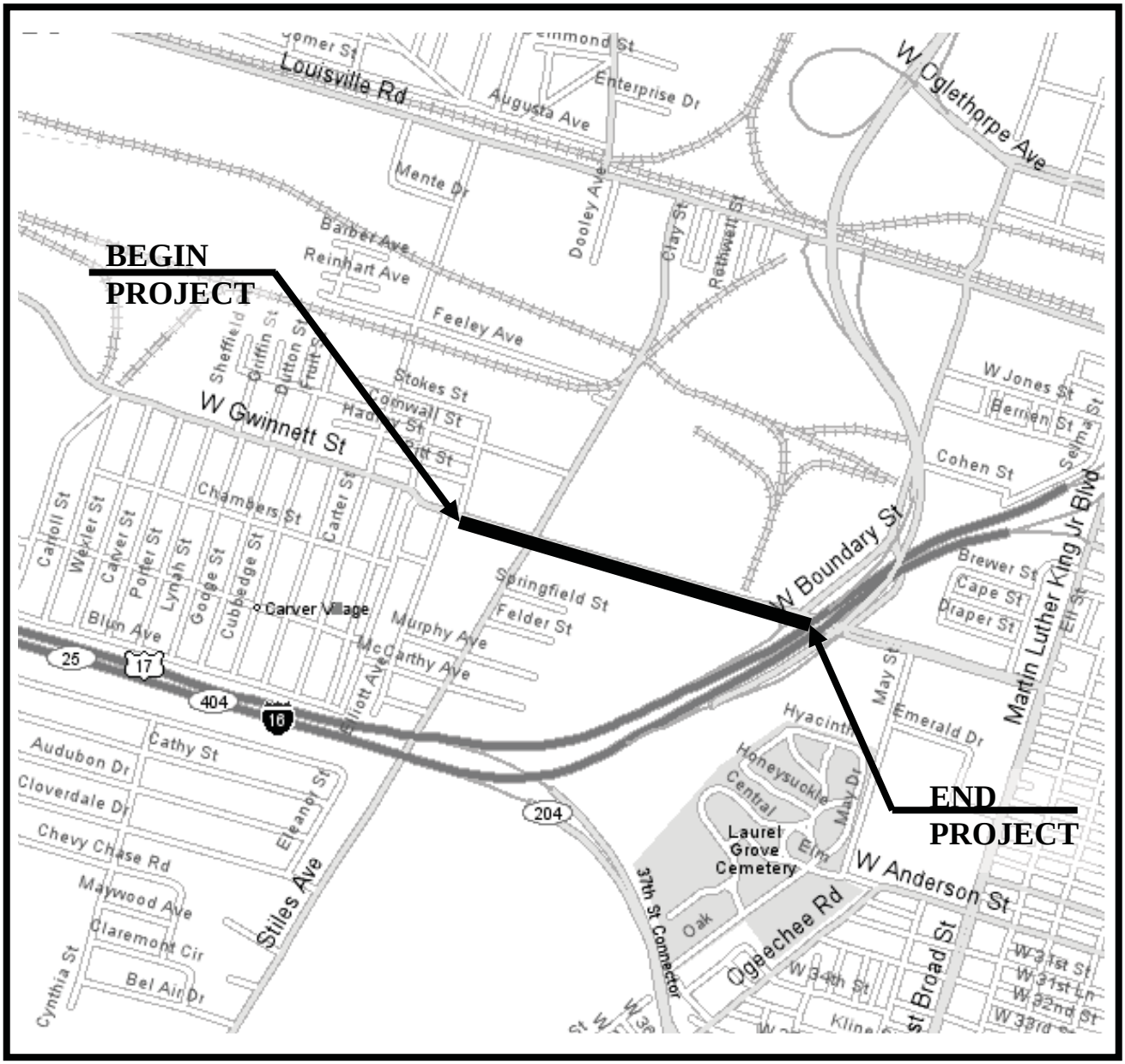
DATE _____ _____
State Environmental/Location Engineer

DATE 5-22-06 _____
State Traffic Safety and Design Engineer

DATE 5/9/06 _____
District Engineer

DATE _____ _____
Project Review Engineer

PROJECT LOCATION MAP
NTS



Purpose and Need:

Gwinnett Street is a minor urban arterial facilitating the movement of east-west traffic between residential portions of West Savannah and Garden City to the west and Savannah's downtown and Historic District to the east. The street also provides access between downtown and the City Lot located on the north side of Gwinnett Street at Stiles Avenue. The City of Savannah is currently planning significant development on several large tracts of land located adjacent to Gwinnett Street between Stiles Avenue and Interstate 16/West Boundary Street. Major improvements for vehicular access to this area will be required to accommodate this development including improvement of the 0.40 mile section of Gwinnett Street between the two aforementioned intersections.

The proposed Westside Master Plan Development is to be located along both the north and south sides of Gwinnett Street between Stiles Avenue and Interstate 16/West Boundary Street. The 50 acre development will include a new City office complex, a 12,000 seat arena, a 7500 seat baseball stadium, a 4000 seat amphitheater, a 2800 seat theater, a 250 room hotel complex featuring two restaurants, meeting rooms, a ballroom, several parking lots and a 750 space parking deck.

The purpose of the project is to improve the capacity of Gwinnett Street to accommodate the expected increase in traffic associated with the planned development. This will be accomplished by replacing the current two lane road with a four lane road featuring a raised median, curb and gutter and sidewalks. Improvements to both the Stiles Avenue and Interstate16 intersections will also be involved.

In addition to the primary purpose noted above, the project has the secondary purpose of meeting the need to avoid flooding and loss of access on the roadway. Currently, the roadway elevations near the middle of the project to the east of the Springfield Canal crossing are low. During large rainfall events the out of bank flow from the canal will cover portions of the road, blocking the east-west traffic movement. The proposed project will increase the capacity of the Springfield Canal crossing and raise the roadway elevations so that overtopping and loss of access will be a thing of the past.

Gwinnett Street continues to the west of Stiles Avenue as a two-lane section through a residential area. Beginning at Interstate 16 and continuing east to Martin Luther King, Jr. Boulevard, Gwinnett Street consists of four lanes, including two eastbound and two westbound lanes separated by a raised median. The current project will essentially extend the western terminus of the four-lane section from Interstate 16 to Stiles Avenue. Convenient access to the planned facilities will be provided by Interstate 16, West Boundary Street, and Martin Luther King, Jr. Boulevard to the east. Due to the lack of similar convenient access points east of Stiles Avenue, it is expected that a great majority of the traffic increases will utilize Gwinnett Street between Stiles Avenue and Interstate 16 with relatively small increases on Gwinnett Street west of Stiles Avenue. Existing traffic patterns support this assumption, as Stiles Avenue and the City Lot currently represent the westernmost significant traffic generators.

According to the 2005 Traffic Study performed for this project and included with this report, Georgia Department of Transportation (GaDOT) data give an average daily traffic volume for 2002 on Gwinnett Street of 8518 vehicles per day along the project corridor. The traffic report includes estimates of the additional traffic that will be generated by the proposed development. Assuming that the development will be complete in 2008, the report projects an average daily traffic volume of 17,820 vehicles in the 2008 base year and 18,270 in the 2028 design year. These figures represent a doubling of the current volumes and are based on expected daily traffic, not the larger traffic loadings associated with a major event.

Gwinnett Street's primary purpose will be to facilitate access to the proposed development. The street will continue to provide access to downtown and the Historic District for residential areas further to the west. There is only a minimal truck presence; most of these are the smaller panel and delivery type trucks, not full size over the road trucks. The percentage of trucks on this project for both current and future years is assumed to be less than 1% of the average daily traffic volumes.

Level of Service (LOS) is used as a general qualitative measure of how adequate a particular roadway or intersection configuration performs in handling a given traffic load. Level of Service varies from the least impeded conditions for traffic with an LOS of A to conditions where cars experience unacceptable delays with an LOS of F. An in-depth discussion of the Level of Service concept and its potential impacts on the project can be found in the 2005 Traffic Study for the project and included with this report. Under current year conditions, Gwinnett Street operates at an arterial LOS A for westbound traffic and LOS B for eastbound traffic under normal conditions. With the improvements in place, Gwinnett Street is expected to operate at LOS B for westbound traffic and LOS C for eastbound traffic under normal conditions in the design year. During major "sell-out" events, the arterial is expected to operate at LOS C for westbound traffic and LOS E for eastbound traffic.

The widening project will provide adequate access to the proposed development while improving safety along the project corridor through separation of traffic, signalization of the Stiles Avenue intersection, and the provision of sidewalks for pedestrians.

Description of the proposed project:

The proposed project involves widening 0.40 miles of Gwinnett Street in the City of Savannah. The project begins approximately 375 feet west of the Stiles Avenue intersection where the existing two-lane section is to be reconfigured with longer taper lengths to match the proposed four-lane section to be constructed east of Stiles. Beginning at Stiles Avenue and continuing eastward to the intersection with Interstate 16/West Boundary Street, a four lane divided roadway section is to be constructed. The eastern project terminus will tie to the existing four lane divided configuration at the foot of the Interstate 16 southbound ramps.

The existing roadway consists of two 12-foot lanes; one in each direction with curb and gutter and a sidewalk on the south side or the roadway.

The improvements consist of adding two additional lanes and a 20' raised grass median. The widening will be accomplished to the south of the existing lanes. The section will include 30-inch curb and gutter and 5-foot sidewalks on both sides of the road separated from the curb by a 2-foot grass strip. The project will also include the replacement of an existing 32-foot bridge over the Springfield Canal with a new wider bridge that will accommodate the new section including sidewalks. The length and height of the new bridge will need to be determined by performing a hydraulic bridge study and by considering the City's plans for the Canal in relation to this development. This will assure that the new bridge will provide adequate drainage capacity for the flows in the Springfield Canal. A plan view of the proposed improvements can be found on the exhibits accompanying this report and will also include the following:

- A 150-foot left turn lane for the westbound approach to Stiles Avenue.
- A median opening at the entrance to the City Lot located 400 feet east of the Stiles Avenue Intersection and including a 100-foot left turn bay for the eastbound approach. This drive and the associated median opening will be large enough to handle the large City vehicles which currently use the drive as well as the traffic which will be generated by the future redevelopment.
- A median opening for the main entrance to the proposed development on the north side of Gwinnett Street located 400 feet west of the of the southbound Interstate 16 ramps and including a 200-foot left turn bay for the eastbound approach and both a 150-foot right turn lane and a 150-foot left turn bay for the westbound approach.
- Installation of a new traffic signal at the Stiles Avenue Intersection

Is the project located in a Non-attainment area? _____ **Yes** __X__ **No**

PDP Classification: Major_____ Minor __X__
Federal Oversight: Full Oversight ( ), Exempt(X), State Funded( ), or Other ( )

Functional Classification: Major Collector

U. S. Route Number(s): N/A **State Route Number(s):** N/A

Traffic (AADT):
Current Year: (2008) 17,820 Design Year: (2028) 18,270

Existing design features:

- Typical Section: two twelve-foot lanes with 24-inch curb and gutter. A five-foot sidewalk is provided on the south side of the street separated from the curb by a two foot grass strip.
- Posted speed 35 mph Maximum degree of curvature: N/A
- Maximum super-elevation rate for curve: N/A
- Maximum grade Mainline: 2.4% Maximum grade Side Street: N/A
- Width of right of way: 40 to 83 ft.
- Major structures: Single Bridge (over the Springfield Canal)
- Major interchanges or intersections along the project: Stiles Avenue and Interstate 16 / West Boundary Street
- Existing length of roadway segment and the beginning mile logs for each county segment: 0.4 miles, located entirely in the City of Savannah in Chatham County

Proposed Design Features:

- Proposed typical section: Four twelve-foot lanes with twenty-foot raised median and occasional auxiliary left turn / right turn lanes. Twelve foot shoulders which include thirty-inch curb and gutter and five foot sidewalks separated from the back of the curb by a two-foot grass strip.

- Proposed Design Speed Mainline 35 mph

- Proposed Maximum grade Mainline 3 % Maximum grade allowable 5 %

- Proposed Maximum grade Side Street 3 % Maximum grade allowable 5 %

- Proposed Minimum radius for curve 5000 ft

- Proposed Maximum super-elevation rate for curve: None

- Right of way
  - Width 115 to 140 ft.
  - Easements: Temporary (X), Permanent ( ), Utility ( ), Other ( ).
  - Type of access control: Full ( ), Partial ( ), By Permit (X), Other ( ).
  - Number of parcels: 16 Number of displacements:
    - Business: 0
    - Residences: 0
    - Mobile homes: 0
    - Other: 0

- Structures: Replacement of existing bridge over Springfield Canal

- Major intersections and interchanges: Stiles Avenue, Interstate 16/West Boundary Street

- Traffic control during construction: Maintain traffic on existing roadway.

  Should road closure prove necessary public meetings will be held in advance of the closure to inform the public and gather information.

- Design Exceptions to controlling criteria anticipated:

	UNDETERMINED	YES	NO
HORIZONTAL ALIGNMENT:	( )	( )	(X)
ROADWAY WIDTH:	( )	( )	(X)
SHOULDER WIDTH:	( )	( )	(X)
VERTICAL GRADES:	( )	( )	(X)
CROSS SLOPES:	( )	( )	(X)
STOPPING SIGHT DISTANCE:	( )	( )	(X)
SUPERELEVATION RATES:	( )	( )	(X)
HORIZONTAL CLEARANCE:	( )	( )	(X)
SPEED DESIGN:	( )	( )	(X)
VERTICAL CLEARANCE:	( )	( )	(X)
BRIDGE WIDTH:	( )	( )	(X)
BRIDGE STRUCTURAL CAPACITY:	( )	( )	(X)

- Design Variances: None

- Environmental concerns:
  There are five possible locations for UST's within the project area. These are the northwest, southwest and southeast corners of Stiles Avenue, the City Lot on the north side of Gwinnett Street, and the parcel on the south side of Gwinnett Street adjacent to the I-16 right-of-way.

- Level of environmental analysis:
  - Are Time Savings Procedures appropriate? Yes ( ), No (X),
  - Categorical exclusion (X),
  - Environmental Assessment/Finding of No Significant Impact (FONSI) ( ), or
  - Environmental Impact Statement (EIS) ( ).

- Utility involvements:
  Known utilities in the area include City of Savannah (water and sewer), Atlanta Gas Light (gas lines), Savannah Electric (power lines), Bell South (communication lines), and Comcast (cable television), City of Savannah (fiber optic traffic control cables).

Project responsibilities:

- Design – City of Savannah
- Right of Way Acquisition – City of Savannah
- Relocation of Utilities – City of Savannah
- Letting to contract – GDOT
- Supervision of construction - GDOT
- Providing material pits – Contractor
- Providing detours – City of Savannah

Coordination

- Initial Concept Meeting date and brief summary: Initial concept meeting held on January 25, 2006. Second Concept Meeting held on April 4, 2006. Minutes and summary of both of these meetings are included as Attachment 1.
- P. A. R. meetings, dates and results: N/A
- FEMA, USCG, and/or TVA: Not Required.
- Public involvement: Public meeting to be scheduled.
- Local government comments: The City of Savannah supports the project.
- Other projects in the area: None
- Other coordination to date: None
- Future Passenger Rail Corridor? _____ Yes X No

Scheduling – Responsible Parties' Estimate

- Time to complete the environmental process: 18 Months.
- Time to complete preliminary construction plans: 6 Months.
- Time to complete right of way plans: 3 Months.
- Time to complete the Section 404 Permit: N/A Months.
- Time to complete final construction plans: 6 Months.
- Time to complete to purchase right of way: 12 Months.
- List other major items that will affect the project schedule: None Months.

Other alternates considered: None

Comments: A conceptual layout of the proposed project has been developed and is included as part of this report.

Attachments:

1. Minutes of Concept Meetings.
2. Preliminary Cost Estimate
3. Typical Section
4. Capacity Analysis
5. Concept Layout

DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA

Project Number: CSSTP-0007-00(402)

P.I. Number: 0007402

County: Chatham

Subject: Minutes of Concept Meeting

On January 25, 2006, a Concept Meeting was held for the above referenced project. The meeting was held in the conference room at the City of Savannah Traffic Engineering Department. Those in attendance were as listed below:

Mike Weiner – City of Savannah
Billy Jones – City of Savannah
Teresa Scott – Georgia Department of Transportation
Dennis Odom – Georgia Department of Transportation
Keith Stewart – Georgia Department of Transportation
Cynthia Phillips – Georgia Department of Transportation
Nick Milionis – City of Savannah
Abe Nadji – City of Savannah
Cindy Coddington – City of Savannah
Buddy Bishop – City of Savannah
Bill Nicholson – Hussey, Gay, Bell & DeYoung

The meeting was opened by Mike Weiner who gave a brief introduction and requested that the attendees introduce themselves. Teresa Scott followed with a brief description of the role of the Department of Transportation in the project and provided the project number and PI number which have been assigned to the project by the Department. Following this Bill Nicholson provided an in-depth project description, summarized as follows:

CSSTP-0007-00(402) involves the widening and reconstruction of approximately 0.40 miles of existing Gwinnett Street in Chatham County. The project begins approximately 375 feet west of the Stiles Avenue intersection and ends at Gwinnett Street intersection with the I-16 ramps.

The project consists of widening and reconstructing the existing two lane section to a four lane urban section, with two lanes in each direction separated by a 20’ raised median. The roadway will have 12’ wide lanes, curb and gutter with 12’ shoulders. Each shoulder will have a 5’ sidewalk separated from the curb by a 2’ grassed strip. Appropriate turning lanes and median openings will be provided.

The proposed widening is to the south of the existing pavement. The existing pavement will be retained and overlaid where possible, but will be reconstructed where elevation changes would result in excessive buildup.

The project will include replacement of the existing bridge structure over the Springfield Canal with a newer, higher bridge that will accommodate the entire roadway section. A new traffic signal installation will be made at the Stiles Avenue intersection.

The listed design speed is 35 mph. The existing right-of-way varies from 40 feet to 83 feet. The estimated proposed right-of-way varies from 115 feet to 190 feet.

The description also included discussion of construction cost, displacements, constructability and environmental concerns as found in the draft Concept Report.

Following the description and the presentation of the project conceptual layout, the floor was opened to general discussion and comment. The following issues were raised and discussed:

Abe Nadji asked for assurances that the project would provide adequate drainage capacity for the Springfield Canal beneath Gwinnett Street. Bill Nicholson stated that HGBD had the City's Springfield Canal Study and that this document would be utilized in the project's design.

Abe Nadji expressed concern about turning movements at median openings. Bill Nicholson stated that HGBD would use turning templates during the design process to assure that median openings were wide enough.

Buddy Bishop noted that ADA concurrence would be needed at locations where the sidewalks cross side roads and driveways. It was agreed that ADA concurrence is part of all GDOT projects.

It was noted that the driveway at the City lot was shown to be retained. Concern was expressed that this drive be large enough to handle the large City vehicles which leave the lot currently, as well as any future redevelopment. Bill Nicholson stated that this would be incorporated into the roadway design.

Mike Weiner pointed out that there are City of Savannah wells at the City lot driveway and on the northwest corner of the I-16 ramps. Bill Nicholson stated that these locations would be taken into account in the design phase and that the wells would be preserved.

It was noted for the record that there are existing monitoring wells on the City lot, but that these will probably not impact the project.

Cynthia Phillips noted that the proposed layout shows the westbound outside lane becoming the through lane, while the inside lane is forced into the left turn movement. She suggested that the right lane become a right turn only lane ending at Stiles Avenue, while the inside lane becomes the through movement. Bill Nicholson agreed to reexamine this and to revise the concept layout as necessary.

Billy Jones noted that the concept report need and purpose was mostly written around the City's plan for area redevelopment as the impetus for the roadway project. Mr. Jones stated that the project was also needed due to the need to avoid flooding and loss of access on the street. Bill Nicholson agreed to incorporate these items into the concept report.

Teresa Scott mentioned that the City's revision to their operations could result in a doubling of traffic on the roadway under normal circumstances not associated with events. Bill Nicholson agreed that this should be incorporated into the project concept report.

During the discussion of constructability the possibility of closing the roadway was revised. Teresa Scott noted that if that occurs public meetings on the closure/detour would be necessary in advance of discussion. Mike Weiner stated that the City would take care of this. This further led to a discussion on the need for a Public Information Open House (PIOH) during the environmental document phase. Mike Weiner said that the City would schedule this meeting after the environmental work was around 60% complete.

Teresa Scott pointed out that construction funding was set up for fiscal year 2008, which means that the project must be let no later than June, 2008. If this does not occur, the funds would be lost. Bill Nicholson was asked if HGBD could have final plans by that time. He stated that, bearing unforeseen circumstances or delays, the plans should be completed well in advance of this necessary date.

It was noted in the discussion that HGBD had been working on the environmental document, but that the Office of Environment and Location had not been able to review reports because there were no funds. Teresa Scott pointed out that with funding approved these reviews could now proceed. Bill Nicholson agreed that HGBD would follow up on this.

Teresa Scott stated that all contacts on the project should be through District 5. She suggested that all environmental issues flow through Sherree Smart, the district's environmental person.

Cynthia Phillips pointed out that a variance would be needed for the substandard median opening separation from the I-16 ramps to the first opening, which is a drive to the proposed City arena. Bill Nicholson agreed that this was necessary if the drive stays

where it is. Billy Jones pointed out that the City's plans had been modified and would be provided to HGBD so that the median opening could be adjusted. Following this the need for a variance will be reassessed.

Teresa Scott noted that this meeting was the initial concept report. She pointed out that representatives of the area office were unable to attend due to a conflict and that their input was needed. It was agreed that the adjustments resulting from this meeting will be incorporated into a revised concept report which will be resubmitted to GDOT. After reviewing this document the Department will determine if another concept meeting is needed.

There is a historic building on the City property near the intersection of Stiles and Gwinnett. It was asked whether this building would be impacted by the project. It was noted that the building was outside of the proposed work area and would therefore not be impacted by the project.

It was reiterated, as noted in the concept report, that no hazardous materials known on the corridor at this time, that there are no wetlands other than the Springfield Canal, and that no permits are expected to be required.

Mike Weiner pointed out that there is a fiber optic cable for traffic signal communication on the north side of Gwinnett Street. Bill Nicholson stated that HGBD would try to design around this cable after it is located.

Nick Milionis asked if water and sewer relocation work would be included in the construction contract. Bill Nicholson noted that, while it was a bit early in the process to consider this, he thought that the water and sewer relocations, if any, would be included in the project.

Business relocations/displacements were discussed. It was noted that the existing business buildings on the south corners of Stiles and Gwinnett would be impacted, but that no true total displacement would occur.

Teresa Scott suggested that the ADT for 2008 and projections be included on a summary sheet.

The meeting was adjourned at 11:10 a.m.

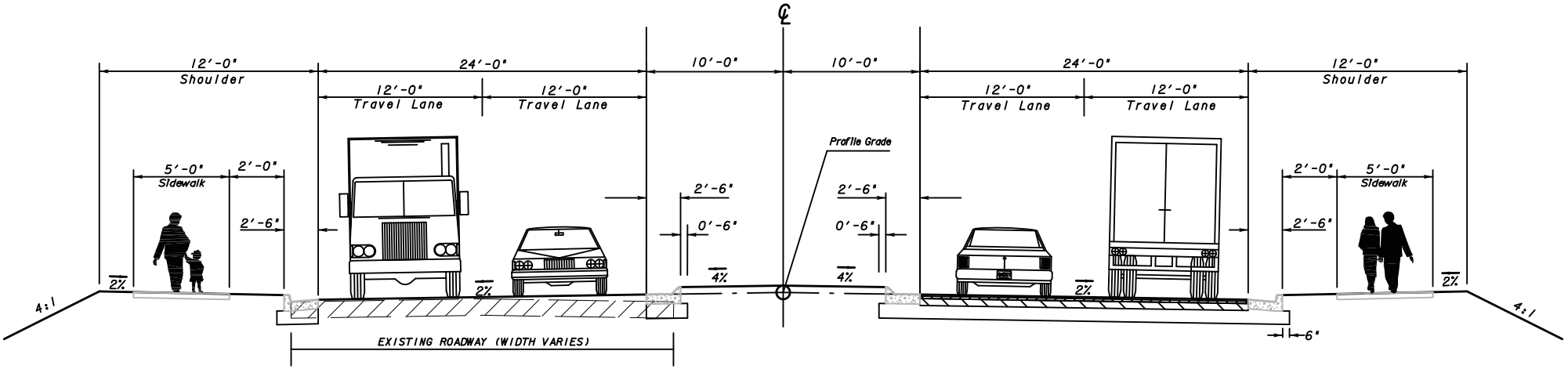
Gwinnett Street Widening: Conceptual Cost Estimate

Item Number	Item	Quantity	Unit	Unit Cost	Cost, Raw	Cost, Rounded
	Right-of-Way					
A1	Property (Land and Structures) / 16 parcels	2.0	acre	$ 200,000.00	$ 400,000.00	$ 400,000.00
A2	Displacements - Res: 0, Bus: 1, MH: 0	1	each	$ 100,000.00	$ 100,000.00	$ 100,000.00
A3	Other Costs (Administrative Costs, Inflation)	1	lump sum	$ 300,000.00	$ 300,000.00	$ 300,000.00
					Subtotal A	**$ 800,000.00**
	Reimbursable Utilities					
B1	Railroad		lump sum			
B2	Transmission Lines		lump sum			
B3	Services		lump sum			
					Subtotal B	**$ -**
	Construction: Major Structures					
C1a	Retaining Walls		linear foot			
C1b	Bridges	1	lump sum	$ 375,000.00	$ 375,000.00	$ 375,000.00
C1c	Detour Bridges		lump sum			
C1d	Box Culverts		lump sum			
					Subtotal C1	**$ 375,000.00**
	Construction: Grading and Drainage					
C2a	Earthwork	25,000	cubic yard	$ 8.50	$ 212,500.00	$ 213,000.00
C2b-1	Drainage, Cross Drain Pipe		lump sum			
C2b-2	Drainage, Curb & Gutter, 9000 linear feet	9,000	linear foot	$ 12.00	$ 108,000.00	$ 108,000.00
C2b-3	Drainage, Longitudinal System	1	lump sum	$ 110,000.00	$ 110,000.00	$ 110,000.00
					Subtotal C2	**$ 431,000.00**
	Construction: Base and Paving					
C3a	Aggregate Base - Graded Aggregate (10")	15,700	square yard	$ 12.00	$ 188,400.00	$ 190,000.00
C3b-1	Asphalt Paving Surface Course (12.5mm SP)	1,350	ton	$ 42.00	$ 56,700.00	$ 60,000.00
C3b-2	Asphalt Paving Binder Course (19.0mm SP)	1,550	ton	$ 42.00	$ 65,100.00	$ 70,000.00
C3b-3	Asphalt Paving Base Course (25.0mm SP)	2,350	ton	$ 42.00	$ 98,700.00	$ 100,000.00
					subtotal C3b	**$ 230,000.00**
C3-c	Concrete Paving		square yard			
C3-d	Other - Asphalt Concrete Leveling	800	ton	$ 40.00	$ 32,000.00	$ 32,000.00
					Subtotal C3	**$ 452,000.00**
	Construction: Lump Items					
C4a	Traffic Control	1	lump sum	$ 100,000.00	$ 100,000.00	$ 100,000.00
C4b	Clearing and Grubbing (includes demolition)	6.5	acre	$ 8,000.00	$ 52,000.00	$ 52,000.00
C4c	Landscaping	1	lump sum	$ 55,000.00	$ 55,000.00	$ 55,000.00
C4d	Erosion Control	0.5	mile	$ 40,000.00	$ 20,000.00	$ 20,000.00
C4e	Detours		lump sum			
					Subtotal C4	**$ 227,000.00**
	Construction: Miscellaneous					
C5a	Lighting		lump sum			
C5b	Signing - Striping - Signalization	1	lump sum	$ 90,000.00	$ 90,000.00	$ 90,000.00
C5c	Guardrail	160	linear foot	$ 15.00	$ 2,400.00	$ 3,000.00
C5d	Sidewalk - Driveways	2,800	square yard	$ 35.00	$ 98,000.00	$ 98,000.00
					Subtotal C5	**$ 191,000.00**
	Construction: Special Features					
C6	Special Features		lump sum			
					Subtotal C6	**$ -**

Summary

Subtotal A	$	800,000.00
Subtotal B	$	-
Subtotal C1	$	375,000.00
Subtotal C2	$	431,000.00
Subtotal C3	$	452,000.00
Subtotal C4	$	227,000.00
Subtotal C5	$	191,000.00
Subtotal C6	$	-
Raw Subtotal C	$	1,676,000.00
E & C (15%)	$	252,000.00
Inflation (5%, 2 years)	$	198,000.00
Subtotal C	$	2,126,000.00
Grand Total	**$**	**2,926,000.00**

GWINNETT STREET WIDENING
TYPICAL SECTION



Gwinnett Street Widening
Traffic Study

PREPARED FOR

City of Savannah

PREPARED BY

Hussey, Gay, Bell & DeYoung, Inc.
Consulting Engineers
Savannah, Georgia

January, 2005

Introduction

Gwinnett Street is currently a minor collector just to the west of the City of Savannah's Historic District. The City has an active project underway for the widening of the street from I-16 to Stiles Avenue. The City of Savannah is also in the process of planning a new development in this area to house new city offices and multiple entertainment venues. As a part of the planning for the projects a Traffic Study has been developed for the 0.4 miles of Gwinnett Street between Stiles Avenue and I-16 / West Boundary Street.

The purpose of this report is to determine the traffic loadings on Gwinnett Street under current conditions and with the proposed developments in place. The purpose is to also analyze the effects of the increase in traffic generated by the proposed Development on adjacent Gwinnett Street and to recommend to the City of Savannah optimal improvements to Gwinnett Street for adequate Level of Service (LOS) during normal peak hour traffic conditions and to determine the anticipated LOS during special event traffic conditions.

Existing Conditions

Currently the 0.4 miles of Gwinnett Street between Stiles Avenue and West Boundary Street is a two-lane (one lane in each direction) roadway with grassed shoulders. Most of the land adjacent to the roadway is currently vacant and driveway access is minimal. The road is currently a minor collector facilitating the movement of traffic from nearby businesses and residential neighborhoods to downtown Savannah and I-16. The intersection of Gwinnett Street and Stiles Avenue at the beginning of the project and the intersection of Gwinnett Street and I-16 / West Boundary Street at the end of the project are the only intersections in the project corridor.

Proposed Development

The proposed Westside Master Plan Development is to be located along both the north and south sides of Gwinnett Street between Stiles Avenue and West Boundary Street. The approximately 50-acre Development is to include the following:

- City Office Complex (600 persons)
- Arena (12,000 seats)
- Baseball Field (7500 seats)
- Amphitheater (4000 seats)
- Theater (2800 seats)
- Meeting Rooms / Ballroom
- Hotel / Restaurant Complex (2-250 room hotels, 4-300 seat restaurants)
- Parking Garage (700 spaces)
- Parking Lot (5000 total spaces)

The Arena, Baseball Field, Meeting Rooms / Ballroom facilities and approximately 70% of the parking spaces have two access points, one via Gwinnett Street and the other via West Boundary

Street. The other proposed facilities including the City office complex, Parking Garage, Amphitheatre, Theatre and 30% of the parking facilities are separated by a canal and have access via Stiles Avenue only.

The proposed project is forecast to generate trips associated with the City Office Complex and the Hotel / Restaurant Complex on a daily basis with minimal regularly occurring traffic being associated with the entertainment venues. The proposed entertainment venues along the project corridor are assumed to generate trips on a non-regular basis.

Trip Generation Methodology

The *Trip Generation Manual (6th Edition)* and *Trip Generation Handbook* both published by ITE were used in estimating the traffic volumes that will be generated by the proposed facilities. The *Trip Generation Manual* (TGM) is a compilation of more than 3,750 trip generation studies. Studies are grouped together by specific land use codes and where sufficient studies exist data plots of independent variables versus vehicles per day or vehicles per peak hour have been provided and analyzed. *The Trip Generation Handbook* is the accompanying proposed recommended practices manual.

There are three methods provided for estimating trip generation:

- Plot of trip ends versus size of independent variable for each study
- Weighted Average trip generation rate
- Regression equation relating trip ends to the size of the independent variable

If a regression equation is provided and the independent variable is within the data range the *Trip Generation Handbook* instructs to use the regression equation for estimating trip ends. If there is no regression equation provided and at least three data points are provided and the independent variable is within the data range the weighted average rate should be used to estimate the number of trip ends. In all other cases the manual suggests that local data be collected. In this analysis if studies were not provided for specific Land Use Codes or insufficient information was available for specific Land Use Codes then engineering judgment was used to estimate the traffic generated by the proposed improvements since the improvements proposed in this development do not currently exist and could not be readily studied.

The Land Use Codes description and summary of available data are provided below for each of the proposed facilities:

City Office Complex

The proposed city office complex does not match the descriptions exactly of any of the listed Land Use Codes, however several are relevant. General Office Building (710), Corporate Headquarters Building (714), Single Tenant Office Building (715), and Government Office Complex (733) were all analyzed and averaged to obtain the estimated Trip Ends per Weekday and Trip Ends per P.M. Peak Hour. The independent variable used in all cases was the number of employees. Regression equations were

available for all Land Use Codes except Government Office Complex where the average generation rate was used in the estimation.

Hotel

The proposed hotels match land use code Hotel (310) for places of lodging that provide sleeping accommodations and various other facilities. The data showed that the average occupancy rate for hotels in these studies was 83%. Using the independent variables total number of rooms and total number of rooms occupied, Trip Ends per Weekday and Trip Ends per P.M. Peak Hour were estimated. Regression equations were available for use in analysis of all data in this Land Use Code. The average of results from both independent variables was used.

Restaurants

The exact nature of the proposed restaurants is not known. It is assumed that they could fall into one of two available categories: Quality Restaurant (831) or High-Turnover (Sit-Down) Restaurant (832). Quality Restaurants generally require reservations while High-Turnover Restaurants are typical of medium priced chain restaurants. The independent variable total number of seats was used to estimate Trip Ends per Weekday and Trip Ends per P.M. Peak Hour. Regression equations were not available, therefore the average generation rate was used in estimation.

Arena, Baseball Field, Amphitheatre, Theatre, Meeting Rooms, & Ballrooms

This group of proposed facilities is not assumed to generate traffic on a regular basis and is assumed to be comparatively small compared to the other proposed facilities. Daily trip ends were estimated based Land Use Code Arena (460). One study previously done for this Land Use Code found an average trip generation rate of 33.33 trip ends per acre. The total acreage for the site is estimated at approximately 50 acres. The Trip Ends per P.M. Peak Hour are assumed to be 9% of the estimated Trip Ends per Day.

During a sell out event at the Arena however, the generated traffic is assumed to be 10,000 trip ends per event corresponding to the total number of parking spaces available with 50% coming prior to the event and 50% leaving after the event. As stated earlier 30% would have access via Stiles Avenue and 70% would have access via either Gwinnett Street or West Boundary Street. It is estimated that the two access points via Gwinnett Street and West Boundary Street would have equal traffic distribution. It is assumed that 35% of event Traffic would access the Arena parking area via Gwinnett Street.

Trip Generation

Results of the Trip Generation Analysis follow along with estimated distributions. A summary chart is also provided in Appendix A Exhibit A-4:

City Office Complex

The estimated trip ends per weekday for the 600 person City Office Complex with 700 space parking garage is 2246 with a 50%/50% distribution. The estimated Trip Ends per P.M. Peak Hour is 315 with an 86% exiting and 13% entering distribution.

Hotels

The estimated trip ends per weekday for the two 250 room hotels is 4282 with a 50/50 distribution. The estimated Trip Ends per P.M. Peak Hour is 270 with an 45% exiting and 55% entering distribution.

Restaurants

The estimated trip ends per weekday for the four 300 seat Restaurants is 4614 with a 50/50 distribution. The estimated Trip Ends per P.M. Peak Hour is 408 with an 45% exiting and 55% entering distribution.

Arena Baseball Field, Theatres, Meeting Rooms

The combined estimated trip ends per weekday for the Entertainment Venues is 1670 with a 50/50 distribution. The estimated Trip Ends per P.M. Peak Hour is 150 with an 93% exiting and 7% entering distribution during the average P.M. Peak hour when no events are taking place. The estimated Trip Ends per "Sell Out Event" is 10000 with 50% entering before the event and 50% exiting after the event.

Traffic Analysis Methodology

In order to best assess both the existing traffic situation and the predicted future traffic patterns and to recommend solutions with respect to lane configuration along the project corridor and at each intersection, procedures and methodologies outlined in the Transportation Research Board's 2000 Edition of the Highway Capacity Manual (HCM2000) were employed. Application of the HCM 2000 methodologies in devising a solution to a traffic problem typically requires an analyst to iteratively perform lengthy series of calculations. In an effort to save time in obtaining these solutions, the analyses performed for this study were completed using several modules of the McTrans Highway Capacity Software 2000 (HCS2000), which automates many of HCM 2000's methodologies.

One of the key evaluation parameters established in HCM 2000, as in all previous editions, is the "level of service" (LOS). Level of service is used as a general qualitative measure of how adequate a particular roadway or intersection configuration performs in handling a given traffic load. The particular criterion used to measure level of service varies depending upon which

aspect of traffic flow is being assessed. In this study, both arterial capacity and intersection capacity are examined.

Arterial Level of Service

Arterial level of service is defined in terms of the average travel speed of all through vehicles using the arterial. The average running speed is compared to the free-flow speed. The free-flow speed for any specific arterial depends upon the functional classification. Gwinnett Street is functionally classified as Type II, which is defined as having a free-flow speed in the range of 35 to 45 mph, typically 40 mph. Each arterial level of service is generally defined below (with the minimum average speed for a Type II arterial appearing in parentheses after each):

1. LOS A: Primarily free-flow operations at average travel speeds, typically 90% of the free flow speed for a particular arterial classification. Vehicles are seldom impeded in their ability to maneuver in the traffic stream. Any delay at a signalized intersection is minimal. (≥ 35 mph)
2. LOS B: Reasonably unimpeded operations at average travel speeds, typically 70% of the free-flow speed for the arterial classification. A vehicles ability to maneuver in the traffic stream is slightly restricted and signal delays are generally short. (≥ 28 mph)
3. LOS C: Stable Operations. Ability to maneuver is intermittently restricted. Average travel speeds are roughly 50% of free-flow speed. Signal delays are increasingly common. (≥ 22 mph)
4. LOS D: Borders on a range wherein small increases in flow can cause substantial increases in approach delay. Delays at signals are to be expected. Average travel speed is 40% of free-flow speed. (≥ 17 mph)
5. LOS E: Characterized by significant delays and average travel speeds around 33% of free-flow speeds. Long delays can be expected at signals with stop-and-go travel between intersections common. (≥ 13 mph)
6. LOS F: Extremely slow progression along arterials. Frequent very long delays at signals with extensive queuing. Average travel speeds are approximately 25% of free-flow speed or less. (< 13 mph)

Signalized Intersection Level of Service

Signalized intersection level of service is defined in terms of the control delay (also referred to as signal delay) measured in seconds and defined as the portion of delay caused by the existence of the traffic signal in absence of any geometric delay associated with the connecting roadway. Each service level is uniquely considered for a signalized intersection as follows (with the control delay per vehicle following in parentheses):

1. LOS A: Operations with very low control delay, occurring when progression is extremely favorable to a particular movement and most vehicles arrive during a green phase and do not stop at all. (≤ 10 seconds)
2. LOS B: Operations with generally good progression with short cycle lengths and vehicles experiencing a higher likelihood of stopping briefly. (≤ 20 seconds)

3. LOS C: Operations with fair progression, longer cycle lengths and significant numbers of vehicles required to stop, though many others still pass through unimpeded. Individual cycle failures may begin to appear. (≤ 35 seconds)
4. LOS D: Influence of congestion becomes more pronounced. Longer delays may result from some combination of unfavorable progression. The number of vehicles stopping is significant, though a few may occasionally pass through unimpeded. (≤ 55 seconds)
5. LOS E: Many agencies consider this level the limit of acceptable delay. Typified by poor progression, long cycle lengths and high volume-to-capacity (v/c) ratios. Individual cycle failures are frequent occurrences. (≤ 80 seconds)
6. LOS F: Considered unacceptable to most drivers, these intersections experience frequent over-saturation with arrival flow rates exceeding the intersection capacity. Very poor progression, long cycle lengths and frequently long delays. (> 80 seconds)

Unsignalized Intersection Level of Service

Unsignalized intersection level of service is defined in terms of the control delay measured in seconds. For Two-Way Stop Control (TWSC) intersections the control delay can be measured for any stop-controlled approach by summing the control delay for each approach movement. Each service level is uniquely considered for an unsignalized intersection as follows (with the control delay per vehicle following in parentheses):

1. LOS A: Operations with very low control delay. Vehicles can readily find a suitable gap in the major street movements. Usually first to arrive at stop sign. (≤ 10 seconds)
2. LOS B: Operations with generally low control delay. Queues are very short, two cars or less and can readily cross the intersection. (≤ 15 seconds)
3. LOS C: Operations with longer control delay. Vehicles cannot readily cross and must wait for sufficient gap. Queues start to form. (≤ 25 seconds)
4. LOS D: Gaps in major street movements are becoming shorter and progression is slow. Lengthy queues are starting to from. (≤ 35 seconds)
5. LOS E: Typified by long delays. Gaps in the major street are becoming increasingly short. Queues are lengthy. (≤ 50 seconds)
6. LOS F: Considered unacceptable to most drivers, usually occurs when there is insufficient gaps in the major street to allow the minor street to safely enter. Long queues are highly likely. (> 50 seconds)

Analysis of Existing Traffic Conditions

According to Georgia Department of Transportation (GDOT) data for 2002, traffic volumes along Gwinnett Street averaged 8518 vehicles per day between Stiles Avenue and I-16 / West Boundary Street. Exhibit A-1 in Appendix A presents historical data for ADT along Gwinnett Street between 1997 and 2002.

The project corridor includes two major intersections. The first is the intersection with Stiles Avenue. The 2002 volume on Stiles Avenue is 6100 vehicles per day south of the Gwinnett Avenue and Stiles Avenue intersection. ADT's north of the intersection on Stiles were not provided. The ADT's for Stiles avenue north of the intersection with Gwinnett Street were extrapolated from the approach volumes provided by the City of Savannah. The other intersection is the intersection of Gwinnett Street with I-16 / West Boundary Street. The 2002 volume on the West Boundary Street approach to Gwinnett Street was 1700 vehicles per day. ADT's for the I-16 ramps were not provided and were extrapolated from the approach volumes provided by the City of Savannah.

Approach volumes for each of the intersections provided by the City of Savannah were examined in order to complete a preliminary investigation of the flow of traffic in the existing system. The Stiles Avenue counts were obtained in 1993 and The I-16 / West Boundary Street approach volumes were obtained in late 1999-early 2000. Approach volumes for each intersection are presented as Exhibits A-2 through A-3 in Appendix A. An inspection of these volumes reveals a traffic pattern wherein traffic builds throughout the day, experiencing slight peaks during the A.M. and noon rush hours with an overall peak during the P.M. rush hour. The approach volumes provided by the city show that westbound traffic tends to dominate eastbound traffic throughout the day along Gwinnett Street between I-16/West Boundary Street and Stiles Avenue with the distribution being as great as 62%. However the more recent traffic ADT diagrams provided by GDOT state that the overall daily directional distribution is closer to 50%. For the purposes of this project a daily directional distribution of 50% was used. The approach volume data also showed the average percentage of Average Daily Traffic using the arterial during the peak hour to be 8%. However a more conservative value of 9% was used in this analysis to convert ADT's to Peak Hour Volumes. An arterial analysis of the existing system based upon both the ADT and the Peak Hour Volume using HCS 2000's Arterial Capacity Module shows it to be operating at LOS A in the westbound direction and at a LOS B in the eastbound direction with average travel speeds of 35.5 mph and 34.4 mph respectively during the P.M. peak hour.

Turning movement counts were not available for this analysis. Since an assumed directional distribution volume of 50% was used, all existing turning movements used in the ADT diagrams are estimations based on the ratio of the movements receiving lane's corresponding approach volume to the total intersection volume.

Development of Projected Traffic Conditions

In order to establish volumes and volume distributions for predicted future conditions, it was necessary to extrapolate existing traffic volumes based on anticipated growth. In addition to accounting for growth, the projected volumes must also be adjusted to reflect anticipated changes in the current traffic pattern associated with the opening of the proposed developments.

The growth rate used for extrapolation of the current traffic volumes was established by examining the historical data for Gwinnett Street (Exhibit A-1). The exhibit shows that Gwinnett Street has actually been in a decline over the last several years. With the anticipation of the new developments in this area a modest growth rate of 0.25% was used in this analysis.

The estimated 2005 existing traffic volumes were grown at 0.25% for three years to the anticipated base year 2008. Then the estimated traffic generated by the completion of the proposed development was added to form the traffic volumes for 2008. The traffic generated by the proposed facilities is not anticipated to change on a yearly basis while the overall growth in the area is. The 2008 traffic volumes minus the traffic generated by the proposed facilities were then grown by 0.25% for 20 years to 2028 the proposed design year. Then the traffic generated by the proposed facilities was added back in and redistributed.

Analysis of Projected Traffic Conditions

All improvements recommended by this study focus on devising a system with sufficient capacity to handle projected traffic volumes in the 2028 design year at LOS E or better.

Arterial Capacity Analysis

The improvement concept along the proposed project corridor involves widening the existing roadway between Stiles Avenue and I-16 / West Boundary Street to a continuous 4-lane section comprised of 2 eastbound and 2 westbound lanes separated by a raised 20-foot median accommodating left turn bays as required. An analysis using HCS 2000's Arterial Capacity Modules shows the roadway will operate at LOS C in the eastbound direction and at LOS B in the westbound direction with average travel speeds of 26.1 mph and 30.5 mph respectively during the P.M. peak hour if these improvements are completed. During major "sell-out" events the arterial is estimated to operate at a LOS E in the eastbound direction and a LOS C in the westbound direction. The arterial analysis results for both the existing and proposed systems are included in Appendix B.

Signalized Intersection Capacity Analysis

Various lane configurations and signal cycle lengths were devised and analyzed for each currently signalized intersection. All analyses were performed using HCS's 2000's Signalized Intersection Capacity Module.

Intersection 1: Gwinnett Street at Stiles Avenue

The Gwinnett Street and Stiles Avenue intersection is estimated to operate at a LOS B in the design year 2028 with an average intersection delay of 15.0 seconds. During peak hours with major events it is expected to operate at an LOS C with a total intersection delay of 27.5 seconds. The eastbound approach movement operates at an estimated LOS E in its current shared lane configuration.

Intersection 2: Gwinnett Street at I-16 / West Boundary Street

The Gwinnett Street and I-16 / West Boundary Street intersection is estimated to operate at a LOS B in the design year 2028. During peak hours with major events it is expected to operate at a LOS F. The left-turn movement from the northbound I-16 exit ramp is the reason for the LOS F, through movements are expected to perform at a higher LOS. Improvements to the exit ramp should be considered.

Unsignalized Intersection Capacity Analysis

The main entrance to the proposed development with Gwinnett Street intersection was analyzed using HCS 2000's Two-Way Stop Control unsignalized intersection Capacity Module. The stop-controlled approach is estimated to operate at a LOS C in the design year 2028 with a control delay of 17.6 seconds. During major events it is expected to operate at a LOS F, although it can be anticipated that manual traffic control and direction would be in place at such events.

Conclusions and Recommendations

Based on the assumptions and analysis as described in this report, the following improvements are recommended:

1. In order to enhance the roadways safety and improve traffic flow along the study corridor, designers should consider a 4-lane section separated by a 20-food raised median installed throughout the project length.

2. A 150' left-turn lane should be provided for the westbound approach to the Gwinnett Street and Stiles Avenue intersection.

3. In this analysis the second Gwinnett Street westbound thru lane was assumed to be dropped at the Gwinnett Street and Stiles Avenue intersection. If it is carried through the intersection then a 200' right turn lane should be provided for the westbound approach.

4. A 300' left-turn lane should be provided for the southbound approach to the Gwinnett Street and Stiles Avenue intersection.

5. A 150' right-turn lane should be provided for the southbound approach to the Gwinnett Street and Stiles Avenue intersection.

6. A 150' right-turn lane should be provided for the northbound approach to the Gwinnett Street and Stiles Avenue intersection.

7. A 100' left-turn lane should be provided for the northbound approach to the Gwinnett Street and Stiles Avenue intersection.

8. No improvements are recommended for the eastbound approach to the Gwinnett Street and Stiles Avenue intersection. During normal PM Peak Hours the intersection operates acceptably, though a left turn lane should be considered for improved LOS operations during major events.

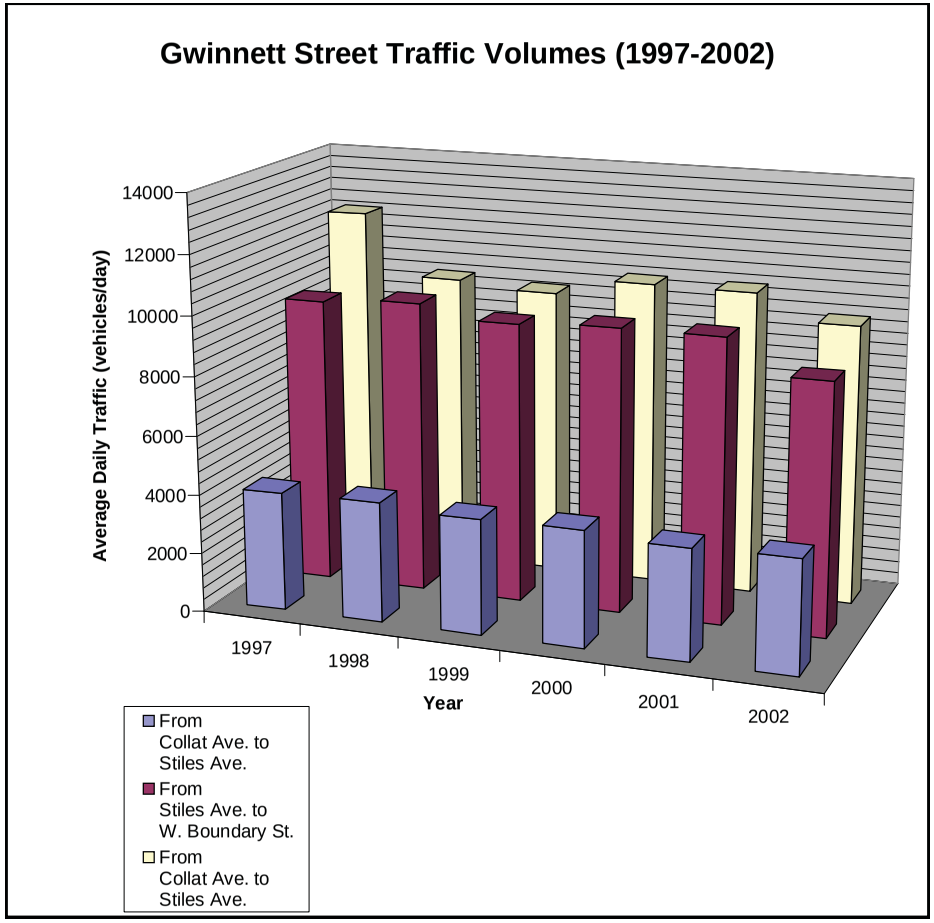
9. No improvements are recommended for the Gwinnett Street and I-16 / West Boundary street intersection for adequate LOS during non-event peak hours. Improvements to the I-16 off ramp should be considered for improved operations during major events.

10. A 100' right-turn lane and 100' left-turn lane into the development's primary entrance off Gwinnett Street should be provided.

This analysis was performed to provide adequate LOS during non-event peak hour conditions and estimate the LOS during major "sell-out" events for Gwinnett Street Only. A separate traffic study for the entire development area is needed to access the function of the system as a whole during major events. Alternate measures of traffic control should also be considered for major events.

APPENDIX A

YEAR	From Collat Ave. to Stiles Ave.	From Stiles Ave. to W. Boundary St.	From W.Boundary St. to MLK Blvd.
1997	4016	9703	12063
1998	4074	9906	9984
1999	3908	9480	9786
2000	3940	9643	10357
2001	3754	9646	10336
2002	3821	8518	9500

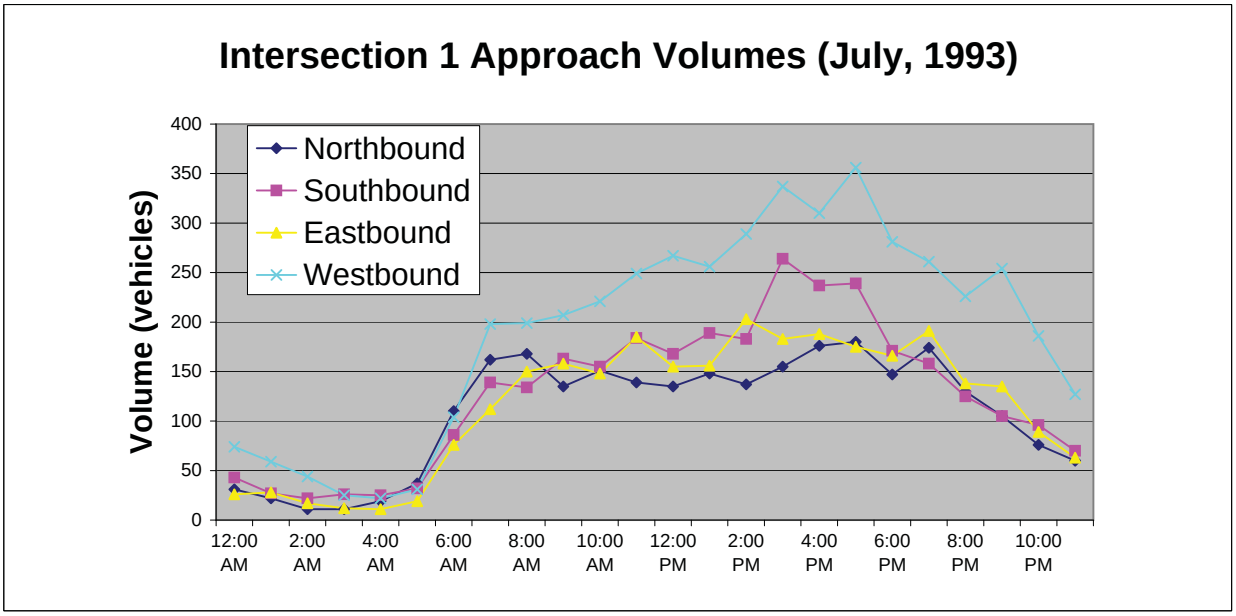


Approach Volumes for Intersection of Gwinnett Street & Stiles Avenue

Intersection 1 of 2 July 1993	Stiles Avenue		Gwinnett Street		Hour Total for Intersection
	Northbound	Southbound	Eastbound	Westbound	
12:00 AM to 1:00 AM	31	43	26	74	174
1:00 AM to 2:00 AM	22	27	28	59	136
2:00 AM to 3:00 AM	11	22	17	44	94
3:00 AM to 4:00 AM	11	26	12	25	74
4:00 AM to 5:00 AM	19	25	11	22	77
5:00 AM to 6:00 AM	37	32	19	31	119
6:00 AM to 7:00 AM	110	86	76	104	376
7:00 AM to 8:00 AM	162	139	112	198	611
8:00 AM to 9:00 AM	168	134	150	199	651
9:00 AM to 10:00 AM	135	163	158	207	663
10:00 AM to 11:00 AM	151	155	148	221	675
11:00 AM to 12:00 PM	139	184	185	249	757
12:00 PM to 1:00 PM	135	168	155	267	725
1:00 PM to 2:00 PM	148	189	156	256	749
2:00 PM to 3:00 PM	137	183	203	289	812
3:00 PM to 4:00 PM	155	264	183	337	939
4:00 PM to 5:00 PM	176	237	188	310	911
5:00 PM to 6:00 PM	180	239	175	356	950
6:00 PM to 7:00 PM	147	171	166	281	765
7:00 PM to 8:00 PM	174	158	191	261	784
8:00 PM to 9:00 PM	130	125	138	226	619
9:00 PM to 10:00 PM	105	105	135	254	599
10:00 PM to 11:00 PM	76	96	89	186	447
11:00 PM to 12:00 AM	60	70	63	127	320
Total	2619	3041	2784	4583	13027

Peak Hour

Peak Hour	5:00 PM to 6:00 PM	3:00 PM to 4:00 PM	2:00 PM to 3:00 PM	5:00 PM to 6:00 PM	5:00 PM to 6:00 PM
Volume	180	264	203	356	950
Percentage	6.87%	8.68%	7.29%	7.77%	7.29%

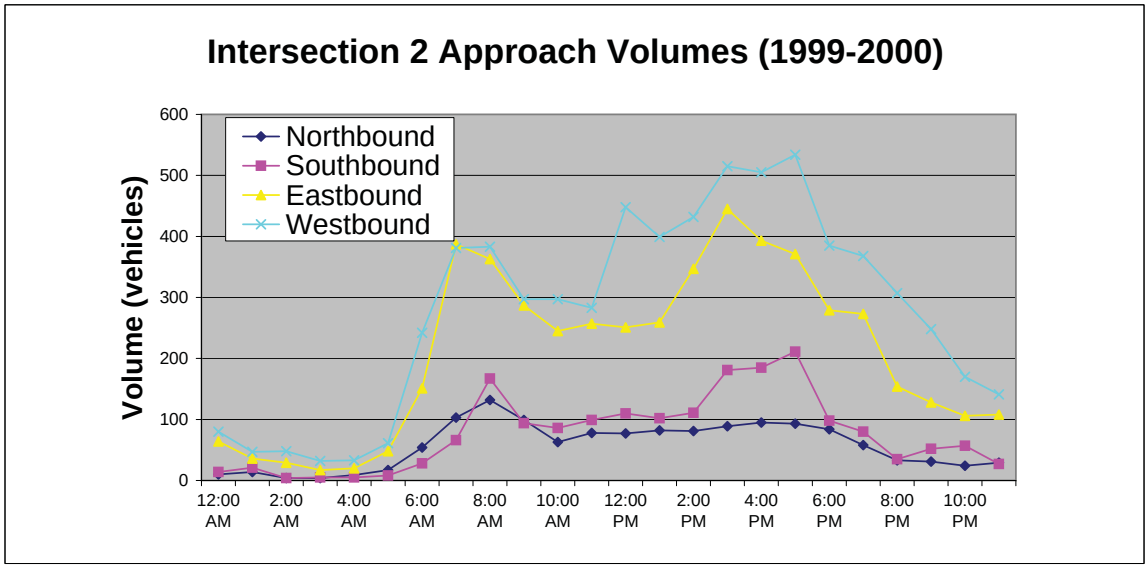


Approach Volumes for Intersection of Gwinnett Street & I-16 / West Boundary Street

Intersection 2 of 2 (varies) 1999-2000	I-16 Off Ramp / West Boundary Street		Gwinnett Street		Hour Total for Intersection
	Northbound	Southbound	Eastbound	Westbound	
12:00 AM to 1:00 AM	10	14	64	80	168
1:00 AM to 2:00 AM	14	21	36	47	118
2:00 AM to 3:00 AM	4	4	29	48	85
3:00 AM to 4:00 AM	4	5	17	32	58
4:00 AM to 5:00 AM	9	5	20	33	67
5:00 AM to 6:00 AM	17	8	48	61	134
6:00 AM to 7:00 AM	54	28	151	242	475
7:00 AM to 8:00 AM	103	66	387	381	937
8:00 AM to 9:00 AM	132	167	363	383	1045
9:00 AM to 10:00 AM	99	94	287	297	777
10:00 AM to 11:00 AM	63	86	245	297	691
11:00 AM to 12:00 PM	78	99	257	283	717
12:00 PM to 1:00 PM	77	110	251	448	886
1:00 PM to 2:00 PM	82	102	259	399	842
2:00 PM to 3:00 PM	81	111	347	432	971
3:00 PM to 4:00 PM	89	181	445	515	1230
4:00 PM to 5:00 PM	95	185	393	505	1178
5:00 PM to 6:00 PM	93	211	371	534	1209
6:00 PM to 7:00 PM	84	98	279	385	846
7:00 PM to 8:00 PM	58	80	273	368	779
8:00 PM to 9:00 PM	33	35	154	307	529
9:00 PM to 10:00 PM	31	52	128	248	459
10:00 PM to 11:00 PM	24	57	106	170	357
11:00 PM to 12:00 AM	29	27	108	141	305
Total	1363	1846	5018	6636	14863

Peak Hour

Peak Hour	8:00 AM to 9:00 AM	5:00 PM to 6:00 PM	3:00 PM to 4:00 PM	5:00 PM to 6:00 PM	3:00 PM to 4:00 PM
Volume	132	211	445	534	1230
Percentage	9.68%	11.43%	8.87%	8.05%	8.28%



Trip Generation Calculations of Average Vehicle Trip Ends

City Office Complex

Employees: 600
Parking Spaces: 700

Employees vs.	General Office Building (710)	Corporate Headquarters Building (714)	Single Tenant Office Building (715)	Government Office Complex (733)	Average
Trip Ends per Weekday	2059	1362	1908	3654	2246
Trip Ends per P.M. Peak Hour of Adjacent Side Street	281	263	296	420	315

Hotels

Hotels: 2
Rooms: 250 per Hotel
Occupancy Rate: 83% (Assumed)

Rooms vs.	Hotel (310)	Occupied Rooms vs.	Hotel (310)	Average
Trip Ends per Weekday	4105	Trip Ends per Weekday	4460	4282
Trip Ends per P.M. Peak Hour of Adjacent Side Street	276	Trip Ends per Peak Hour of Adjacent Side Street	263	270

`

Resturants

Resturants: 4
Seats: 300 per Restaurant

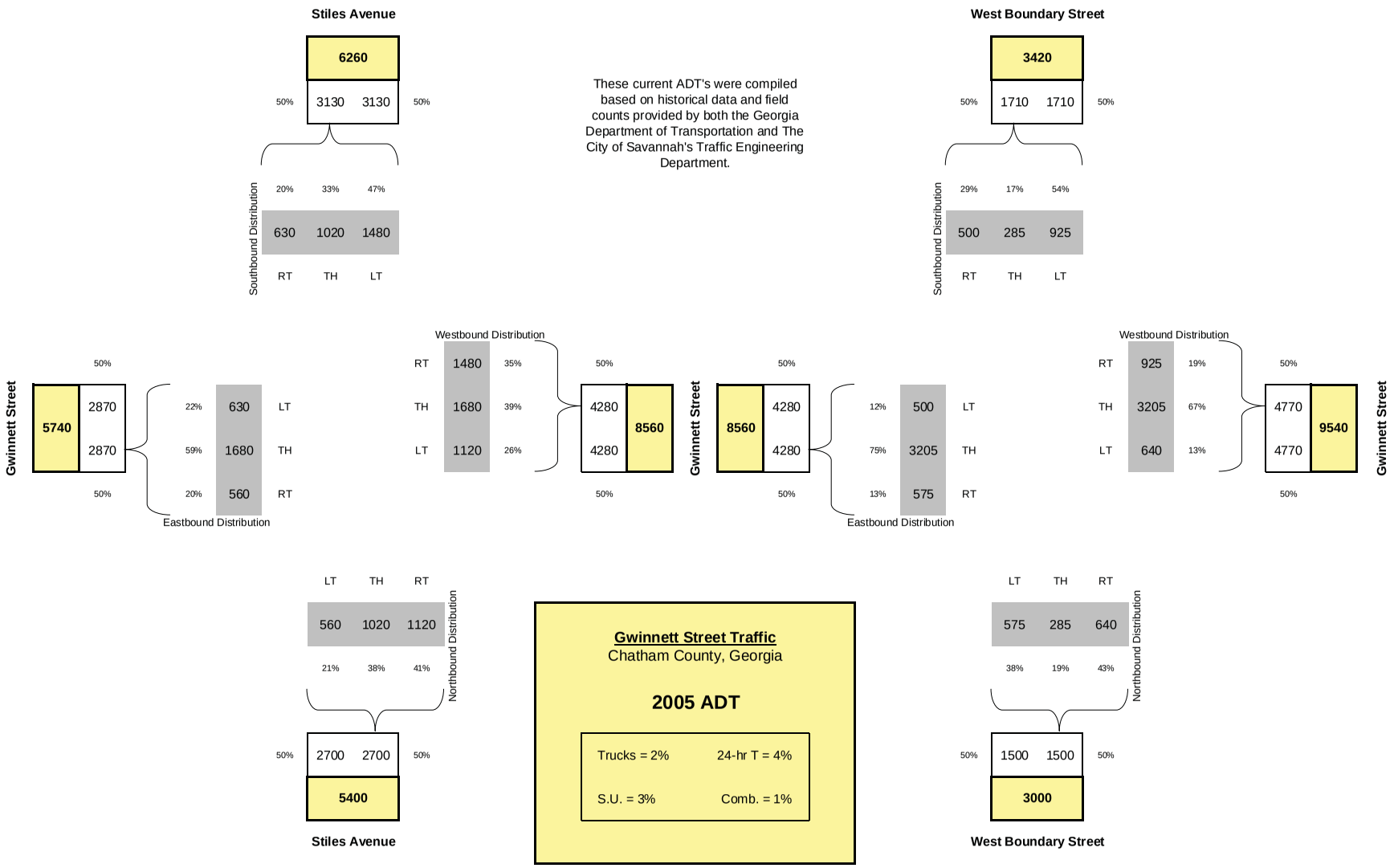
Seats vs.	Quality Restaurant (831)	High-Turnover (Sit-Down) Restaurant (832)	Average
Trip Ends per Weekday	3432	5796	4614
Trip Ends per P.M. Peak Hour of Adjacent Side Street	312	504	408

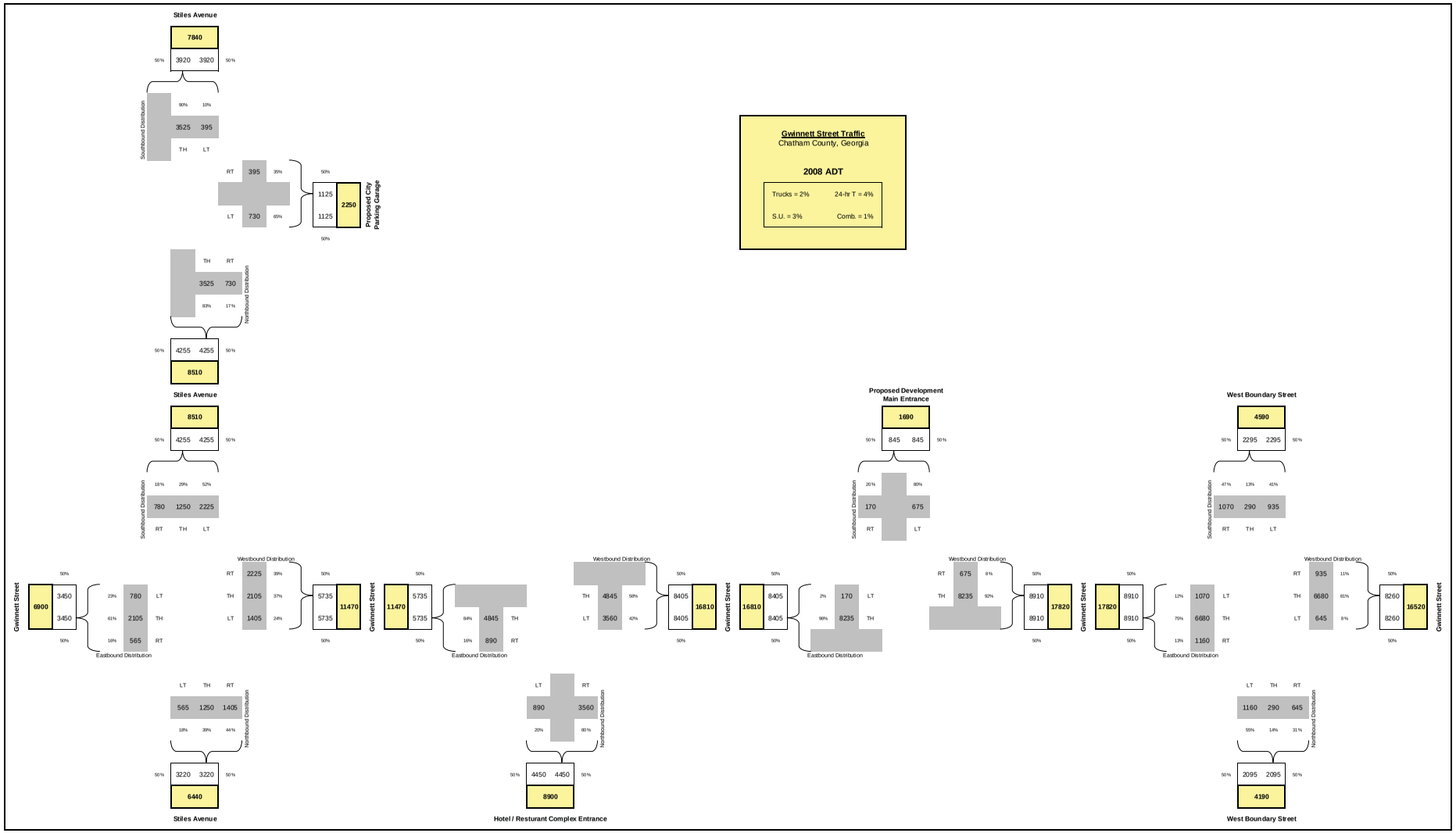
Arena, Baseball Field, Meeting Rooms, etc.

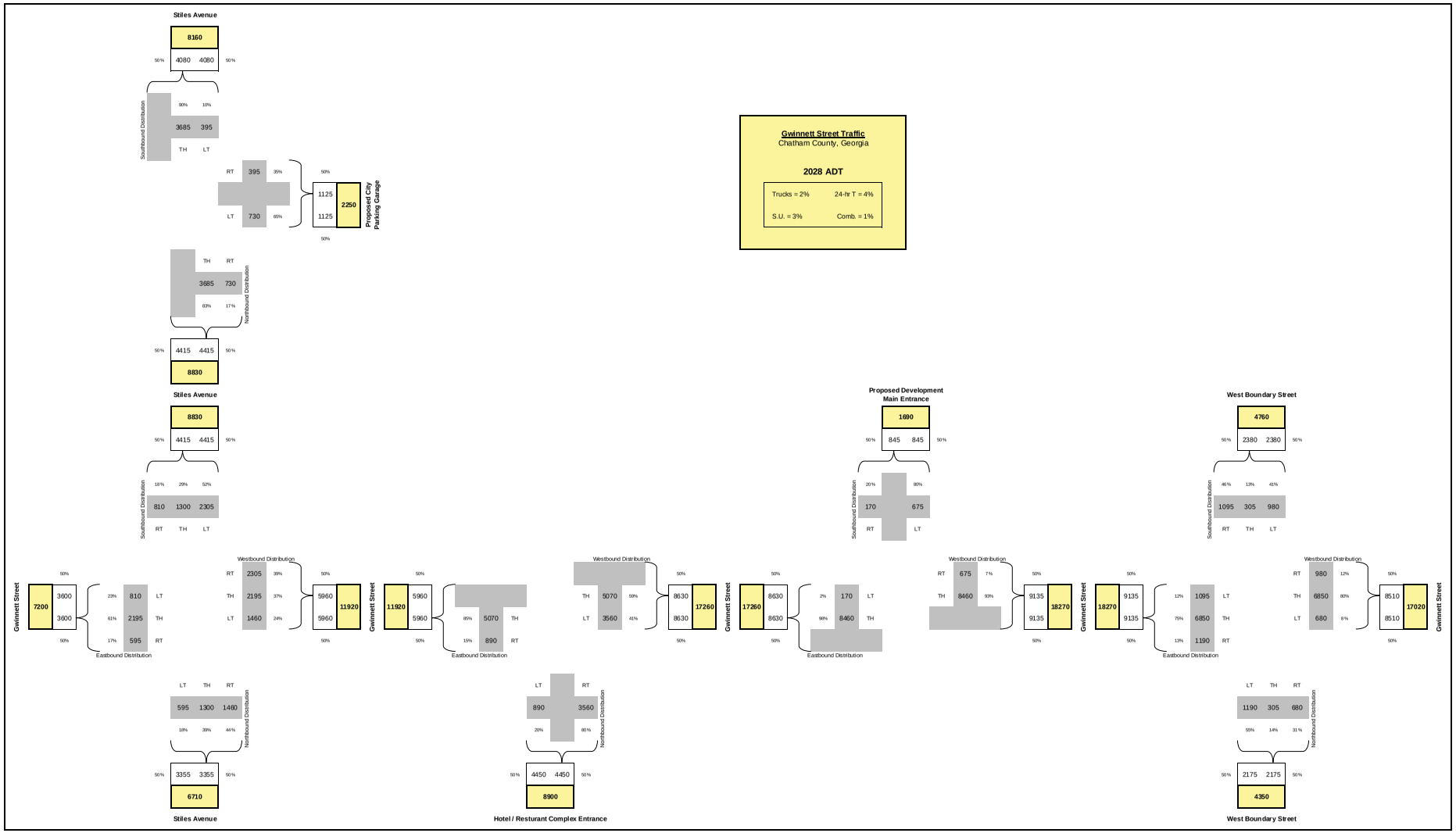
Acres: 50 estimated
Parking Spaces: 5000 (total)
Seats: 26300 (total)

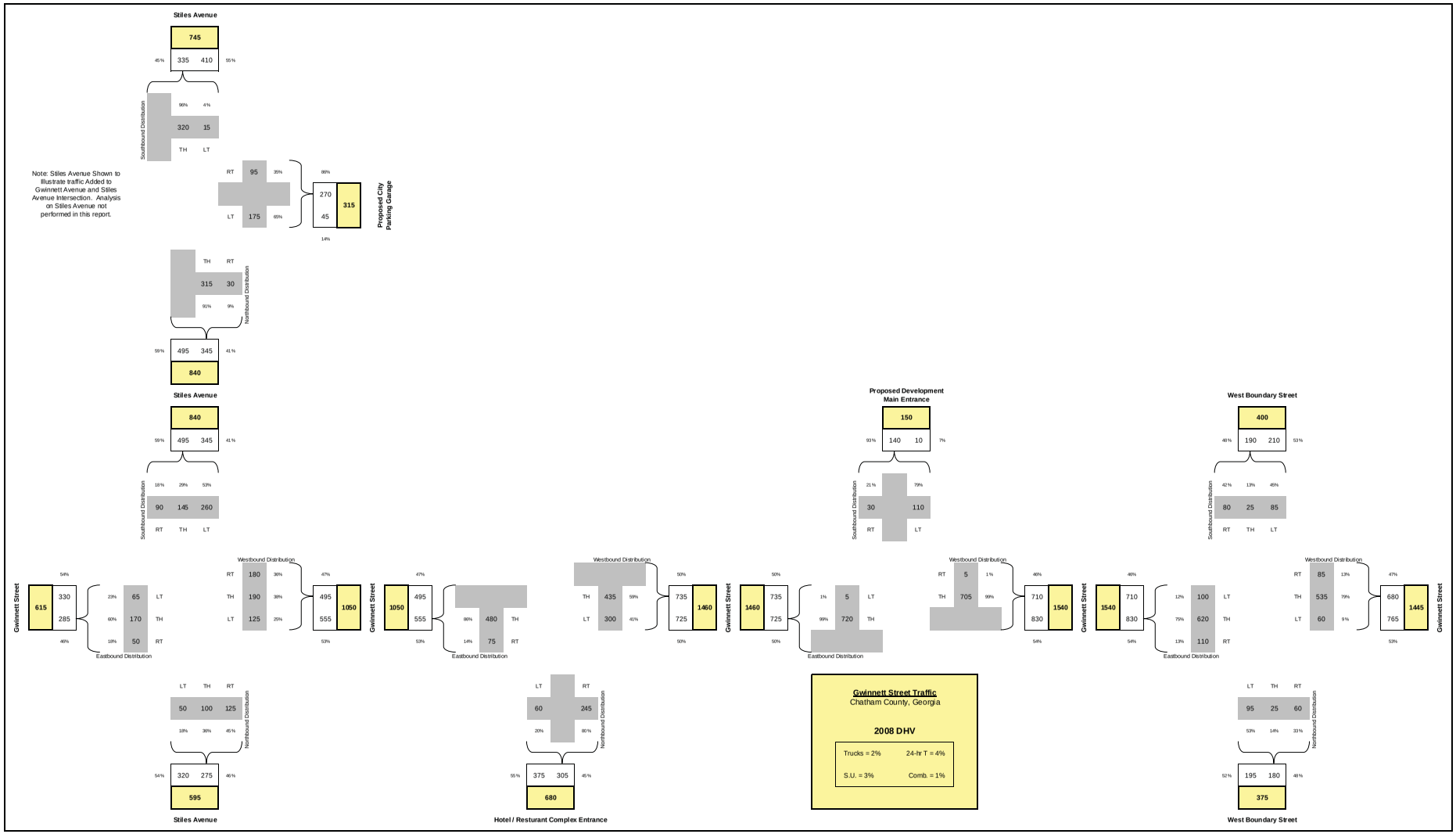
Acres vs.	Arena (460)	Average	
Trip Ends per Weekday	1670	1670	
Trip Ends per P.M. Peak Hour of Adjacent Side Street	150	150	estimated at 0.9% of ADT

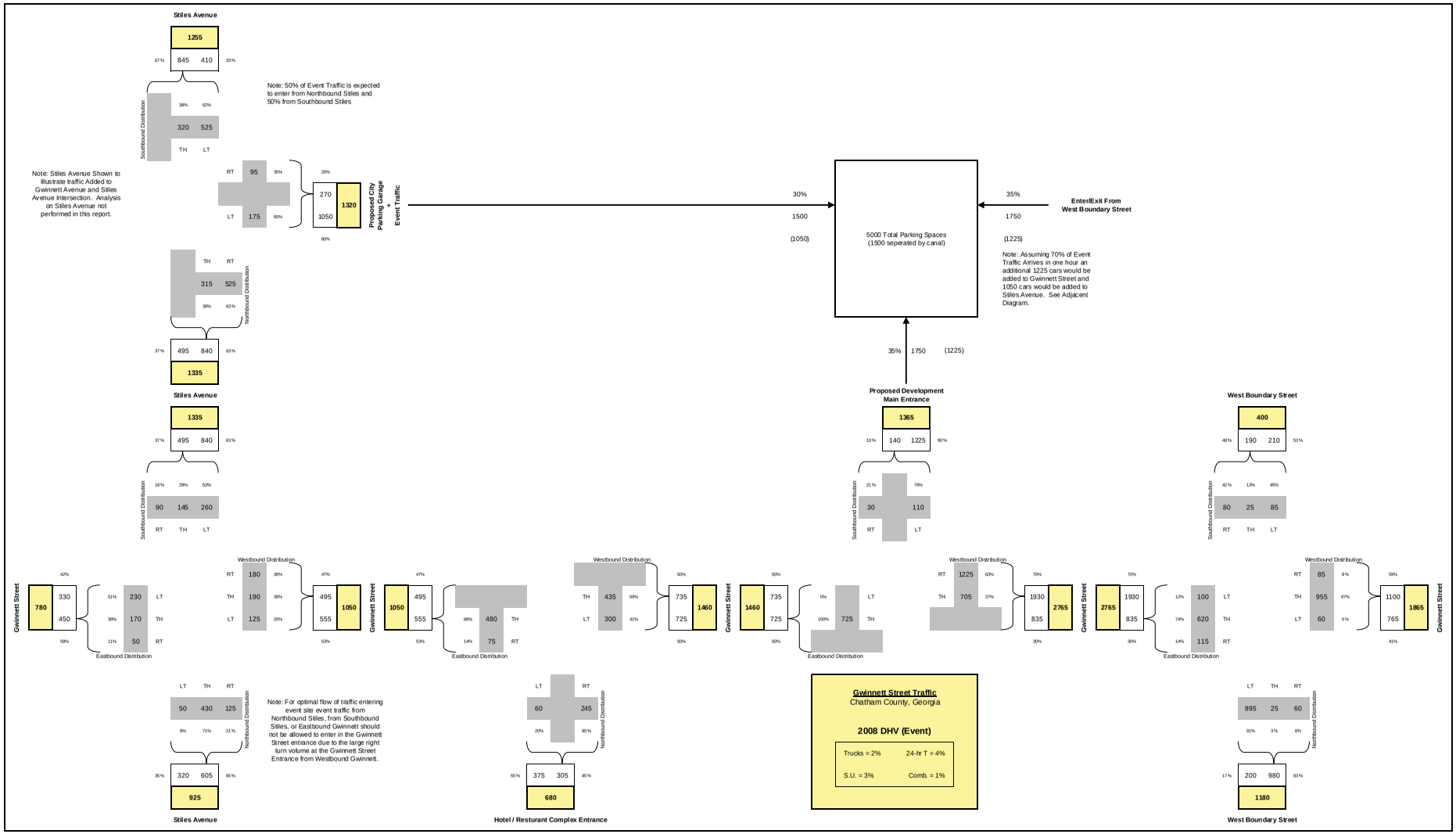
These current ADT's were compiled based on historical data and field counts provided by both the Georgia Department of Transportation and The City of Savannah's Traffic Engineering Department.

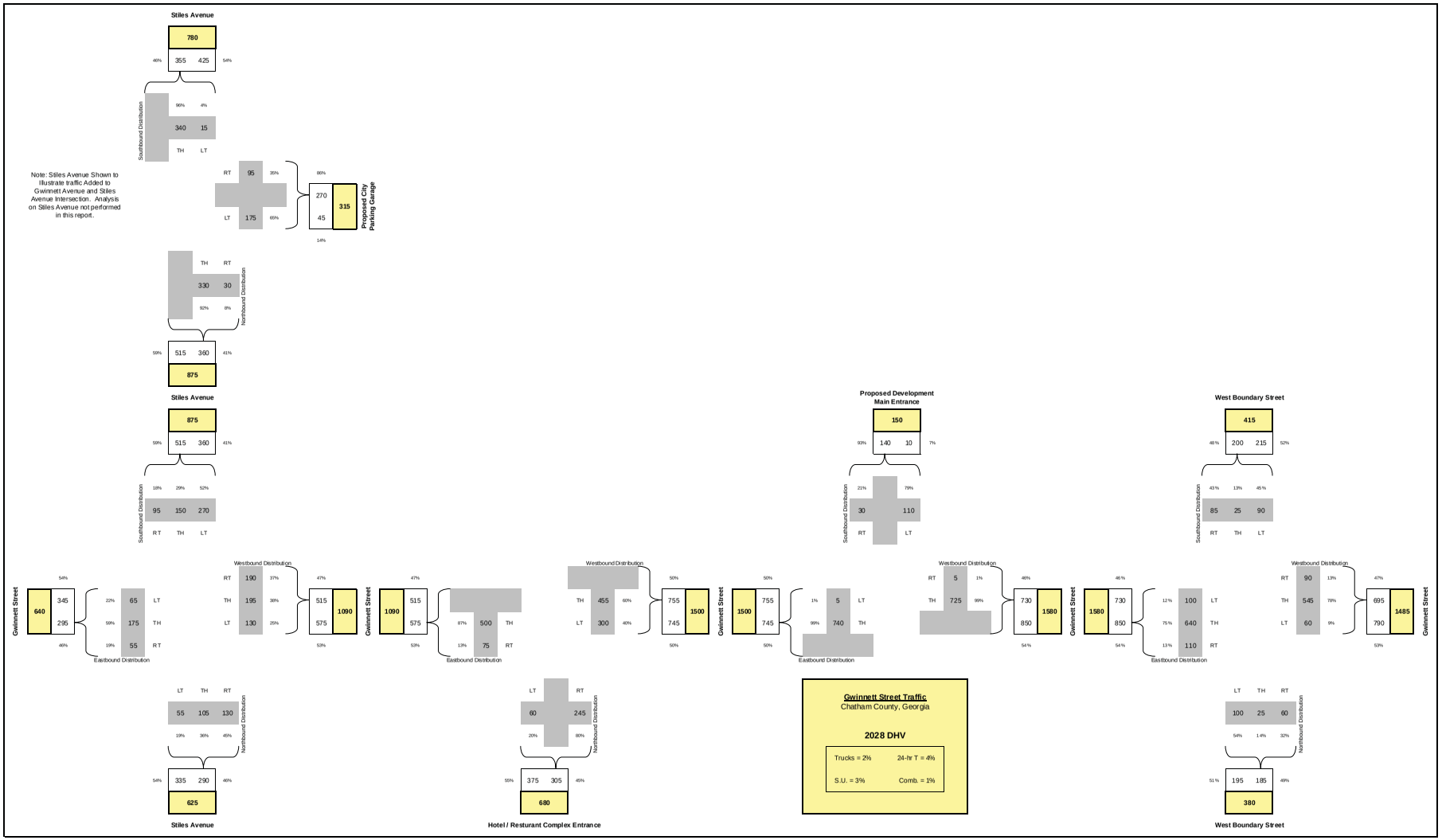


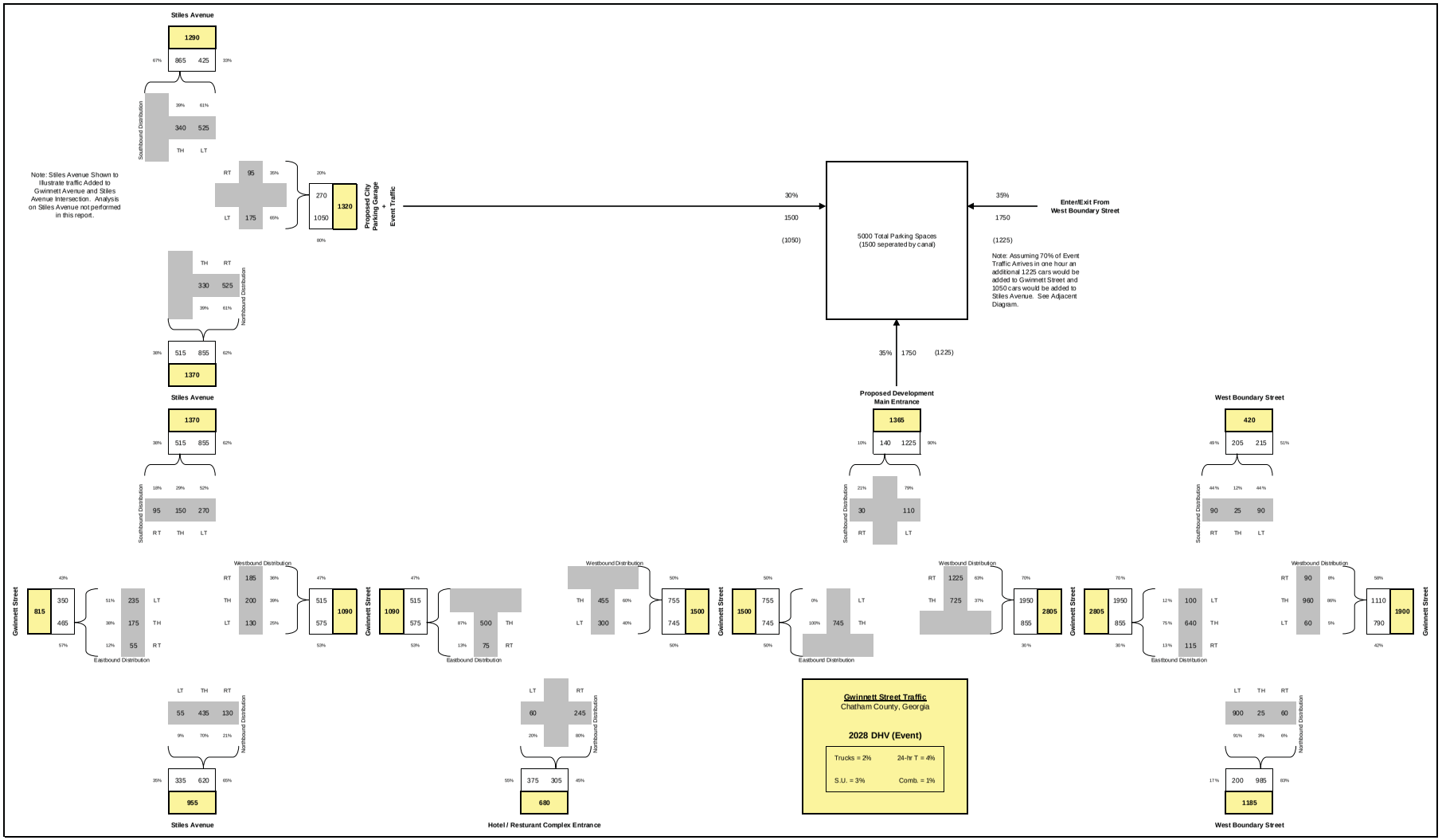

Gwinnett Street Traffic
Chatham County, Georgia
2008 ADT
Trucks = 2%
24-hr T = 4%
S.U. = 3%
Comb. = 1%
Stiles Avenue
7840
3920 3920
50% 50%
Southbound Distribution
90% 10%
3525 395
TH LT
RT 395 35%
LT 730 65%
50%
1125
1125
2250
Proposed City Parking Garage
TH RT
3525 730
83% 17%
Northbound Distribution
4255 4255
8510
Stiles Avenue
8510
4255 4255
18% 29% 52%
780 1250 2225
RT TH LT
Proposed Development Main Entrance
1690
845 845
20% 80%
170 675
RT LT
West Boundary Street
4590
2295 2295
47% 13% 41%
1070 290 935
RT TH LT
Gwinnett Street
6900
3450
3450
23% 61% 16%
780 LT
2105 TH
565 RT
Eastbound Distribution
Westbound Distribution
RT 2225 39%
TH 2105 37%
LT 1405 24%
5735
5735
11470
Gwinnett Street
11470
5735
5735
84% 16%
4845 TH
890 RT
Eastbound Distribution
Westbound Distribution
TH 4845 58%
LT 3560 42%
8405
8405
16810
Gwinnett Street
16810
8405
8405
2% 98%
170 LT
8235 TH
Eastbound Distribution
Westbound Distribution
RT 675 8%
TH 8235 92%
8910
8910
17820
Gwinnett Street
17820
8910
8910
12% 75% 13%
1070 LT
6680 TH
1160 RT
Eastbound Distribution
Westbound Distribution
RT 935 11%
TH 6680 81%
LT 645 8%
8260
8260
16520
Gwinnett Street
LT TH RT
565 1250 1405
18% 39% 44%
Northbound Distribution
3220 3220
6440
Stiles Avenue
LT RT
890 3560
20% 80%
Northbound Distribution
4450 4450
8900
Hotel / Resturant Complex Entrance
LT TH RT
1160 290 645
55% 14% 31%
Northbound Distribution
2095 2095
4190
West Boundary Street


Gwinnett Street Traffic
Chatham County, Georgia
2028 ADT
Trucks = 2%
24-hr T = 4%
S.U. = 3%
Comb. = 1%
Stiles Avenue
8160
4080 4080
50% 50%
Southbound Distribution
90% 10%
3685 395
TH LT
RT 395 35%
LT 730 65%
50%
1125
1125
2250
Proposed City Parking Garage
TH RT
3685 730
83% 17%
Northbound Distribution
4415 4415
8830
Stiles Avenue
8830
4415 4415
18% 29% 52%
810 1300 2305
RT TH LT
Proposed Development Main Entrance
1690
845 845
20% 80%
170 675
RT LT
West Boundary Street
4760
2380 2380
46% 13% 41%
1095 305 980
RT TH LT
Gwinnett Street
7200
3600
3600
23% 61% 17%
810 LT
2195 TH
595 RT
Eastbound Distribution
Westbound Distribution
RT 2305 39%
TH 2195 37%
LT 1460 24%
5960
5960
11920
Gwinnett Street
11920
5960
5960
85% 15%
5070 TH
890 RT
Eastbound Distribution
Westbound Distribution
TH 5070 59%
LT 3560 41%
8630
8630
17260
Gwinnett Street
17260
8630
8630
2% 98%
170 LT
8460 TH
Eastbound Distribution
Westbound Distribution
RT 675 7%
TH 8460 93%
9135
9135
18270
Gwinnett Street
18270
9135
9135
12% 75% 13%
1095 LT
6850 TH
1190 RT
Eastbound Distribution
Westbound Distribution
RT 980 12%
TH 6850 80%
LT 680 8%
8510
8510
17020
Gwinnett Street
LT TH RT
595 1300 1460
18% 39% 44%
Northbound Distribution
3355 3355
6710
Stiles Avenue
LT RT
890 3560
20% 80%
Northbound Distribution
4450 4450
8900
Hotel / Resturant Complex Entrance
LT TH RT
1190 305 680
55% 14% 31%
Northbound Distribution
2175 2175
4350
West Boundary Street


Stiles Avenue
745
45% 335 410 55%
Southbound Distribution
96% 4%
320 15
TH LT
Note: Stiles Avenue Shown to illustrate traffic Added to Gwinnett Avenue and Stiles Avenue Intersection. Analysis on Stiles Avenue not performed in this report.
RT 95 35%
LT 175 65%
86%
270
45
315
14%
Proposed City Parking Garage
TH RT
315 30
91% 9%
Northbound Distribution
59% 495 345 41%
840
Stiles Avenue
840
59% 495 345 41%
Southbound Distribution
18% 29% 53%
90 145 260
RT TH LT
Proposed Development Main Entrance
150
93% 140 10 7%
Southbound Distribution
21% 79%
30 110
RT LT
West Boundary Street
400
48% 190 210 53%
Southbound Distribution
42% 13% 45%
80 25 85
RT TH LT
Gwinnett Street
615
54% 330
46% 285
23% 65 LT
60% 170 TH
18% 50 RT
Eastbound Distribution
Westbound Distribution
RT 180 36%
TH 190 38%
LT 125 25%
47% 495
53% 555
1050
Gwinnett Street
1050
47% 495
53% 555
86% 480 TH
14% 75 RT
Eastbound Distribution
Westbound Distribution
TH 435 59%
LT 300 41%
50% 735
50% 725
1460
Gwinnett Street
1460
50% 735
50% 725
1% 5 LT
99% 720 TH
Eastbound Distribution
Westbound Distribution
RT 5 1%
TH 705 99%
46% 710
54% 830
1540
Gwinnett Street
1540
46% 710
54% 830
12% 100 LT
75% 620 TH
13% 110 RT
Eastbound Distribution
Westbound Distribution
RT 85 13%
TH 535 79%
LT 60 9%
47% 680
53% 765
1445
Gwinnett Street
LT TH RT
50 100 125
18% 36% 45%
Northbound Distribution
54% 320 275 46%
595
Stiles Avenue
LT RT
60 245
20% 80%
Northbound Distribution
55% 375 305 45%
680
Hotel / Resturant Complex Entrance
Gwinnett Street Traffic
Chatham County, Georgia
2008 DHV
Trucks = 2% 24-hr T = 4%
S.U. = 3% Comb. = 1%
LT TH RT
95 25 60
53% 14% 33%
Northbound Distribution
52% 195 180 48%
375
West Boundary Street


Stiles Avenue
1255
67%
845
410
33%
Southbound Distribution
38%
62%
320
525
TH
LT
Note: 50% of Event Traffic is expected to enter from Northbound Stiles and 50% from Southbound Stiles
Note: Stiles Avenue Shown to illustrate traffic Added to Gwinnett Avenue and Stiles Avenue Intersection. Analysis on Stiles Avenue not performed in this report.
RT
95
35%
LT
175
65%
20%
270
1050
1320
80%
Proposed City Parking Garage + Event Traffic
30%
1500
(1050)
5000 Total Parking Spaces
(1500 seperated by canal)
35%
1750
(1225)
Enter/Exit From West Boundary Street
Note: Assuming 70% of Event Traffic Arrives in one hour an additional 1225 cars would be added to Gwinnett Street and 1050 cars would be added to Stiles Avenue. See Adjacent Diagram.
TH
RT
315
525
38%
63%
Northbound Distribution
37%
495
840
63%
1335
Stiles Avenue
1335
37%
495
840
63%
Southbound Distribution
18%
29%
53%
90
145
260
RT
TH
LT
35%
1750
(1225)
Proposed Development Main Entrance
1365
10%
140
1225
90%
Southbound Distribution
21%
79%
30
110
RT
LT
West Boundary Street
400
48%
190
210
53%
Southbound Distribution
42%
13%
45%
80
25
85
RT
TH
LT
Gwinnett Street
42%
780
330
450
58%
51%
230
LT
38%
170
TH
11%
50
RT
Eastbound Distribution
Westbound Distribution
RT
180
30%
TH
190
38%
LT
125
25%
47%
495
555
1050
53%
Gwinnett Street
47%
1050
495
555
53%
86%
480
TH
14%
75
RT
Eastbound Distribution
Westbound Distribution
TH
435
59%
LT
300
41%
50%
735
725
1460
50%
Gwinnett Street
50%
1460
735
725
50%
0%
LT
100%
725
TH
Eastbound Distribution
Westbound Distribution
RT
1225
63%
TH
705
37%
70%
1930
835
2765
30%
Gwinnett Street
70%
2765
1930
835
30%
12%
100
LT
74%
620
TH
14%
115
RT
Eastbound Distribution
Westbound Distribution
RT
85
8%
TH
955
87%
LT
60
5%
59%
1100
765
1865
41%
Gwinnett Street
LT
TH
RT
50
430
125
8%
71%
21%
Northbound Distribution
35%
320
605
65%
925
Stiles Avenue
Note: For optimal flow of traffic entering event site event traffic from Northbound Stiles, from Southbound Stiles, or Eastbound Gwinnett should not be allowed to enter in the Gwinnett Street entrance due to the large right turn volume at the Gwinnett Street Entrance from Westbound Gwinnett.
LT
RT
60
245
20%
80%
Northbound Distribution
55%
375
305
45%
680
Hotel / Resturant Complex Entrance
Gwinnett Street Traffic
Chatham County, Georgia
2008 DHV (Event)
Trucks = 2%
24-hr T = 4%
S.U. = 3%
Comb. = 1%
LT
TH
RT
895
25
60
91%
3%
6%
Northbound Distribution
17%
200
980
83%
1180
West Boundary Street


Stiles Avenue
780
46% 355 425 54%
Southbound Distribution
96% 4%
340 15
TH LT
RT 95 35%
LT 175 65%
86%
270
45
315
14%
Proposed City Parking Garage
Note: Stiles Avenue Shown to Illustrate traffic Added to Gwinnett Avenue and Stiles Avenue Intersection. Analysis on Stiles Avenue not performed in this report.
TH RT
330 30
92% 8%
Northbound Distribution
59% 515 360 41%
875
Stiles Avenue
875
59% 515 360 41%
Southbound Distribution
18% 29% 52%
95 150 270
RT TH LT
Proposed Development Main Entrance
150
93% 140 10 7%
Southbound Distribution
21% 79%
30 110
RT LT
West Boundary Street
415
48% 200 215 52%
Southbound Distribution
43% 13% 45%
85 25 90
RT TH LT
Gwinnett Street
640
54%
345
295
46%
22% 65 LT
59% 175 TH
19% 55 RT
Eastbound Distribution
Westbound Distribution
RT 190 37%
TH 195 38%
LT 130 25%
47%
515
575
1090
53%
Gwinnett Street
1090
47%
515
575
53%
87% 500 TH
13% 75 RT
Eastbound Distribution
Westbound Distribution
TH 455 60%
LT 300 40%
50%
755
745
1500
50%
Gwinnett Street
1500
50%
755
745
50%
1% 5 LT
99% 740 TH
Eastbound Distribution
Westbound Distribution
RT 5 1%
TH 725 99%
46%
730
850
1580
54%
Gwinnett Street
1580
46%
730
850
54%
12% 100 LT
75% 640 TH
13% 110 RT
Eastbound Distribution
Westbound Distribution
RT 90 13%
TH 545 78%
LT 60 9%
47%
695
790
1485
53%
Gwinnett Street
LT TH RT
55 105 130
19% 36% 45%
Northbound Distribution
54% 335 290 46%
625
Stiles Avenue
LT RT
60 245
20% 80%
Northbound Distribution
55% 375 305 45%
680
Hotel / Resturant Complex Entrance
Gwinnett Street Traffic
Chatham County, Georgia
2028 DHV
Trucks = 2%
24-hr T = 4%
S.U. = 3%
Comb. = 1%
LT TH RT
100 25 60
54% 14% 32%
Northbound Distribution
51% 195 185 49%
380
West Boundary Street


Stiles Avenue
1290
67%
865
425
33%
Southbound Distribution
39%
61%
340
525
TH
LT
Note: Stiles Avenue Shown to Illustrate traffic Added to Gwinnett Avenue and Stiles Avenue Intersection. Analysis on Stiles Avenue not performed in this report.
RT
95
35%
LT
175
65%
20%
270
1050
1320
80%
Proposed City Parking Garage + Event Traffic
30%
1500
(1050)
5000 Total Parking Spaces
(1500 seperated by canal)
35%
1750
(1225)
Enter/Exit From West Boundary Street
Note: Assuming 70% of Event Traffic Arrives in one hour an additional 1225 cars would be added to Gwinnett Street and 1050 cars would be added to Stiles Avenue. See Adjacent Diagram.
TH
RT
330
525
39%
61%
Northbound Distribution
38%
515
855
62%
1370
Stiles Avenue
1370
38%
515
855
62%
Southbound Distribution
18%
29%
52%
95
150
270
RT
TH
LT
35%
1750
(1225)
Proposed Development Main Entrance
1365
10%
140
1225
90%
Southbound Distribution
21%
79%
30
110
RT
LT
West Boundary Street
420
49%
205
215
51%
Southbound Distribution
44%
12%
44%
90
25
90
RT
TH
LT
Gwinnett Street
815
43%
350
465
57%
51%
235
LT
38%
175
TH
12%
55
RT
Eastbound Distribution
Westbound Distribution
RT
185
36%
TH
200
39%
LT
130
25%
47%
515
575
1090
53%
Gwinnett Street
1090
47%
515
575
53%
87%
500
TH
13%
75
RT
Eastbound Distribution
Westbound Distribution
TH
455
60%
LT
300
40%
50%
755
745
1500
50%
Gwinnett Street
1500
50%
755
745
50%
0%
LT
100%
745
TH
Eastbound Distribution
Westbound Distribution
RT
1225
63%
TH
725
37%
70%
1950
855
2805
30%
Gwinnett Street
2805
70%
1950
855
30%
12%
100
LT
75%
640
TH
13%
115
RT
Eastbound Distribution
Westbound Distribution
RT
90
8%
TH
960
86%
LT
60
5%
58%
1110
790
1900
42%
Gwinnett Street
LT
TH
RT
55
435
130
9%
70%
21%
Northbound Distribution
35%
335
620
65%
955
Stiles Avenue
LT
RT
60
245
20%
80%
Northbound Distribution
55%
375
305
45%
680
Hotel / Restaurant Complex Entrance
Gwinnett Street Traffic
Chatham County, Georgia
2028 DHV (Event)
Trucks = 2%
24-hr T = 4%
S.U. = 3%
Comb. = 1%
LT
TH
RT
900
25
60
91%
3%
6%
Northbound Distribution
17%
200
985
83%
1185
West Boundary Street

APPENDIX B

Gwinnett Arterial Planning Analysis of Unimproved Conditions
(Analysis Year: 2005)

HCS2000: Urban Streets Release 4.1d

Courtney Lane
Hussey, Gay, Bell and DeYoung
329 Commercial Drive
Savannah, GA 31416

Phone: (912) 354-4626 Fax: (912) 354-6754
E-Mail: clane@hgbd.com

OPERATIONAL ANALYSIS

Analyst: Courtney Lane
Agency/Co.: HGBD, Inc.
Date Performed: 1/17/2005
Analysis Time Period: PM Peak Hour
Urban Street: Gwinnett
Direction of Travel: East-bound
Jurisdiction: City of Savannah
Analysis Year: 2005
Project ID: Gwinnett Street Traffic Study

Description of Arterial

Analysis period length 0.25 hr

Seg.	Cross street name	Length of segment (mi)	Urban street class	Free flow speed (mph)	Running time (sec)	Section
0	Gwinnett					
1	Stiles	0.40	2	40	38.4	1
2	I-16 On / W. Boundary					
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						

Intersection Delay Estimates

Seg	Cycle length C	Green ratio g/C	v/c ratio X	Lane cap. c	PVG if Input	Arr. type AT	I fac-tor	Unit ext. (sec)	Init. queue (veh)	Cntrl. delay (sec)	Other delay (sec)	Inter. LOS
1	70.0	0.429	0.412	689		3	1.000	0.0	0	15.7	0.0	B
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												

Arterial Level of Service

Seg.	Sect.	Running time (sec)	Inter. control. delay (sec)	Other delay (sec)	Sum of time by section (sec)	Sum of length by section (mi)	Arterial speed (mph)	Arterial LOS by section
1	1	38.4	15.7	0.0	54.1	0.40	26.6	C
2								
3								
4								
5								
6								

```
7
8
9
10
11
12
13
14
15
_____________________________________________________________________________

Total travel time (x)                   =  54.1      sec
Total length (y)                        =  0.40      miles
Total travel speed, Sa = 3600 x (y)/(x) =  26.6      mph
Total urban street LOS (Exhibit 15-2)   =  C

_________________________Intersection Files in the Analysis_______________________
 1: C:\Documents and Settings\End-user\My Documents\HGBD\Gwinnett-Stiles 2005 PM  2:
 2: C:\Documents and Settings\End-user\My Documents\HGBD\Gwinnett-I16 a 2005 PM P 3:
 3:
 4:
 5:
 6:
 7:
 8:
 9:
10:
11:
12:
13:
14:
15:
```

HCS2000: Urban Streets Release 4.1d

Courtney Lane
Hussey, Gay, Bell and DeYoung
329 Commercial Drive
Savannah, GA 31416

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E-Mail: clane@hgbd.com

OPERATIONAL ANALYSIS

Analyst:	Courtney Lane
Agency/Co.:	HGBD, Inc
Date Performed:	1/17/2005
Analysis Time Period:	PM Peak Hour
Urban Street:	Gwinnett
Direction of Travel:	West-bound
Jurisdiction:	City of Savannah
Analysis Year:	2005

Project ID: Gwinnett Street Traffic Study

Description of Arterial

Analysis period length 0.25 hr

Seg.	Cross street name	Length of segment (mi)	Urban street class	Free flow speed (mph)	Running time (sec)	Section
0	Gwinnett					
1	I-16 On / W. Boundary	0.40	2	40	38.4	1
2	Stiles					
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						

Intersection Delay Estimates

Seg	Cycle length C	Green ratio g/C	v/c ratio X	Lane cap. c	PVG if Input	Arr. type AT	I fac-tor	Unit ext. (sec)	Init. queue (veh)	Cntrl. delay (sec)	Other delay (sec)	Inter. LOS
1	60.0	0.533	0.380	994		3	1.000	0.0	0	9.3	0.0	A
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												

Arterial Level of Service

Seg.	Sect.	Running time (sec)	Inter. control. delay (sec)	Other delay (sec)	Sum of time by section (sec)	Sum of length by section (mi)	Arterial speed (mph)	Arterial LOS by section
1	1	38.4	9.3	0.0	47.7	0.40	30.2	B
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								

```
12
13
14
15
_____________________________________________________________________________

Total travel time (x)                   =  47.7      sec
Total length (y)                        =  0.40      miles
Total travel speed, Sa = 3600 x (y)/(x) =  30.2      mph
Total urban street LOS (Exhibit 15-2)   =  B

_________________________Intersection Files in the Analysis_________________________
 1: C:\Documents and Settings\End-user\My Documents\HGBD\Gwinnett-I16 a 2005 PM P 2:
 2: C:\Documents and Settings\End-user\My Documents\HGBD\Gwinnett-Stiles 2005 PM  3:
 3:
 4:
 5:
 6:
 7:
 8:
 9:
10:
11:
12:
13:
14:
15:
```

Gwinnett Arterial Planning Analysis of Proposed Conditions
(Analysis Year: 2028)

HCS2000: Urban Streets Release 4.1d

Courtney Lane
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329 Commercial Drive
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OPERATIONAL ANALYSIS

Analyst:	Courtney Lane
Agency/Co.:	HGBD, Inc.
Date Performed:	1/17/2005
Analysis Time Period:	PM Peak Hour
Urban Street:	Gwinnett
Direction of Travel:	East-bound
Jurisdiction:	City of Savannah
Analysis Year:	2028

Project ID: Gwinnett Street Traffic Study

Description of Arterial

Analysis period length 0.25 hr

Seg.	Cross street name	Length of segment (mi)	Urban street class	Free flow speed (mph)	Running time (sec)	Section
0	Gwinnett					
1	Stiles Avenue	0.40	2	40	38.4	1
2	I-16 On / W. Boundary					
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						

Intersection Delay Estimates

Seg	Cycle length C	Green ratio g/C	v/c ratio X	Lane cap. c	PVG if Input	Arr. type AT	I fac-tor	Unit ext. (sec)	Init. queue (veh)	Cntrl. delay (sec)	Other delay (sec)	Inter. LOS
1	70.0	0.429	0.475	688		3	1.000	0.0	0	16.7	0.0	B
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												

Arterial Level of Service

Seg.	Sect.	Running time (sec)	Inter. control. delay (sec)	Other delay (sec)	Sum of time by section (sec)	Sum of length by section (mi)	Arterial speed (mph)	Arterial LOS by section
1	1	38.4	16.7	0.0	55.1	0.40	26.1	C
2								
3								

```
4
5
6
7
8
9
10
11
12
13
14
15
_____________________________________________________________________________

Total travel time (x)                   =  55.1      sec
Total length (y)                        =  0.40      miles
Total travel speed, Sa = 3600 x (y)/(x) =  26.1      mph
Total urban street LOS (Exhibit 15-2)   =  C

_________________________Intersection Files in the Analysis_______________________
 1: C:\Documents and Settings\End-user\My Documents\HGBD\Gwinnett-Stiles 2028 PM  2:
 2: C:\Documents and Settings\End-user\My Documents\HGBD\Gwinnett-I16 a 2028 PM P 3:
 3:
 4:
 5:
 6:
 7:
 8:
 9:
10:
11:
12:
13:
14:
15:
```

HCS2000: Urban Streets Release 4.1d

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OPERATIONAL ANALYSIS

Analyst:	Courtney Lane
Agency/Co.:	HGBD, Inc.
Date Performed:	1/17/2005
Analysis Time Period:	PM Peak Hour
Urban Street:	Gwinnett
Direction of Travel:	West-bound
Jurisdiction:	City of Savannah
Analysis Year:	2028

Project ID: Gwinnett Street Traffic Study

Description of Arterial

Analysis period length 0.25 hr

Seg.	Cross street name	Length of segment (mi)	Urban street class	Free flow speed (mph)	Running time (sec)	Section
0	Gwinnett					
1	I-16 On / W. Boundary	0.40	2	40	38.4	1
2	Stiles Avenue					
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						

Intersection Delay Estimates

Seg	Cycle length C	Green ratio g/C	v/c ratio X	Lane cap. c	PVG if Input	Arr. type AT	I fac-tor	Unit ext. (sec)	Init. queue (veh)	Cntrl. delay (sec)	Other delay (sec)	Inter. LOS
1	60.0	0.533	0.379	1892		3	1.000	0.0	0	8.8	0.0	A
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												

Arterial Level of Service

Seg.	Sect.	Running time (sec)	Inter. control. delay (sec)	Other delay (sec)	Sum of time by section (sec)	Sum of length by section (mi)	Arterial speed (mph)	Arterial LOS by section
1	1	38.4	8.8	0.0	47.2	0.40	30.5	B
2								
3								
4								
5								
6								
7								
8								
9								
10								

```
11
12
13
14
15
_____________________________________________________________________________

Total travel time (x)                   =  47.2      sec
Total length (y)                        =  0.40      miles
Total travel speed, Sa = 3600 x (y)/(x) =  30.5      mph
Total urban street LOS (Exhibit 15-2)   =  B

_________________________Intersection Files in the Analysis_______________________
 1: C:\Documents and Settings\End-user\My Documents\HGBD\Gwinnett-I16 a 2028 PM P 2:
 2: C:\Documents and Settings\End-user\My Documents\HGBD\Gwinnett-Stiles 2028 PM  3:
 3:
 4:
 5:
 6:
 7:
 8:
 9:
10:
11:
12:
13:
14:
15:
```

Gwinnett Arterial Planning Analysis of Proposed Conditions
"Sell Out Event"
(Analysis Year: 2028)

HCS2000: Urban Streets Release 4.1d

Courtney Lane
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Phone: (912) 354-4626 Fax: (912) 354-6754
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OPERATIONAL ANALYSIS

Analyst:	Courtney Lane
Agency/Co.:	HGBD, Inc.
Date Performed:	1/17/2005
Analysis Time Period:	PM Peak Hour w/ Event
Urban Street:	Gwinnett
Direction of Travel:	East-bound
Jurisdiction:	City of Savannah
Analysis Year:	2028
Project ID:	Gwinnett Street Traffic Study

Description of Arterial

Analysis period length 0.25 hr

Seg.	Cross street name	Length of segment (mi)	Urban street class	Free flow speed (mph)	Running time (sec)	Section
0						
1	Stiles Avenue	0.40	2	40	38.4	1
2	I-16 On / W. Boundary					
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						

Intersection Delay Estimates

Seg	Cycle length C	Green ratio g/C	v/c ratio X	Lane cap. c	PVG if Input	Arr. type AT	I fac-tor	Unit ext. (sec)	Init. queue (veh)	Cntrl. delay (sec)	Other delay (sec)	Inter. LOS
1	70.0	0.429	1.012	510		3	1.000	0.0	0	62.8	0.0	E
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												

Arterial Level of Service

Seg.	Sect.	Running time (sec)	Inter. control. delay (sec)	Other delay (sec)	Sum of time by section (sec)	Sum of length by section (mi)	Arterial speed (mph)	Arterial LOS by section
1	1	38.4	62.8	0.0	101.2	0.40	14.2	E
2								
3								
4								

```
5
6
7
8
9
10
11
12
13
14
15
_____________________________________________________________________________

Total travel time (x)                   =  101.2     sec
Total length (y)                        =  0.40      miles
Total travel speed, Sa = 3600 x (y)/(x) =  14.2      mph
Total urban street LOS (Exhibit 15-2)   =  E

_________________________Intersection Files in the Analysis_______________________
 1: C:\Documents and Settings\End-user\My Documents\HGBD\Gwinnett-Stiles 2028 PM  2:
 2: C:\Documents and Settings\End-user\My Documents\HGBD\Gwinnett-I16 a 2028 PM P 3:
 3:
 4:
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 9:
10:
11:
12:
13:
14:
15:
```

HCS2000: Urban Streets Release 4.1d

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OPERATIONAL ANALYSIS

Analyst:	Courtney Lane
Agency/Co.:	HGBD, Inc.
Date Performed:	1/17/2005
Analysis Time Period:	PM Peak Hour w/ Event
Urban Street:	Gwinnett
Direction of Travel:	West-bound
Jurisdiction:	City of Savannah
Analysis Year:	2028

Project ID: Gwinnett Street Traffic Study

Description of Arterial

Analysis period length 0.25 hr

Seg.	Cross street name	Length of segment (mi)	Urban street class	Free flow speed (mph)	Running time (sec)	Section
0						
1	I-16 On / W. Boundary	0.40	2	40	38.4	1
2	Stiles Avenue					
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						

Intersection Delay Estimates

Seg	Cycle length C	Green ratio g/C	v/c ratio X	Lane cap. c	PVG if Input	Arr. type AT	I fac-tor	Unit ext. (sec)	Init. queue (veh)	Cntrl. delay (sec)	Other delay (sec)	Inter. LOS
1	85.0	0.647	0.901	2295		3	1.000	0.0	0	18.9	0.0	B
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												

Arterial Level of Service

Seg.	Sect.	Running time (sec)	Inter. control. delay (sec)	Other delay (sec)	Sum of time by section (sec)	Sum of length by section (mi)	Arterial speed (mph)	Arterial LOS by section
1	1	38.4	18.9	0.0	57.3	0.40	25.1	C
2								
3								
4								
5								
6								
7								
8								
9								
10								

```
11
12
13
14
15
_____________________________________________________________________________

Total travel time (x)                   =  57.3      sec
Total length (y)                        =  0.40      miles
Total travel speed, Sa = 3600 x (y)/(x) =  25.1      mph
Total urban street LOS (Exhibit 15-2)   =  C

_________________________Intersection Files in the Analysis_________________________
 1: C:\Documents and Settings\End-user\My Documents\HGBD\Gwinnett-I16 a 2028 PM P 2: C:\Documents and
Settings\End-user\My Documents\HGBD\Gwinnett-Stiles 2028 PM  3:
 4:
 5:
 6:
 7:
 8:
 9:
10:
11:
12:
13:
14:
15:
```

Gwinnett Signalized Intersection Operational Analysis for Gwinnett Street and Stiles Avenue Intersection Unimproved Conditions (Analysis Year: 2005)

HCS2000: Signalized Intersections Release 4.1e

Analyst: Courtney Lane
Agency: HGBD, Inc.
Date: 1/16/2005
Period: PM Peak Hour
Project ID: Gwinnett Street Traffic Study
E/W St: Gwinnett

Inter.: Gwinnett & Stiles
Area Type: All other areas
Jurisd: City of Savannah
Year : 2005
N/S St: Stiles

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	1	1	0	1	1	0
LGConfig		LTR		L	TR		L	TR		L	TR	
Volume	55	150	50	100	150	135	50	90	100	135	90	55
Lane Width		12.0		12.0	12.0		12.0	12.0		12.0	12.0	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4			5	6	7	8
EB Left	P				NB	Left	P			
Thru	P					Thru	P			
Right	P					Right	P			
Peds						Peds				
WB Left	P				SB	Left	P			
Thru	P					Thru	P			
Right	P					Right	P			
Peds						Peds				
NB Right					EB	Right				
SB Right					WB	Right				
Green	30.0						30.0			
Yellow	4.0						4.0			
All Red	1.0						1.0			

Cycle Length: 70.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
LTR	689	1607	0.41	0.43	15.7	B	15.7	B
Westbound								
L	461	1076	0.24	0.43	14.0	B		
TR	756	1765	0.42	0.43	15.6	B	15.2	B
Northbound								
L	534	1245	0.10	0.43	12.4	B		
TR	750	1750	0.28	0.43	13.9	B	13.6	B
Southbound								
L	504	1177	0.30	0.43	14.6	B		
TR	768	1792	0.21	0.43	13.2	B	13.9	B

Intersection Delay = 14.7 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst:	Courtney Lane
Agency/Co.:	HGBD, Inc.
Date Performed:	1/16/2005
Analysis Time Period:	PM Peak Hour
Intersection:	Gwinnett & Stiles
Area Type:	All other areas
Jurisdiction:	City of Savannah
Analysis Year:	2005

Project ID: Gwinnett Street Traffic Study
East/West Street: Gwinnett — North/South Street: Stiles

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	55	150	50	100	150	135	50	90	100	135	90	55
% Heavy Veh	0	0	0	0	0	0	0	0	0	0	0	0
PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
PK 15 Vol	15	42	14	28	42	38	14	25	28	38	25	15
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900		1900	1900		1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	0	1	0	1	1	0	1	1	0	1	1	0
LGConfig		LTR		L	TR		L	TR		L	TR	
Lane Width		12.0		12.0	12.0		12.0	12.0		12.0	12.0	
RTOR Vol			0			0			0			0
Adj Flow		284		111	317		56	211		150	161	
%InSharedLn												
Prop LTs		0.215		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs	0.197			0.473			0.526			0.379		
Peds Bikes	0			0			0			0		
Buses		0		0	0		0	0		0	0	
%InProtPhase												

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Arriv. Type		3		3	3		3	3		3	3	
Unit Ext.		3.0		3.0	3.0		3.0	3.0		3.0	3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time		2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Ext of g		2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				30.0			
Yellow	4.0				4.0			
All Red	1.0				1.0			

Cycle Length: 70.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	55	150	50	100	150	135	50	90	100	135	90	55
PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj flow	61	167	56	111	167	150	56	100	111	150	100	61
No. Lanes	0	1	0	1	1	0	1	1	0	1	1	0
Lane group		LTR		L	TR		L	TR		L	TR	
Adj flow		284		111	317		56	211		150	161	
Prop LTs		0.215		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.197			0.473			0.526			0.379	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)____

	Eastbound			Westbound			Northbound			Southbound		
LG		LTR		L	TR		L	TR		L	TR	
So		1900		1900	1900		1900	1900		1900	1900	
Lanes	0	1	0	1	1	0	1	1	0	1	1	0
fW		1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fHV		1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fG		1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fP		1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fBB		1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fA		1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fLU		1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRT		0.973			0.929			0.921			0.943	
fLT		0.869		0.566	1.000		0.655	1.000		0.619	1.000	
Sec.												
fLpb		1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000			1.000			1.000			1.000	
S		1607		1076	1765		1245	1750		1177	1792	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	284	1607	0.18	0.43	689	0.41
Right							
Westbound							
Prot							
Perm							
Left	L	111	1076	0.10	0.43	461	0.24
Prot							
Perm							
Thru	TR	317	1765	# 0.18	0.43	756	0.42
Right							
Northbound							
Prot							
Perm							
Left	L	56	1245	0.04	0.43	534	0.10
Prot							
Perm							
Thru	TR	211	1750	0.12	0.43	750	0.28
Right							
Southbound							
Prot							
Perm							
Left	L	150	1177	# 0.13	0.43	504	0.30
Prot							
Perm							
Thru	TR	161	1792	0.09	0.43	768	0.21
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.31
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.36

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound												
LTR	0.41	0.43	13.9	1.000	689	0.50	1.8	0.0	15.7	B	15.7	B
Westbound												
L	0.24	0.43	12.7	1.000	461	0.50	1.2	0.0	14.0	B		
TR	0.42	0.43	13.9	1.000	756	0.50	1.7	0.0	15.6	B	15.2	B
Northbound												

L	0.10	0.43	12.0	1.000	534	0.50	0.4	0.0	12.4	B		
TR	0.28	0.43	13.0	1.000	750	0.50	0.9	0.0	13.9	B	13.6	B
Southbound												
L	0.30	0.43	13.1	1.000	504	0.50	1.5	0.0	14.6	B		
TR	0.21	0.43	12.6	1.000	768	0.50	0.6	0.0	13.2	B	13.9	B

Intersection delay = 14.7 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach		S	M	M
Cycle length, C 70.0 sec				
Total actual green time for LT lane group, G (s)		30.0	30.0	30.0
Effective permitted green time for LT lane group, g(s)		30.0	30.0	30.0
Opposing effective green time, go (s)		30.0	30.0	30.0
Number of lanes in LT lane group, N		1	1	1
Number of lanes in opposing approach, No		1	1	1
Adjusted LT flow rate, VLT (veh/h)		111	56	150
Proportion of LT in LT lane group, PLT		1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo		0.21	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)		284	161	211
Lost time for LT lane group, tL		5.00	5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600		2.16	1.09	2.92
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		5.52	3.13	4.10
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g		0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.57	0.57	0.57
gq, (see Exhibit C16-4,5,6,7,8)		5.04	0.00	0.31
gu=g-gq if gq>=gf, or = g-gf if gq<gf		24.96	30.00	29.69
n=Max(gq-gf)/2,0)		2.52	0.00	0.16
PTHo=1-PLTo		0.79	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)		1.71	1.53	1.60
EL2=Max((1-Ptho**n)/Plto, 1.0)		2.12		
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.13	0.13	0.13
gdiff=max(gq-gf,0)		5.04	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.57	0.66	0.62
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.566	0.655	0.619

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M			
Cycle length, C 70.0 sec				
Total actual green time for LT lane group, G (s)	30.0			
Effective permitted green time for LT lane group, g(s)	30.0			
Opposing effective green time, go (s)	30.0			
Number of lanes in LT lane group, N	1			
Number of lanes in opposing approach, No	1			
Adjusted LT flow rate, VLT (veh/h)	61			
Proportion of LT in LT lane group, PLT	0.215	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo	0.00			
Adjusted opposing flow rate, Vo (veh/h)	317			
Lost time for LT lane group, tL	5.00			
Computation				
LT volume per cycle, LTC=VLTC/3600	1.19			
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	6.16			
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	6.1			
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.57			
gq, (see Exhibit C16-4,5,6,7,8)	5.91			
gu=g-gq if gq>=gf, or = g-gf if gq<gf	23.93			
n=Max(gq-gf)/2,0)	0.00			
PTHo=1-PLTo	1.00			
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.21			
EL1 (refer to Exhibit C16-3)	1.91			
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.08			
gdiff=max(gq-gf,0)	0.00			

```
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)    0.87
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)
or flt=[fm+0.91(N-1)]/N**
Left-turn adjustment, fLT                              0.869

For special case of single-lane approach opposed by multilane approach,
see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
  left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when gf>gq, see text.

_______________SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_______________
Permitted Left Turns
                                                        EB    WB    NB    SB
Effective pedestrian green time, gp (s)
Conflicting pedestrian volume, Vped (p/h)
Pedestrian flow rate, Vpedg (p/h)
OCCpedg
Opposing queue clearing green, gq (s)
Eff. ped. green consumed by opp. veh. queue, gq/gp
OCCpedu
Opposing flow rate, Vo (veh/h)
OCCr
Number of cross-street receiving lanes, Nrec
Number of turning lanes, Nturn
ApbT
Proportion of left turns, PLT
Proportion of left turns using protected phase, PLTA
Left-turn adjustment, fLpb
Permitted Right Turns
Effective pedestrian green time, gp (s)
Conflicting pedestrian volume, Vped (p/h)
Conflicting bicycle volume, Vbic (bicycles/h)
Vpedg
OCCpedg
Effective green, g (s)
Vbicg
OCCbicg
OCCr
Number of cross-street receiving lanes, Nrec
Number of turning lanes, Nturn
ApbT
Proportion right-turns, PRT
Proportion right-turns using protected phase, PRTA
Right turn adjustment, fRpb

_____________________SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____________________

                                                       EBLT  WBLT  NBLT  SBLT
Cycle length, C                           70.0   sec
Adj. LT vol from Vol Adjustment Worksheet, v
v/c ratio from Capacity Worksheet, X
Protected phase effective green interval, g (s)
Opposing queue effective green interval, gq
Unopposed green interval, gu
Red time r=(C-g-gq-gu)
Arrival rate, qa=v/(3600(max[X,1.0]))
Protected ph. departure rate, Sp=s/3600
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)
XPerm
XProt
Case
Queue at beginning of green arrow, Qa
Queue at beginning of unsaturated green, Qu
Residual queue, Qr
Uniform Delay, d1

_________________DELAY/LOS WORKSHEET WITH INITIAL QUEUE_________________________

        Initial Dur.    Uniform Delay   Initial Final   Initial Lane
Appr/   Unmet   Unmet   ______________  Queue   Unmet   Queue   Group
Lane    Demand  Demand  Unadj.  Adj.    Param.  Demand  Delay   Delay
Group   Q veh   t hrs.  ds      d1 sec    u     Q veh   d3 sec  d sec
_____________________________________________________________________________
Eastbound



Westbound



Northbound
```

Southbound

Intersection Delay 14.7 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound	Westbound		Northbound		Southbound	
LaneGroup	LTR	L	TR	L	TR	L	TR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	284	111	317	56	211	150	161
So	1900	1900	1900	1900	1900	1900	1900
No.Lanes	0 1 0	1	1 0	1	1 0	1	1 0
SL	1607	1076	1765	1245	1750	1177	1792
LnCapacity	689	461	756	534	750	504	768
Flow Ratio	0.18	0.10	0.18	0.04	0.12	0.13	0.09
v/c Ratio	0.41	0.24	0.42	0.10	0.28	0.30	0.21
Grn Ratio	0.43	0.43	0.43	0.43	0.43	0.43	0.43
I Factor	1.000		1.000		1.000		1.000
AT or PVG	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	3.8	1.4	4.3	0.7	2.7	1.9	2.0
kB	0.7	0.6	0.8	0.6	0.8	0.6	0.8
Q2	0.5	0.2	0.6	0.1	0.3	0.2	0.2
Q Average	4.3	1.6	4.9	0.7	3.0	2.2	2.2
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Q Storage	100	50	100	50	100	50	100
Q S Ratio	1.1	0.8	1.2	0.4	0.7	1.1	0.5
70th Percentile Output:							
fB%	1.2	1.3	1.2	1.3	1.3	1.3	1.3
BOQ	5.4	2.0	6.0	0.9	3.7	2.7	2.8
QSRatio	1.3	1.0	1.5	0.5	0.9	1.4	0.7
85th Percentile Output:							
fB%	1.5	1.6	1.5	1.7	1.6	1.6	1.6
BOQ	6.6	2.5	7.4	1.2	4.7	3.4	3.5
QSRatio	1.7	1.3	1.8	0.6	1.2	1.7	0.9
90th Percentile Output:							
fB%	1.7	1.9	1.7	1.9	1.8	1.8	1.8
BOQ	7.4	2.9	8.2	1.4	5.3	3.9	4.0
QSRatio	1.9	1.4	2.1	0.7	1.3	2.0	1.0
95th Percentile Output:							
fB%	2.0	2.3	2.0	2.5	2.2	2.2	2.2
BOQ	8.8	3.6	9.6	1.8	6.4	4.9	4.9
QSRatio	2.2	1.8	2.4	0.9	1.6	2.4	1.2
98th Percentile Output:							
fB%	2.3	2.8	2.3	3.0	2.5	2.7	2.7
BOQ	10.1	4.3	11.0	2.2	7.5	5.8	5.8
QSRatio	2.5	2.2	2.8	1.1	1.9	2.9	1.5

ERROR MESSAGES

No errors to report.

Gwinnett Signalized Intersection Operational Analysis for Gwinnett Street and Stiles Avenue Intersection Proposed Conditions (Analysis Year: 2028)

HCS2000: Signalized Intersections Release 4.1e

Analyst: Courtney Lane
Agency: HGBD, Inc.
Date: 1/12/2005
Period: PM Peak Hour
Project ID: Gwinnett Street Traffic Study
E/W St: Gwinnett Street

Inter.: Gwinnett & Stiles
Area Type: All other areas
Jurisd: City of Savannah
Year : 2028
N/S St: Stiles Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	1	1	2	1	1	2	1
LGConfig		LTR		L	T	R	L	T	R	L	T	R
Volume	65	175	55	130	195	190	55	105	130	270	150	95
Lane Width		12.0		12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4			5	6	7	8
EB Left	P				NB	Left	P			
Thru	P					Thru	P			
Right	P					Right	P			
Peds						Peds				
WB Left	P				SB	Left	P			
Thru	P					Thru	P			
Right	P					Right	P			
Peds						Peds				
NB Right					EB	Right				
SB Right					WB	Right				
Green	30.0						30.0			
Yellow	4.0						4.0			
All Red	1.0						1.0			

Cycle Length: 70.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
LTR	688	1605	0.48	0.43	16.7	B	16.7	B
Westbound								
L	424	990	0.34	0.43	15.5	B		
T	798	1863	0.27	0.43	13.8	B	14.4	B
R	678	1583	0.31	0.43	14.4	B		
Northbound								
L	516	1204	0.12	0.43	12.5	B		
T	1520	3547	0.08	0.43	11.9	B	12.6	B
R	678	1583	0.21	0.43	13.3	B		
Southbound								
L	541	1263	0.55	0.43	19.1	B		
T	1520	3547	0.11	0.43	12.1	B	15.9	B
R	678	1583	0.16	0.43	12.9	B		

Intersection Delay = 15.0 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst: Courtney Lane
Agency/Co.: HGBD, Inc.
Date Performed: 1/12/2005
Analysis Time Period: PM Peak Hour
Intersection: Gwinnett & Stiles
Area Type: All other areas
Jurisdiction: City of Savannah
Analysis Year: 2028
Project ID: Gwinnett Street Traffic Study
East/West Street: Gwinnett Street
North/South Street: Stiles Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	65	175	55	130	195	190	55	105	130	270	150	95
% Heavy Veh	2	2	2	2	2	2	2	2	2	2	2	2
PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
PK 15 Vol	18	49	15	36	54	53	15	29	36	75	42	26
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900		1900	1900	1900	1900	1900	1900	1900	1900	1900
ParkExist												
NumPark												
No. Lanes	0	1	0	1	1	1	1	2	1	1	2	1
LGConfig		LTR		L	T	R	L	T	R	L	T	R
Lane Width		12.0		12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
RTOR Vol			0			0			0			0
Adj Flow		327		144	217	211	61	117	144	300	167	106
%InSharedLn												
Prop LTs		0.220		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs	0.187				0.000	1.000		0.000	1.000		0.000	1.000
Peds Bikes	0				0			0			0	
Buses		0		0	0	0	0	0	0	0	0	0
%InProtPhase												
Duration	0.25											

Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0
Arriv. Type		3		3	3	3	3	3	3	3	3	3
Unit Ext.		3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time		2.0		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Ext of g		2.0		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				30.0			
Yellow	4.0				4.0			
All Red	1.0				1.0			

Cycle Length: 70.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	65	175	55	130	195	190	55	105	130	270	150	95
PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj flow	72	194	61	144	217	211	61	117	144	300	167	106
No. Lanes	0	1	0	1	1	1	1	2	1	1	2	1
Lane group		LTR		L	T	R	L	T	R	L	T	R
Adj flow		327		144	217	211	61	117	144	300	167	106
Prop LTs		0.220		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.187			0.000	1.000		0.000	1.000		0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)____

	Eastbound		Westbound			Northbound			Southbound		
LG	LTR		L	T	R	L	T	R	L	T	R
So	1900		1900	1900	1900	1900	1900	1900	1900	1900	1900
Lanes 0	1	0	1	1	1	1	2	1	1	2	1
fW	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fHV	0.980		0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980
fG	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fP	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fBB	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fA	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fLU	1.000		1.000	1.000	1.000	1.000	0.952	1.000	1.000	0.952	1.000
fRT	0.975			1.000	0.850		1.000	0.850		1.000	0.850
fLT	0.884		0.532	1.000		0.646	1.000		0.678	1.000	
Sec.											
fLpb	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb	1.000			1.000	1.000		1.000	1.000		1.000	1.000
S	1605		990	1863	1583	1204	3547	1583	1263	3547	1583
Sec.											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	327	1605	# 0.20	0.43	688	0.48
Right							
Westbound							
Prot							
Perm							
Left	L	144	990	0.15	0.43	424	0.34
Prot							
Perm							
Thru	T	217	1863	0.12	0.43	798	0.27
Right	R	211	1583	0.13	0.43	678	0.31
Northbound							
Prot							
Perm							
Left	L	61	1204	0.05	0.43	516	0.12
Prot							
Perm							
Thru	T	117	3547	0.03	0.43	1520	0.08
Right	R	144	1583	0.09	0.43	678	0.21
Southbound							
Prot							
Perm							
Left	L	300	1263	# 0.24	0.43	541	0.55
Prot							
Perm							
Thru	T	167	3547	0.05	0.43	1520	0.11
Right	R	106	1583	0.07	0.43	678	0.16

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.44
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.51

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor Del k	d2	Res Del d3	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound												
LTR	0.48	0.43	14.4	1.000	688	0.50	2.3	0.0	16.7	B	16.7	B
Westbound												
L	0.34	0.43	13.4	1.000	424	0.50	2.2	0.0	15.5	B		
T	0.27	0.43	12.9	1.000	798	0.50	0.8	0.0	13.8	B	14.4	B
R	0.31	0.43	13.2	1.000	678	0.50	1.2	0.0	14.4	B		
Northbound												

L	0.12	0.43	12.0	1.000	516	0.50	0.5	0.0	12.5	B		
T	0.08	0.43	11.8	1.000	1520	0.50	0.1	0.0	11.9	B	12.6	B
R	0.21	0.43	12.6	1.000	678	0.50	0.7	0.0	13.3	B		
Southbound												
L	0.55	0.43	15.0	1.000	541	0.50	4.1	0.0	19.1	B		
T	0.11	0.43	12.0	1.000	1520	0.50	0.1	0.0	12.1	B	15.9	B
R	0.16	0.43	12.4	1.000	678	0.50	0.5	0.1	12.9	B		

Intersection delay = 15.0 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach		S	M	M
Cycle length, C 70.0 sec				
Total actual green time for LT lane group, G (s)		30.0	30.0	30.0
Effective permitted green time for LT lane group, g(s)		30.0	30.0	30.0
Opposing effective green time, go (s)		30.0	30.0	30.0
Number of lanes in LT lane group, N		1	1	1
Number of lanes in opposing approach, No		1	2	2
Adjusted LT flow rate, VLT (veh/h)		144	61	300
Proportion of LT in LT lane group, PLT		1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo		0.22	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)		327	167	117
Lost time for LT lane group, tL		5.00	5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600		2.80	1.19	5.83
Opposing lane util. factor, fLUo	1.000	1.000	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		6.36	1.71	1.19
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g		0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.57	0.57	0.57
gq, (see Exhibit C16-4,5,6,7,8)		6.18	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf		23.82	30.00	30.00
n=Max(gq-gf)/2,0)		3.09	0.00	0.00
PTHo=1-PLTo		0.78	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)		1.78	1.55	1.47
EL2=Max((1-Ptho**n)/Plto, 1.0)		2.43		
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.13	0.13	0.13
gdiff=max(gq-gf,0)		6.18	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.53	0.65	0.68
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.532	0.646	0.678

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M			
Cycle length, C 70.0 sec				
Total actual green time for LT lane group, G (s)	30.0			
Effective permitted green time for LT lane group, g(s)	30.0			
Opposing effective green time, go (s)	30.0			
Number of lanes in LT lane group, N	1			
Number of lanes in opposing approach, No	1			
Adjusted LT flow rate, VLT (veh/h)	72			
Proportion of LT in LT lane group, PLT	0.220	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo	0.00			
Adjusted opposing flow rate, Vo (veh/h)	217			
Lost time for LT lane group, tL	5.00			
Computation				
LT volume per cycle, LTC=VLTC/3600	1.40			
Opposing lane util. factor, fLUo	1.000	1.000	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	4.22			
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	4.8			
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.57			
gq, (see Exhibit C16-4,5,6,7,8)	3.18			
gu=g-gq if gq>=gf, or = g-gf if gq<gf	25.24			
n=Max(gq-gf)/2,0)	0.00			
PTHo=1-PLTo	1.00			
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.22			
EL1 (refer to Exhibit C16-3)	1.73			
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.08			
gdiff=max(gq-gf,0)	0.00			

```
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)    0.88
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)
or flt=[fm+0.91(N-1)]/N**
Left-turn adjustment, fLT                              0.884

For special case of single-lane approach opposed by multilane approach,
see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
  left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when gf>gq, see text.

_______________SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_______________
Permitted Left Turns
                                                        EB    WB    NB    SB
Effective pedestrian green time, gp (s)
Conflicting pedestrian volume, Vped (p/h)
Pedestrian flow rate, Vpedg (p/h)
OCCpedg
Opposing queue clearing green, gq (s)
Eff. ped. green consumed by opp. veh. queue, gq/gp
OCCpedu
Opposing flow rate, Vo (veh/h)
OCCr
Number of cross-street receiving lanes, Nrec
Number of turning lanes, Nturn
ApbT
Proportion of left turns, PLT
Proportion of left turns using protected phase, PLTA
Left-turn adjustment, fLpb
Permitted Right Turns
Effective pedestrian green time, gp (s)
Conflicting pedestrian volume, Vped (p/h)
Conflicting bicycle volume, Vbic (bicycles/h)
Vpedg
OCCpedg
Effective green, g (s)
Vbicg
OCCbicg
OCCr
Number of cross-street receiving lanes, Nrec
Number of turning lanes, Nturn
ApbT
Proportion right-turns, PRT
Proportion right-turns using protected phase, PRTA
Right turn adjustment, fRpb

_____________________SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____________________

                                                       EBLT  WBLT  NBLT  SBLT
Cycle length, C                           70.0   sec
Adj. LT vol from Vol Adjustment Worksheet, v
v/c ratio from Capacity Worksheet, X
Protected phase effective green interval, g (s)
Opposing queue effective green interval, gq
Unopposed green interval, gu
Red time r=(C-g-gq-gu)
Arrival rate, qa=v/(3600(max[X,1.0]))
Protected ph. departure rate, Sp=s/3600
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)
XPerm
XProt
Case
Queue at beginning of green arrow, Qa
Queue at beginning of unsaturated green, Qu
Residual queue, Qr
Uniform Delay, d1

_________________DELAY/LOS WORKSHEET WITH INITIAL QUEUE_________________________

        Initial Dur.    Uniform Delay   Initial Final   Initial Lane
Appr/   Unmet   Unmet   ______________  Queue   Unmet   Queue   Group
Lane    Demand  Demand  Unadj.  Adj.    Param.  Demand  Delay   Delay
Group   Q veh   t hrs.  ds      d1 sec    u     Q veh   d3 sec  d sec
_____________________________________________________________________________
Eastbound



Westbound



Northbound
```

Southbound

R	2.0	0.00	20.0	12.4	0.00	0.0	0.1	12.9

Intersection Delay 15.0 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound	Westbound			Northbound			Southbound		
LaneGroup	LTR	L	T	R	L	T	R	L	T	R
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0
Flow Rate	327	144	217	211	61	61	144	300	87	114
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	0 1 0	1	1	1	1	2	1	1	2	1
SL	1605	990	1863	1583	1204	1862	1583	1263	1862	1583
LnCapacity	688	424	798	678	516	798	678	541	798	678
Flow Ratio	0.20	0.15	0.12	0.13	0.05	0.03	0.09	0.24	0.05	0.07
v/c Ratio	0.48	0.34	0.27	0.31	0.12	0.08	0.21	0.55	0.11	0.17
Grn Ratio	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43
I Factor	1.000		1.000			1.000			1.000	
AT or PVG	3	3	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	4.6	1.9	2.7	2.7	0.7	0.7	1.8	4.4	1.0	1.4
kB	0.7	0.5	0.8	0.7	0.6	0.8	0.7	0.6	0.8	0.7
Q2	0.7	0.3	0.3	0.3	0.1	0.1	0.2	0.8	0.1	0.2
Q Average	5.2	2.1	3.0	3.0	0.8	0.8	2.0	5.1	1.1	1.5
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Q Storage	500	100	500	100	100	500	100	100	500	100
Q S Ratio	0.3	0.5	0.2	0.8	0.2	0.0	0.5	1.3	0.1	0.4
70th Percentile Output:										
fB%	1.2	1.3	1.3	1.3	1.3	1.3	1.3	1.2	1.3	1.3
BOQ	6.4	2.7	3.8	3.8	1.0	1.0	2.5	6.3	1.4	2.0
QSRatio	0.3	0.7	0.2	1.0	0.3	0.0	0.6	1.6	0.1	0.5
85th Percentile Output:										
fB%	1.5	1.6	1.6	1.6	1.7	1.7	1.6	1.5	1.6	1.6
BOQ	7.9	3.4	4.7	4.7	1.3	1.3	3.1	7.7	1.8	2.5
QSRatio	0.4	0.9	0.2	1.2	0.3	0.1	0.8	1.9	0.1	0.6
90th Percentile Output:										
fB%	1.7	1.8	1.8	1.8	1.9	1.9	1.8	1.7	1.9	1.9
BOQ	8.8	3.9	5.4	5.4	1.5	1.5	3.6	8.6	2.1	2.9
QSRatio	0.4	1.0	0.3	1.3	0.4	0.1	0.9	2.2	0.1	0.7
95th Percentile Output:										
fB%	2.0	2.3	2.1	2.1	2.5	2.5	2.3	2.0	2.4	2.3
BOQ	10.2	4.8	6.5	6.5	1.9	1.9	4.5	10.0	2.7	3.6
QSRatio	0.5	1.2	0.3	1.6	0.5	0.1	1.1	2.5	0.1	0.9
98th Percentile Output:										
fB%	2.2	2.7	2.5	2.5	3.0	3.0	2.7	2.2	2.9	2.8
BOQ	11.6	5.7	7.6	7.6	2.4	2.3	5.3	11.5	3.2	4.3
QSRatio	0.6	1.4	0.4	1.9	0.6	0.1	1.3	2.9	0.2	1.1

ERROR MESSAGES

No errors to report.

Gwinnett Signalized Intersection Operational Analysis for Gwinnett Street and Stiles Avenue Intersection Proposed Conditions "Sell Out Event" (Analysis Year: 2028)

HCS2000: Signalized Intersections Release 4.1e

Analyst: Courtney Lane
Agency: HGBD, Inc.
Date: 1/12/2005
Period: PM Peak Hour w/ Event
Project ID: Gwinnett Street Traffic Study
E/W St: Gwinnett Street

Inter.: Gwinnett & Stiles
Area Type: All other areas
Jurisd: City of Savannah
Year : 2028
N/S St: Stiles Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	1	1	2	1	1	2	1
LGConfig		LTR		L	T	R	L	T	R	L	T	R
Volume	235	175	55	130	200	185	55	435	130	270	150	95
Lane Width		12.0		12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4			5	6	7	8
EB Left	P				NB	Left	P			
Thru	P					Thru	P			
Right	P					Right	P			
Peds						Peds				
WB Left	P				SB	Left	P			
Thru	P					Thru	P			
Right	P					Right	P			
Peds						Peds				
NB Right					EB	Right				
SB Right					WB	Right				
Green	30.0						30.0			
Yellow	4.0						4.0			
All Red	1.0						1.0			

Cycle Length: 70.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
LTR	510	1190	1.01	0.43	62.8	E	62.8	E
Westbound								
L	390	911	0.37	0.43	16.3	B		
T	798	1863	0.28	0.43	13.8	B	14.6	B
R	678	1583	0.30	0.43	14.3	B		
Northbound								
L	516	1204	0.12	0.43	12.5	B		
T	1520	3547	0.32	0.43	13.8	B	13.6	B
R	678	1583	0.21	0.43	13.3	B		
Southbound								
L	361	842	0.83	0.43	37.3	D		
T	1520	3547	0.11	0.43	12.1	B	25.4	C
R	678	1583	0.16	0.43	12.9	B		

Intersection Delay = 27.5 (sec/veh) Intersection LOS = C

HCS2000: Signalized Intersections Release 4.1e

Courtney Lane
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OPERATIONAL ANALYSIS

Analyst: Courtney Lane
Agency/Co.: HGBD, Inc.
Date Performed: 1/12/2005
Analysis Time Period: PM Peak Hour w/ Event
Intersection: Gwinnett & Stiles
Area Type: All other areas
Jurisdiction: City of Savannah
Analysis Year: 2028
Project ID: Gwinnett Street Traffic Study
East/West Street: Gwinnett Street
North/South Street: Stiles Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	235	175	55	130	200	185	55	435	130	270	150	95
% Heavy Veh	2	2	0	2	2	2	2	2	2	2	2	2
PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
PK 15 Vol	65	49	15	36	56	51	15	121	36	75	42	26
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900		1900	1900	1900	1900	1900	1900	1900	1900	1900
ParkExist												
NumPark												
No. Lanes	0	1	0	1	1	1	1	2	1	1	2	1
LGConfig		LTR		L	T	R	L	T	R	L	T	R
Lane Width		12.0		12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
RTOR Vol			0			0			0			0
Adj Flow		516		144	222	206	61	483	144	300	167	106
%InSharedLn												
Prop LTs		0.506		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs	0.118				0.000	1.000		0.000	1.000		0.000	1.000
Peds Bikes	0				0			0			0	
Buses		0		0	0	0	0	0	0	0	0	0
%InProtPhase												
Duration	0.25											

Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0
Arriv. Type		3		3	3	3	3	3	3	3	3	3
Unit Ext.		3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I Factor		1.000			1.000			1.000			1.000	
Lost Time		2.0		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Ext of g		2.0		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				30.0			
Yellow	4.0				4.0			
All Red	1.0				1.0			

Cycle Length: 70.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	235	175	55	130	200	185	55	435	130	270	150	95
PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj flow	261	194	61	144	222	206	61	483	144	300	167	106
No. Lanes	0	1	0	1	1	1	1	2	1	1	2	1
Lane group		LTR		L	T	R	L	T	R	L	T	R
Adj flow		516		144	222	206	61	483	144	300	167	106
Prop LTs		0.506		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.118			0.000	1.000		0.000	1.000		0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)____

	Eastbound		Westbound			Northbound			Southbound		
LG	LTR		L	T	R	L	T	R	L	T	R
So	1900		1900	1900	1900	1900	1900	1900	1900	1900	1900
Lanes 0	1	0	1	1	1	1	2	1	1	2	1
fW	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fHV	0.983		0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980
fG	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fP	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fBB	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fA	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fLU	1.000		1.000	1.000	1.000	1.000	0.952	1.000	1.000	0.952	1.000
fRT	0.984			1.000	0.850		1.000	0.850		1.000	0.850
fLT	0.648		0.489	1.000		0.646	1.000		0.452	1.000	
Sec.											
fLpb	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb	1.000			1.000	1.000		1.000	1.000		1.000	1.000
S	1190		911	1863	1583	1204	3547	1583	842	3547	1583
Sec.											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Flow Rate (v)	Adj Sat Flow Rate (s)		Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru	LTR	516	1190	#	0.43	0.43	510	1.01
Right								
Westbound								
Prot								
Perm								
Left	L	144	911		0.16	0.43	390	0.37
Prot								
Perm								
Thru	T	222	1863		0.12	0.43	798	0.28
Right	R	206	1583		0.13	0.43	678	0.30
Northbound								
Prot								
Perm								
Left	L	61	1204		0.05	0.43	516	0.12
Prot								
Perm								
Thru	T	483	3547		0.14	0.43	1520	0.32
Right	R	144	1583		0.09	0.43	678	0.21
Southbound								
Prot								
Perm								
Left	L	300	842	#	0.36	0.43	361	0.83
Prot								
Perm								
Thru	T	167	3547		0.05	0.43	1520	0.11
Right	R	106	1583		0.07	0.43	678	0.16

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.79
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.92

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor Del k	d2	Res Del d3	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound												
LTR	1.01	0.43	20.0	1.000	510	0.50	42.8	0.0	62.8	E	62.8	E
Westbound												
L	0.37	0.43	13.6	1.000	390	0.50	2.7	0.0	16.3	B		
T	0.28	0.43	13.0	1.000	798	0.50	0.9	0.0	13.8	B	14.6	B
R	0.30	0.43	13.1	1.000	678	0.50	1.2	0.0	14.3	B		
Northbound												

L	0.12	0.43	12.0	1.000	516	0.50	0.5	0.0	12.5	B		
T	0.32	0.43	13.2	1.000	1520	0.50	0.6	0.0	13.8	B	13.6	B
R	0.21	0.43	12.6	1.000	678	0.50	0.7	0.0	13.3	B		
Southbound												
L	0.83	0.43	17.8	1.000	361	0.50	19.5	0.0	37.3	D		
T	0.11	0.43	12.0	1.000	1520	0.50	0.1	0.0	12.1	B	25.4	C
R	0.16	0.43	12.4	1.000	678	0.50	0.5	0.1	12.9	B		

Intersection delay = 27.5 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach		S	M	M
Cycle length, C 70.0 sec				
Total actual green time for LT lane group, G (s)		30.0	30.0	30.0
Effective permitted green time for LT lane group, g(s)		30.0	30.0	30.0
Opposing effective green time, go (s)		30.0	30.0	30.0
Number of lanes in LT lane group, N		1	1	1
Number of lanes in opposing approach, No		1	2	2
Adjusted LT flow rate, VLT (veh/h)		144	61	300
Proportion of LT in LT lane group, PLT		1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo		0.51	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)		516	167	483
Lost time for LT lane group, tL		5.00	5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600		2.80	1.19	5.83
Opposing lane util. factor, fLUo	1.000	1.000	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		10.03	1.71	4.93
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g		0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.57	0.57	0.57
gq, (see Exhibit C16-4,5,6,7,8)		10.82	0.00	1.56
gu=g-gq if gq>=gf, or = g-gf if gq<gf		19.18	30.00	28.44
n=Max(gq-gf)/2,0)		5.41	0.00	0.78
PTHo=1-PLTo		0.49	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)		2.11	1.55	2.10
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.93		
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.13	0.13	0.13
gdiff=max(gq-gf,0)		10.82	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.49	0.65	0.45
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.489	0.646	0.452

For special case of single-lane approach opposed by multilane approach, see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach	M			
Cycle length, C 70.0 sec				
Total actual green time for LT lane group, G (s)	30.0			
Effective permitted green time for LT lane group, g(s)	30.0			
Opposing effective green time, go (s)	30.0			
Number of lanes in LT lane group, N	1			
Number of lanes in opposing approach, No	1			
Adjusted LT flow rate, VLT (veh/h)	261			
Proportion of LT in LT lane group, PLT	0.506	0.000	0.000	0.000
Proportion of LT in opposing flow, PLTo	0.00			
Adjusted opposing flow rate, Vo (veh/h)	222			
Lost time for LT lane group, tL	5.00			
Computation				
LT volume per cycle, LTC=VLTC/3600	5.08			
Opposing lane util. factor, fLUo	1.000	1.000	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	4.32			
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g	0.0			
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.57			
gq, (see Exhibit C16-4,5,6,7,8)	3.32			
gu=g-gq if gq>=gf, or = g-gf if gq<gf	26.68			
n=Max(gq-gf)/2,0)	1.66			
PTHo=1-PLTo	1.00			
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.51			
EL1 (refer to Exhibit C16-3)	1.74			
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.10			
gdiff=max(gq-gf,0)	0.00			

fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00) 0.65
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)
or flt=[fm+0.91(N-1)]/N**
Left-turn adjustment, fLT 0.648

For special case of single-lane approach opposed by multilane approach,
see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

		EBLT	WBLT	NBLT	SBLT
Cycle length, C	70.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v					
v/c ratio from Capacity Worksheet, X					
Protected phase effective green interval, g (s)					
Opposing queue effective green interval, gq					
Unopposed green interval, gu					
Red time r=(C-g-gq-gu)					
Arrival rate, qa=v/(3600(max[X,1.0]))					
Protected ph. departure rate, Sp=s/3600					
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)					
XPerm					
XProt					
Case					
Queue at beginning of green arrow, Qa					
Queue at beginning of unsaturated green, Qu					
Residual queue, Qr					
Uniform Delay, d1					

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								

Southbound

R	2.0	0.00	20.0	12.4	0.00	0.0	0.1	12.9

Intersection Delay 27.5 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound	Westbound			Northbound			Southbound		
LaneGroup	LTR	L	T	R	L	T	R	L	T	R
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0
Flow Rate	516	144	222	206	61	253	144	300	87	114
So	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	0 1 0	1	1	1	1	2	1	1	2	1
SL	1190	911	1863	1583	1204	1862	1583	842	1862	1583
LnCapacity	510	390	798	678	516	798	678	361	798	678
Flow Ratio	0.43	0.16	0.12	0.13	0.05	0.14	0.09	0.36	0.05	0.07
v/c Ratio	1.01	0.37	0.28	0.30	0.12	0.32	0.21	0.83	0.11	0.17
Grn Ratio	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43
I Factor	1.000		1.000			1.000			1.000	
AT or PVG	3	3	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	10.0	1.9	2.8	2.6	0.7	3.3	1.8	5.2	1.0	1.4
kB	0.6	0.5	0.8	0.7	0.6	0.8	0.7	0.5	0.8	0.7
Q2	6.6	0.3	0.3	0.3	0.1	0.4	0.2	1.9	0.1	0.2
Q Average	16.6	2.2	3.1	2.9	0.8	3.6	2.0	7.0	1.1	1.5
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Q Storage	500	100	500	100	100	500	100	100	500	100
Q S Ratio	0.8	0.5	0.2	0.7	0.2	0.2	0.5	1.8	0.1	0.4
70th Percentile Output:										
fB%	1.2	1.3	1.3	1.3	1.3	1.2	1.3	1.2	1.3	1.3
BOQ	20.0	2.8	3.9	3.7	1.0	4.5	2.5	8.6	1.4	2.0
QSRatio	1.0	0.7	0.2	0.9	0.3	0.2	0.6	2.2	0.1	0.5
85th Percentile Output:										
fB%	1.4	1.6	1.6	1.6	1.7	1.5	1.6	1.5	1.6	1.6
BOQ	23.5	3.5	4.9	4.6	1.3	5.6	3.1	10.4	1.8	2.5
QSRatio	1.2	0.9	0.2	1.2	0.3	0.3	0.8	2.6	0.1	0.6
90th Percentile Output:										
fB%	1.5	1.8	1.8	1.8	1.9	1.7	1.8	1.6	1.9	1.9
BOQ	25.2	4.0	5.5	5.2	1.5	6.3	3.6	11.4	2.1	2.9
QSRatio	1.3	1.0	0.3	1.3	0.4	0.3	0.9	2.9	0.1	0.7
95th Percentile Output:										
fB%	1.6	2.2	2.1	2.2	2.5	2.1	2.3	1.8	2.4	2.3
BOQ	27.2	4.9	6.7	6.4	1.9	7.6	4.5	13.0	2.7	3.6
QSRatio	1.4	1.2	0.3	1.6	0.5	0.4	1.1	3.2	0.1	0.9
98th Percentile Output:										
fB%	1.8	2.7	2.5	2.5	3.0	2.4	2.7	2.1	2.9	2.8
BOQ	29.2	5.8	7.8	7.5	2.4	8.8	5.3	14.5	3.2	4.3
QSRatio	1.5	1.5	0.4	1.9	0.6	0.4	1.3	3.6	0.2	1.1

ERROR MESSAGES

No errors to report.

Gwinnett Signalized Intersection Operational Analysis for Gwinnett Street and I-16 / West Boundary Street Intersection Unimproved Conditions (Analysis Year: 2005)

HCS2000: Signalized Intersections Release 4.1e

Analyst: Courtney Lane
Agency: HGBD, Inc.
Date: 1/12/2005
Period: PM Peak Hour
Project ID: Gwinnett Street Traffic Study
E/W St: Gwinnett

Inter.: Gwinnett & I16 On/W.Boundary
Area Type: All other areas
Jurisd: City of Savannah
Year : 2005
N/S St: I-16 On / W. Boundary

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	1	1	0	0	0	0	1	1	0
LGConfig		T	R	L	T					L	TR	
Volume		335	50	55	340					85	25	45
Lane Width		12.0	12.0	12.0	12.0					12.0	12.0	
RTOR Vol			0									0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left				
Thru		P			Thru				
Right		P			Right				
Peds					Peds				
WB Left	P	P			SB Left	P			
Thru	P	P			Thru	P			
Right					Right	P			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	5.0	22.0				18.0			
Yellow	4.0	4.0				4.0			
All Red	1.0	1.0				1.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
T	683	1863	0.54	0.37	18.1	B	17.4	B
R	580	1583	0.10	0.37	12.8	B		
Westbound								
L	435	1770	0.14	0.53	8.3	A		
T	994	1863	0.38	0.53	9.3	A	9.2	A
Northbound								
Southbound								
L	531	1770	0.18	0.30	16.3	B		
TR	505	1684	0.15	0.30	16.1	B	16.2	B

Intersection Delay = 13.7 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

Analyst: Courtney Lane
Agency: HGBD, Inc.
Date: 1/12/2005
Period: PM Peak Hour
Project ID: Gwinnett Street Traffic Study
E/W St: Gwinnett Street

Inter.: Gwinnett & I16 Off/ W.Boundary
Area Type: All other areas
Jurisd: City of Savannah
Year : 2005
N/S St: I-16 Off / W. Boundary

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	0	1	1	1	1	0	0	0	0
LGConfig	L	T			T	R	L	TR				
Volume	45	370		345	85		50	25	55			
Lane Width	12.0	12.0		12.0	12.0		12.0	12.0				
RTOR Vol					0				0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	P	P			NB Left	P			
Thru	P	P			Thru	P			
Right					Right	P			
Peds					Peds				
WB Left					SB Left				
Thru		P			Thru				
Right		P			Right				
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	5.0	23.0				17.0			
Yellow	4.0	4.0				4.0			
All Red	1.0	1.0				1.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	455	1805	0.11	0.55	7.6	A		
T	1045	1900	0.39	0.55	8.9	A	8.7	A
Westbound								
T	728	1900	0.53	0.38	17.0	B	16.1	B
R	619	1615	0.15	0.38	12.6	B		
Northbound								
L	511	1805	0.11	0.28	16.3	B		
TR	483	1705	0.18	0.28	17.1	B	16.8	B
Southbound								

Intersection Delay = 13.1 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

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Savannah, GA 31416

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OPERATIONAL ANALYSIS

Analyst:	Courtney Lane
Agency/Co.:	HGBD, Inc.
Date Performed:	1/12/2005
Analysis Time Period:	PM Peak Hour
Intersection:	Gwinnett & I16 On/W.Boundary
Area Type:	All other areas
Jurisdiction:	City of Savannah
Analysis Year:	2005

Project ID: Gwinnett Street Traffic Study

East/West Street	North/South Street
Gwinnett	I-16 On / W. Boundary

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		335	50	55	340					85	25	45
% Heavy Veh		2	2	2	2					2	2	2
PHF		0.90	0.90	0.90	0.90					0.90	0.90	0.90
PK 15 Vol		93	14	15	94					24	7	13
Hi Ln Vol												
% Grade		0			0						0	
Ideal Sat		1900	1900	1900	1900					1900	1900	
ParkExist												
NumPark												
No. Lanes	0	1	1		1	1	0	0	0	0	1	1	0
LGConfig		T	R	L		T				L		TR
Lane Width		12.0	12.0	12.0	12.0					12.0	12.0	
RTOR Vol			0									0
Adj Flow		372	56	61	378					94	78	
%InSharedLn												
Prop LTs		0.000		1.000	0.000						0.000	
Prop RTs	0.000		1.000		0.000					0.641		
Peds Bikes	0						0			0		
Buses		0	0	0	0					0	0	
%InProtPhase				0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0	0.0	0.0					0.0	0.0	
Arriv. Type		3	3	3	3					3	3	
Unit Ext.		3.0	3.0	3.0	3.0					3.0	3.0	
I Factor		1.000			1.000						1.000	
Lost Time		2.0	2.0	2.0	2.0					2.0	2.0	
Ext of g		2.0	2.0	2.0	2.0					2.0	2.0	
Ped Min g		3.2						3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru		P			Thru			
Right		P			Right			
Peds					Peds			
WB Left	P	P			SB Left	P		
Thru	P	P			Thru	P		
Right					Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	5.0	22.0			18.0			
Yellow	4.0	4.0			4.0			
All Red	1.0	1.0			1.0			

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		335	50	55	340					85	25	45
PHF		0.90	0.90	0.90	0.90					0.90	0.90	0.90
Adj flow		372	56	61	378					94	28	50
No. Lanes	0	1	1	1	1	0	0	0	0	1	1	0
Lane group		T	R	L	T					L	TR	
Adj flow		372	56	61	378					94	78	
Prop LTs		0.000		1.000	0.000						0.000	
Prop RTs		0.000	1.000		0.000					0.641		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)____

	Eastbound		Westbound		Northbound				Southbound		
LG	T	R	L	T					L	TR	
So	1900	1900	1900	1900					1900	1900	
Lanes 0	1	1	1	1	0	0	0	0	1	1	0
fW	1.000	1.000	1.000	1.000					1.000	1.000	
fHV	0.980	0.980	0.980	0.980					0.980	0.980	
fG	1.000	1.000	1.000	1.000					1.000	1.000	
fP	1.000	1.000	1.000	1.000					1.000	1.000	
fBB	1.000	1.000	1.000	1.000					1.000	1.000	
fA	1.000	1.000	1.000	1.000					1.000	1.000	
fLU	1.000	1.000	1.000	1.000					1.000	1.000	
fRT	1.000	0.850		1.000						0.904	
fLT	1.000		0.950	1.000					0.950	1.000	
Sec.			0.342								
fLpb	1.000		1.000	1.000					1.000	1.000	
fRpb	1.000	1.000		1.000						1.000	
S	1863	1583	1770	1863					1770	1684	
Sec.			637								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	372	1863	# 0.20	0.37	683	0.54
Right	R	56	1583	0.04	0.37	580	0.10
Westbound							
Prot		61	1770	# 0.03	0.083	148	0.41
Perm		0	637	0.00	0.450	287	0.00
Left	L	61			0.53	435	0.14
Prot							
Perm							
Thru	T	378	1863	0.20	0.53	994	0.38
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Southbound							
Prot							
Perm							
Left	L	94	1770	# 0.05	0.30	531	0.18
Prot							
Perm							
Thru	TR	78	1684	0.05	0.30	505	0.15
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.29
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.38

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
T	0.54	0.37	15.0	1.000	683	0.50	3.1	0.0	18.1	B	17.4	B
R	0.10	0.37	12.5	1.000	580	0.50	0.3	0.0	12.8	B		
Westbound												
L	0.14	0.53	7.6	1.000	435	0.50	0.7	0.0	8.3	A		
T	0.38	0.53	8.2	1.000	994	0.50	1.1	0.0	9.3	A	9.2	A
Northbound												

```
Southbound
L    0.18  0.30  15.5  1.000 531   0.50   0.7   0.0   16.3   B
TR   0.15  0.30  15.4  1.000 505   0.50   0.6   0.0   16.1   B    16.2   B

_____________________________________________________________________________
         Intersection delay = 13.7  (sec/veh)   Intersection LOS = B


_______________________SUPPLEMENTAL PERMITTED LT WORKSHEET_______________________
                            for exclusive lefts
Input
                                                        EB    WB    NB    SB
Opposed by Single(S) or Multiple(M) lane approach             M
Cycle length, C                          60.0    sec
Total actual green time for LT lane group, G (s)              32.0
Effective permitted green time for LT lane group, g(s)        27.0
Opposing effective green time, go (s)                         22.0
Number of lanes in LT lane group, N                           1
Number of lanes in opposing approach, No                      1
Adjusted LT flow rate, VLT (veh/h)                            61
Proportion of LT in LT lane group, PLT                        1.000
Proportion of LT in opposing flow, PLTo                       0.00
Adjusted opposing flow rate, Vo (veh/h)                       372
Lost time for LT lane group, tL                               5.00
Computation
LT volume per cycle, LTC=VLTC/3600                            1.02
Opposing lane util. factor, fLUo                        1.000 1.000 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)           6.20
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g                         0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)             1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]                  0.63
gq, (see Exhibit C16-4,5,6,7,8)                               9.90
gu=g-gq if gq>=gf, or = g-gf if gq<gf                         17.10
n=Max(gq-gf)/2,0)                                             4.95
PTHo=1-PLTo                                                   1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]                            1.00
EL1 (refer to Exhibit C16-3)                                  1.85
EL2=Max((1-Ptho**n)/Plto, 1.0)
fmin=2(1+PL)/g  or  fmin=2(1+Pl)/g                            0.15
gdiff=max(gq-gf,0)                                            0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)           0.34
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)
or flt=[fm+0.91(N-1)]/N**
Left-turn adjustment, fLT                                     0.342

For special case of single-lane approach opposed by multilane approach,
see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
  left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when gf>gq, see text.

_______________________SUPPLEMENTAL PERMITTED LT WORKSHEET_______________________
                              for shared lefts
Input
                                                        EB    WB    NB    SB
Opposed by Single(S) or Multiple(M) lane approach
Cycle length, C                          60.0    sec
Total actual green time for LT lane group, G (s)
Effective permitted green time for LT lane group, g(s)
Opposing effective green time, go (s)
Number of lanes in LT lane group, N
Number of lanes in opposing approach, No
Adjusted LT flow rate, VLT (veh/h)
Proportion of LT in LT lane group, PLT                  0.000 0.000       0.000
Proportion of LT in opposing flow, PLTo
Adjusted opposing flow rate, Vo (veh/h)
Lost time for LT lane group, tL
Computation
LT volume per cycle, LTC=VLTC/3600
Opposing lane util. factor, fLUo                        1.000 1.000 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g
Opposing platoon ratio, Rpo (refer Exhibit 16-11)
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]
gq, (see Exhibit C16-4,5,6,7,8)
gu=g-gq if gq>=gf, or = g-gf if gq<gf
n=Max(gq-gf)/2,0)
PTHo=1-PLTo
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]
EL1 (refer to Exhibit C16-3)
EL2=Max((1-Ptho**n)/Plto, 1.0)
fmin=2(1+PL)/g  or  fmin=2(1+Pl)/g
gdiff=max(gq-gf,0)
```

fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)
or flt=[fm+0.91(N-1)]/N**
Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach,
see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
  left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

		EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v			61		
v/c ratio from Capacity Worksheet, X			0.14		
Protected phase effective green interval, g (s)			5.0		
Opposing queue effective green interval, gq			9.90		
Unopposed green interval, gu			17.10		
Red time r=(C-g-gq-gu)			28.0		
Arrival rate, qa=v/(3600(max[X,1.0]))			0.02		
Protected ph. departure rate, Sp=s/3600			0.492		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)			0.28		
XPerm			0.10		
XProt			0.23		
Case			1		
Queue at beginning of green arrow, Qa			0.47		
Queue at beginning of unsaturated green, Qu			0.17		
Residual queue, Qr			0.00		
Uniform Delay, d1			7.6		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								

Southbound

Intersection Delay 13.7 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound			Southbound		
LaneGroup	T	R	L	T					L	TR	
Init Queue	0.0	0.0	0.0	0.0					0.0	0.0	
Flow Rate	372	56	61	378					94	78	
So	1900	1900	1900	1900					1900	1900	
No.Lanes	0 1	1	1	1	0	0	0	0	1	1	0
SL	1863	1583	814	1863					1770	1684	
LnCapacity	683	580	435	994					531	505	
Flow Ratio	0.20	0.04	0.07	0.20					0.05	0.05	
v/c Ratio	0.54	0.10	0.14	0.38					0.18	0.15	
Grn Ratio	0.37	0.37	0.53	0.53					0.30	0.30	
I Factor	1.000			1.000						1.000	
AT or PVG	3	3	3	3					3	3	
Pltn Ratio	1.00	1.00	1.00	1.00					1.00	1.00	
PF2	1.00	1.00	1.00	1.00					1.00	1.00	
Q1	4.9	0.6	0.5	3.7					1.2	1.0	
kB	0.7	0.6	0.5	0.9					0.6	0.5	
Q2	0.8	0.1	0.1	0.5					0.1	0.1	
Q Average	5.7	0.7	0.6	4.2					1.3	1.1	
Q Spacing	25.0	25.0	25.0	25.0					25.0	25.0	
Q Storage	500	100	100	500					100	100	
Q S Ratio	0.3	0.2	0.1	0.2					0.3	0.3	
70th Percentile Output:											
fB%	1.2	1.3	1.3	1.2					1.3	1.3	
BOQ	7.0	0.9	0.7	5.2					1.6	1.3	
QSRatio	0.3	0.2	0.2	0.3					0.4	0.3	
85th Percentile Output:											
fB%	1.5	1.7	1.7	1.5					1.6	1.6	
BOQ	8.5	1.1	0.9	6.4					2.1	1.7	
QSRatio	0.4	0.3	0.2	0.3					0.5	0.4	
90th Percentile Output:											
fB%	1.7	1.9	1.9	1.7					1.9	1.9	
BOQ	9.4	1.3	1.1	7.2					2.4	2.0	
QSRatio	0.5	0.3	0.3	0.4					0.6	0.5	
95th Percentile Output:											
fB%	1.9	2.5	2.5	2.0					2.4	2.4	
BOQ	10.9	1.7	1.4	8.5					3.0	2.5	
QSRatio	0.5	0.4	0.3	0.4					0.8	0.6	
98th Percentile Output:											
fB%	2.2	3.0	3.0	2.3					2.9	2.9	
BOQ	12.4	2.0	1.7	9.9					3.7	3.1	
QSRatio	0.6	0.5	0.4	0.5					0.9	0.8	

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Courtney Lane
Hussey, Gay, Bell and DeYoung
329 Commercial Drive
Savannah, GA 31416

Phone: (912) 354-4626 Fax: (912) 354-6754
E-Mail: clane@hgbd.com

OPERATIONAL ANALYSIS

Analyst:	Courtney Lane
Agency/Co.:	HGBD, Inc.
Date Performed:	1/12/2005
Analysis Time Period:	PM Peak Hour
Intersection:	Gwinnett & I16 Off/ W.Boundary
Area Type:	All other areas
Jurisdiction:	City of Savannah
Analysis Year:	2005

Project ID: Gwinnett Street Traffic Study
East/West Street: Gwinnett Street
North/South Street: I-16 Off / W. Boundary

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	45	370			345	85	50	25	55			
% Heavy Veh	0	0			0	0	0	0	0			
PHF	0.90	0.90			0.90	0.90	0.90	0.90	0.90			
PK 15 Vol	13	103			96	24	14	7	15			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat	1900	1900			1900	1900	1900	1900				
ParkExist												
NumPark												
No. Lanes	1	1	0	0	1	1	1	1	0	0	0	0
LGConfig	L	T			T	R	L	TR				
Lane Width	12.0	12.0			12.0	12.0	12.0	12.0				
RTOR Vol						0			0			
Adj Flow	50	411			383	94	56	89				
%InSharedLn												
Prop LTs	1.000	0.000			0.000			0.000				
Prop RTs		0.000		0.000	1.000		0.685					
Peds Bikes				0			0			0		
Buses	0	0			0	0	0	0				
%InProtPhase	0.0											
Duration	0.25											

Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0			0.0	0.0	0.0	0.0				
Arriv. Type	3	3			3	3	3	3				
Unit Ext.	3.0	3.0			3.0	3.0	3.0	3.0				
I Factor		1.000			1.000			1.000				
Lost Time	2.0	2.0			2.0	2.0	2.0	2.0				
Ext of g	2.0	2.0			2.0	2.0	2.0	2.0				
Ped Min g					3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P	P			NB Left	P		
Thru	P	P			Thru	P		
Right					Right	P		
Peds					Peds			
WB Left					SB Left			
Thru		P			Thru			
Right		P			Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	5.0	23.0			17.0			
Yellow	4.0	4.0			4.0			
All Red	1.0	1.0			1.0			

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	45	370			345	85	50	25	55			
PHF	0.90	0.90			0.90	0.90	0.90	0.90	0.90			
Adj flow	50	411			383	94	56	28	61			
No. Lanes	1	1	0	0	1	1	1	1	0	0	0	0
Lane group	L	T			T	R	L	TR				
Adj flow	50	411			383	94	56	89				
Prop LTs	1.000	0.000			0.000			0.000				
Prop RTs	0.000			0.000	1.000		0.685					

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)____

	Eastbound				Westbound		Northbound		Southbound			
LG	L	T			T	R	L	TR				
So	1900	1900			1900	1900	1900	1900				
Lanes	1	1	0	0	1	1	1	1	0	0	0	0
fW	1.000	1.000			1.000	1.000	1.000	1.000				
fHV	1.000	1.000			1.000	1.000	1.000	1.000				
fG	1.000	1.000			1.000	1.000	1.000	1.000				
fP	1.000	1.000			1.000	1.000	1.000	1.000				
fBB	1.000	1.000			1.000	1.000	1.000	1.000				
fA	1.000	1.000			1.000	1.000	1.000	1.000				
fLU	1.000	1.000			1.000	1.000	1.000	1.000				
fRT		1.000			1.000	0.850		0.897				
fLT	0.950	1.000			1.000		0.950	1.000				
Sec.	0.344											
fLpb	1.000	1.000			1.000		1.000	1.000				
fRpb		1.000			1.000	1.000		1.000				
S	1805	1900			1900	1615	1805	1705				
Sec.	653											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)		Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound								
Prot		50	1805	#	0.03	0.083	150	0.33
Perm		0	653		0.00	0.467	305	0.00
Left	L	50				0.55	455	0.11
Prot								
Perm								
Thru	T	411	1900		0.22	0.55	1045	0.39
Right								
Westbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru	T	383	1900	#	0.20	0.38	728	0.53
Right	R	94	1615		0.06	0.38	619	0.15
Northbound								
Prot								
Perm								
Left	L	56	1805		0.03	0.28	511	0.11
Prot								
Perm								
Thru	TR	89	1705	#	0.05	0.28	483	0.18
Right								
Southbound								
Prot								
Perm								
Left								
Prot								
Perm								
Thru								
Right								

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.28
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.38

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound												
L	0.11	0.55	7.1	1.000	455	0.50	0.5	0.0	7.6	A		
T	0.39	0.55	7.8	1.000	1045	0.50	1.1	0.0	8.9	A	8.7	A
Westbound												
T	0.53	0.38	14.3	1.000	728	0.50	2.7	0.0	17.0	B	16.1	B
R	0.15	0.38	12.1	1.000	619	0.50	0.5	0.0	12.6	B		
Northbound												

```
L    0.11  0.28  15.9  1.000 511   0.50   0.4   0.0   16.3   B
TR   0.18  0.28  16.3  1.000 483   0.50   0.8   0.0   17.1   B    16.8   B

Southbound


_____________________________________________________________________________
         Intersection delay = 13.1  (sec/veh)   Intersection LOS = B


_______________________SUPPLEMENTAL PERMITTED LT WORKSHEET_______________________
                            for exclusive lefts
Input
                                                        EB    WB    NB    SB
Opposed by Single(S) or Multiple(M) lane approach       M
Cycle length, C                           60.0    sec
Total actual green time for LT lane group, G (s)        33.0
Effective permitted green time for LT lane group, g(s)  28.0
Opposing effective green time, go (s)                   23.0
Number of lanes in LT lane group, N                     1
Number of lanes in opposing approach, No                1
Adjusted LT flow rate, VLT (veh/h)                      50
Proportion of LT in LT lane group, PLT                  1.000
Proportion of LT in opposing flow, PLTo                 0.00
Adjusted opposing flow rate, Vo (veh/h)                 383
Lost time for LT lane group, tL                         5.00
Computation
LT volume per cycle, LTC=VLTC/3600                      0.83
Opposing lane util. factor, fLUo                        1.000 1.000       1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)     6.38
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g                   0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)       1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]            0.62
gq, (see Exhibit C16-4,5,6,7,8)                         10.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf                   18.00
n=Max(gq-gf)/2,0)                                       5.00
PTHo=1-PLTo                                             1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]                      1.00
EL1 (refer to Exhibit C16-3)                            1.87
EL2=Max((1-Ptho**n)/Plto, 1.0)
fmin=2(1+PL)/g  or  fmin=2(1+Pl)/g                      0.14
gdiff=max(gq-gf,0)                                      0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)     0.34
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)
or flt=[fm+0.91(N-1)]/N**
Left-turn adjustment, fLT                               0.344

For special case of single-lane approach opposed by multilane approach,
see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
  left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when gf>gq, see text.

_______________________SUPPLEMENTAL PERMITTED LT WORKSHEET_______________________
                              for shared lefts
Input
                                                        EB    WB    NB    SB
Opposed by Single(S) or Multiple(M) lane approach
Cycle length, C                           60.0    sec
Total actual green time for LT lane group, G (s)
Effective permitted green time for LT lane group, g(s)
Opposing effective green time, go (s)
Number of lanes in LT lane group, N
Number of lanes in opposing approach, No
Adjusted LT flow rate, VLT (veh/h)
Proportion of LT in LT lane group, PLT                  0.000 0.000 0.000
Proportion of LT in opposing flow, PLTo
Adjusted opposing flow rate, Vo (veh/h)
Lost time for LT lane group, tL
Computation
LT volume per cycle, LTC=VLTC/3600
Opposing lane util. factor, fLUo                        1.000 1.000       1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g
Opposing platoon ratio, Rpo (refer Exhibit 16-11)
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]
gq, (see Exhibit C16-4,5,6,7,8)
gu=g-gq if gq>=gf, or = g-gf if gq<gf
n=Max(gq-gf)/2,0)
PTHo=1-PLTo
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]
EL1 (refer to Exhibit C16-3)
EL2=Max((1-Ptho**n)/Plto, 1.0)
fmin=2(1+PL)/g  or  fmin=2(1+Pl)/g
gdiff=max(gq-gf,0)
```

fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)
or flt=[fm+0.91(N-1)]/N**
Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach,
see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
  left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

		EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v		50			
v/c ratio from Capacity Worksheet, X		0.11			
Protected phase effective green interval, g (s)		5.0			
Opposing queue effective green interval, gq		10.00			
Unopposed green interval, gu		18.00			
Red time r=(C-g-gq-gu)		27.0			
Arrival rate, qa=v/(3600(max[X,1.0]))		0.01			
Protected ph. departure rate, Sp=s/3600		0.501			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)		0.28			
XPerm		0.08			
XProt		0.18			
Case		1			
Queue at beginning of green arrow, Qa		0.38			
Queue at beginning of unsaturated green, Qu		0.14			
Residual queue, Qr		0.00			
Uniform Delay, d1		7.1			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								

Southbound

Intersection Delay 13.1 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound				Westbound		Northbound			Southbound		
LaneGroup	L	T			T	R	L	TR				
Init Queue	0.0	0.0			0.0	0.0	0.0	0.0				
Flow Rate	50	411			383	94	56	89				
So	1900	1900			1900	1900	1900	1900				
No.Lanes	1	1	0	0	1	1	1	1	0	0	0	0
SL	828	1900			1900	1615	1805	1705				
LnCapacity	455	1045			728	619	511	483				
Flow Ratio	0.06	0.22			0.20	0.06	0.03	0.05				
v/c Ratio	0.11	0.39			0.53	0.15	0.11	0.18				
Grn Ratio	0.55	0.55			0.38	0.38	0.28	0.28				
I Factor		1.000			1.000			1.000				
AT or PVG	3	3			3	3	3	3				
Pltn Ratio	1.00	1.00			1.00	1.00	1.00	1.00				
PF2	1.00	1.00			1.00	1.00	1.00	1.00				
Q1	0.4	3.9			4.9	1.0	0.7	1.1				
kB	0.5	0.9			0.7	0.6	0.5	0.5				
Q2	0.1	0.6			0.8	0.1	0.1	0.1				
Q Average	0.4	4.5			5.7	1.1	0.8	1.2				
Q Spacing	25.0	25.0			25.0	25.0	25.0	25.0				
Q Storage	100	500			500	100	100	100				
Q S Ratio	0.1	0.2			0.3	0.3	0.2	0.3				
70th Percentile Output:												
fB%	1.3	1.2			1.2	1.3	1.3	1.3				
BOQ	0.6	5.6			7.0	1.5	1.0	1.6				
QSRatio	0.1	0.3			0.4	0.4	0.2	0.4				
85th Percentile Output:												
fB%	1.7	1.5			1.5	1.6	1.7	1.6				
BOQ	0.7	6.9			8.5	1.9	1.3	2.0				
QSRatio	0.2	0.3			0.4	0.5	0.3	0.5				
90th Percentile Output:												
fB%	2.0	1.7			1.7	1.9	1.9	1.9				
BOQ	0.9	7.7			9.4	2.2	1.5	2.3				
QSRatio	0.2	0.4			0.5	0.5	0.4	0.6				
95th Percentile Output:												
fB%	2.5	2.0			1.9	2.4	2.5	2.4				
BOQ	1.1	9.0			10.9	2.7	1.9	2.9				
QSRatio	0.3	0.5			0.5	0.7	0.5	0.7				
98th Percentile Output:												
fB%	3.1	2.3			2.2	2.9	3.0	2.9				
BOQ	1.4	10.4			12.4	3.3	2.3	3.6				
QSRatio	0.3	0.5			0.6	0.8	0.6	0.9				

ERROR MESSAGES

No errors to report.

Gwinnett Signalized Intersection Operational Analysis for Gwinnett Street and I-16 / West Boundary Street Intersection Proposed Conditions (Analysis Year: 2028)

HCS2000: Signalized Intersections Release 4.1e

Analyst: Courtney Lane
Agency: HGBD, Inc.
Date: 1/12/2005
Period: PM Peak Hour
Project ID: Gwinnett Street Traffic Study
E/W St: Gwinnett

Inter.: Gwinnett & I16 On/W.Boundary
Area Type: All other areas
Jurisd: City of Savannah
Year : 2028
N/S St: I-16 On / W. Boundary

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	1	1	2	0	0	0	0	1	1	0
LGConfig		T	R	L	T					L	TR	
Volume		740	110	60	645					90	25	85
Lane Width		12.0	12.0	12.0	12.0					12.0	12.0	
RTOR Vol			0									0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left				
Thru		P			Thru				
Right		P			Right				
Peds					Peds				
WB Left	P	P			SB Left	P			
Thru	P	P			Thru	P			
Right					Right	P			
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	5.0	22.0				18.0			
Yellow	4.0	4.0				4.0			
All Red	1.0	1.0				1.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
T	1301	3547	0.63	0.37	18.0	B	17.5	B
R	580	1583	0.21	0.37	13.9	B		
Westbound								
L	308	1770	0.22	0.53	9.7	A		
T	1892	3547	0.38	0.53	8.8	A	8.9	A
Northbound								
Southbound								
L	531	1770	0.19	0.30	16.4	B		
TR	494	1647	0.25	0.30	17.1	B	16.8	B

Intersection Delay = 13.9 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

Analyst: Courtney Lane
Agency: HGBD, Inc.
Date: 1/12/2005
Period: PM Peak Hour
Project ID: Gwinnett Street Traffic Study
E/W St: Gwinnett Street

Inter.: Gwinnett & I16 Off/ W.Boundary
Area Type: All other areas
Jurisd: City of Savannah
Year : 2028
N/S St: I-16 Off / W. Boundary

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	0	0	2	1	1	1	0	0	0	0
LGConfig	L	T			T	R	L	TR				
Volume	100	730		605	90		100	25	60			
Lane Width	12.0	12.0		12.0	12.0		12.0	12.0				
RTOR Vol					0				0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	P	P			NB Left	P			
Thru	P	P			Thru	P			
Right					Right	P			
Peds					Peds				
WB Left					SB Left				
Thru		P			Thru				
Right		P			Right				
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	5.0	23.0				17.0			
Yellow	4.0	4.0				4.0			
All Red	1.0	1.0				1.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	388	1805	0.29	0.55	9.1	A		
T	1990	3618	0.41	0.55	8.5	A	8.5	A
Westbound								
T	1387	3618	0.48	0.38	15.2	B	14.9	B
R	619	1615	0.16	0.38	12.7	B		
Northbound								
L	511	1805	0.22	0.28	17.4	B		
TR	481	1699	0.20	0.28	17.2	B	17.3	B
Southbound								

Intersection Delay = 12.1 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

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Savannah, GA 31416

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OPERATIONAL ANALYSIS

Analyst:	Courtney Lane
Agency/Co.:	HGBD, Inc.
Date Performed:	1/12/2005
Analysis Time Period:	PM Peak Hour
Intersection:	Gwinnett & I16 On/W.Boundary
Area Type:	All other areas
Jurisdiction:	City of Savannah
Analysis Year:	2028

Project ID: Gwinnett Street Traffic Study

East/West Street	North/South Street
Gwinnett	I-16 On / W. Boundary

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		740	110	60	645					90	25	85
% Heavy Veh		2	2	2	2					2	2	2
PHF		0.90	0.90	0.90	0.90					0.90	0.90	0.90
PK 15 Vol		206	31	17	179					25	7	24
Hi Ln Vol												
% Grade		0			0						0	
Ideal Sat		1900	1900	1900	1900					1900	1900	
ParkExist												
NumPark												
No. Lanes	0	2	1	1	2	0	0	0	0	1	1	0
LGConfig		T	R	L	T					L	TR	
Lane Width		12.0	12.0	12.0	12.0					12.0	12.0	
RTOR Vol			0									0
Adj Flow		822	122	67	717					100	122	
%InSharedLn												
Prop LTs		0.000		1.000	0.000						0.000	
Prop RTs	0.000		1.000		0.000					0.770		
Peds Bikes	0						0			0		
Buses		0	0	0	0					0	0	
%InProtPhase				0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0	0.0	0.0					0.0	0.0	
Arriv. Type		3	3	3	3					3	3	
Unit Ext.		3.0	3.0	3.0	3.0					3.0	3.0	
I Factor		1.000			1.000						1.000	
Lost Time		2.0	2.0	2.0	2.0					2.0	2.0	
Ext of g		2.0	2.0	2.0	2.0					2.0	2.0	
Ped Min g		3.2						3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru		P			Thru			
Right		P			Right			
Peds					Peds			
WB Left	P	P			SB Left	P		
Thru	P	P			Thru	P		
Right					Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	5.0	22.0			18.0			
Yellow	4.0	4.0			4.0			
All Red	1.0	1.0			1.0			

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		740	110	60	645					90	25	85
PHF		0.90	0.90	0.90	0.90					0.90	0.90	0.90
Adj flow		822	122	67	717					100	28	94
No. Lanes	0	2	1	1	2	0	0	0	0	1	1	0
Lane group		T	R	L	T					L	TR	
Adj flow		822	122	67	717					100	122	
Prop LTs		0.000		1.000	0.000						0.000	
Prop RTs		0.000	1.000		0.000					0.770		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)____

	Eastbound			Westbound			Northbound			Southbound		
LG		T	R		L	T					L	TR
So		1900	1900		1900	1900					1900	1900
Lanes	0	2	1		1	2	0	0	0	0	1	1	0
fW		1.000	1.000		1.000	1.000					1.000	1.000
fHV		0.980	0.980		0.980	0.980					0.980	0.980
fG		1.000	1.000		1.000	1.000					1.000	1.000
fP		1.000	1.000		1.000	1.000					1.000	1.000
fBB		1.000	1.000		1.000	1.000					1.000	1.000
fA		1.000	1.000		1.000	1.000					1.000	1.000
fLU		0.952	1.000		1.000	0.952					1.000	1.000
fRT		1.000	0.850			1.000						0.884
fLT		1.000			0.950	1.000					0.950	1.000
Sec.					0.190							
fLpb		1.000			1.000	1.000					1.000	1.000
fRpb		1.000	1.000			1.000						1.000
S		3547	1583		1770	3547					1770	1647
Sec.					355							

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	822	3547	# 0.23	0.37	1301	0.63
Right	R	122	1583	0.08	0.37	580	0.21
Westbound							
Prot		67	1770	# 0.04	0.083	148	0.45
Perm		0	355	0.00	0.450	160	0.00
Left	L	67			0.53	308	0.22
Prot							
Perm							
Thru	T	717	3547	0.20	0.53	1892	0.38
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Southbound							
Prot							
Perm							
Left	L	100	1770	0.06	0.30	531	0.19
Prot							
Perm							
Thru	TR	122	1647	# 0.07	0.30	494	0.25
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.34
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.46

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Ratios g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Incremental Del d2	Res Del d3	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound												
T	0.63	0.37	15.7	1.000	1301	0.50	2.3	0.0	18.0	B	17.5	B
R	0.21	0.37	13.0	1.000	580	0.50	0.8	0.0	13.9	B		
Westbound												
L	0.22	0.53	8.1	1.000	308	0.50	1.6	0.0	9.7	A		
T	0.38	0.53	8.2	1.000	1892	0.50	0.6	0.0	8.8	A	8.9	A
Northbound												

```
Southbound
L    0.19  0.30  15.6  1.000 531   0.50   0.8   0.0   16.4   B
TR   0.25  0.30  15.9  1.000 494   0.50   1.2   0.0   17.1   B    16.8   B

_____________________________________________________________________________
         Intersection delay = 13.9  (sec/veh)   Intersection LOS = B


_______________________SUPPLEMENTAL PERMITTED LT WORKSHEET_______________________
                            for exclusive lefts
Input
                                                          EB    WB    NB    SB
Opposed by Single(S) or Multiple(M) lane approach               M
Cycle length, C                          60.0    sec
Total actual green time for LT lane group, G (s)                32.0
Effective permitted green time for LT lane group, g(s)          27.0
Opposing effective green time, go (s)                           22.0
Number of lanes in LT lane group, N                             1
Number of lanes in opposing approach, No                        2
Adjusted LT flow rate, VLT (veh/h)                              67
Proportion of LT in LT lane group, PLT                          1.000
Proportion of LT in opposing flow, PLTo                         0.00
Adjusted opposing flow rate, Vo (veh/h)                         822
Lost time for LT lane group, tL                                 5.00
Computation
LT volume per cycle, LTC=VLTC/3600                              1.12
Opposing lane util. factor, fLUo                          0.952 0.952 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)             7.20
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g                           0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)               1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]                    0.63
gq, (see Exhibit C16-4,5,6,7,8)                                 11.99
gu=g-gq if gq>=gf, or = g-gf if gq<gf                           15.01
n=Max(gq-gf)/2,0)                                               5.99
PTHo=1-PLTo                                                     1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]                              1.00
EL1 (refer to Exhibit C16-3)                                    2.92
EL2=Max((1-Ptho**n)/Plto, 1.0)
fmin=2(1+PL)/g  or  fmin=2(1+Pl)/g                              0.15
gdiff=max(gq-gf,0)                                              0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)             0.19
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)
or flt=[fm+0.91(N-1)]/N**
Left-turn adjustment, fLT                                       0.190

For special case of single-lane approach opposed by multilane approach,
see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
  left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when gf>gq, see text.

_______________________SUPPLEMENTAL PERMITTED LT WORKSHEET_______________________
                              for shared lefts
Input
                                                          EB    WB    NB    SB
Opposed by Single(S) or Multiple(M) lane approach
Cycle length, C                          60.0    sec
Total actual green time for LT lane group, G (s)
Effective permitted green time for LT lane group, g(s)
Opposing effective green time, go (s)
Number of lanes in LT lane group, N
Number of lanes in opposing approach, No
Adjusted LT flow rate, VLT (veh/h)
Proportion of LT in LT lane group, PLT                    0.000 0.000       0.000
Proportion of LT in opposing flow, PLTo
Adjusted opposing flow rate, Vo (veh/h)
Lost time for LT lane group, tL
Computation
LT volume per cycle, LTC=VLTC/3600
Opposing lane util. factor, fLUo                          0.952 0.952 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g
Opposing platoon ratio, Rpo (refer Exhibit 16-11)
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]
gq, (see Exhibit C16-4,5,6,7,8)
gu=g-gq if gq>=gf, or = g-gf if gq<gf
n=Max(gq-gf)/2,0)
PTHo=1-PLTo
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]
EL1 (refer to Exhibit C16-3)
EL2=Max((1-Ptho**n)/Plto, 1.0)
fmin=2(1+PL)/g  or  fmin=2(1+Pl)/g
gdiff=max(gq-gf,0)
```

fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)
or flt=[fm+0.91(N-1)]/N**
Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach,
see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
  left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

		EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v			67		
v/c ratio from Capacity Worksheet, X			0.22		
Protected phase effective green interval, g (s)			5.0		
Opposing queue effective green interval, gq			11.99		
Unopposed green interval, gu			15.01		
Red time r=(C-g-gq-gu)			28.0		
Arrival rate, qa=v/(3600(max[X,1.0]))			0.02		
Protected ph. departure rate, Sp=s/3600			0.492		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)			0.18		
XPerm			0.19		
XProt			0.25		
Case			1		
Queue at beginning of green arrow, Qa			0.52		
Queue at beginning of unsaturated green, Qu			0.22		
Residual queue, Qr			0.00		
Uniform Delay, d1			8.1		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								

Southbound

Intersection Delay 13.9 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound			Southbound		
LaneGroup	T	R	L	T					L	TR	
Init Queue	0.0	0.0	0.0	0.0					0.0	0.0	
Flow Rate	431	122	67	376					100	122	
So	1900	1900	1900	1900					1900	1900	
No.Lanes	0 2	1	1	2	0	0	0	0	1	1	0
SL	1862	1583	576	1862					1770	1647	
LnCapacity	683	580	308	993					531	494	
Flow Ratio	0.23	0.08	0.12	0.20					0.06	0.07	
v/c Ratio	0.63	0.21	0.22	0.38					0.19	0.25	
Grn Ratio	0.37	0.37	0.53	0.53					0.30	0.30	
I Factor	1.000			1.000						1.000	
AT or PVG	3	3	3	3					3	3	
Pltn Ratio	1.00	1.00	1.00	1.00					1.00	1.00	
PF2	1.00	1.00	1.00	1.00					1.00	1.00	
Q1	5.9	1.4	0.5	3.7					1.2	1.5	
kB	0.7	0.6	0.4	0.9					0.6	0.5	
Q2	1.1	0.2	0.1	0.5					0.1	0.2	
Q Average	7.0	1.6	0.6	4.2					1.4	1.7	
Q Spacing	25.0	25.0	25.0	25.0					25.0	25.0	
Q Storage	500	100	100	500					100	100	
Q S Ratio	0.4	0.4	0.2	0.2					0.3	0.4	
70th Percentile Output:											
fB%	1.2	1.3	1.3	1.2					1.3	1.3	
BOQ	8.6	2.0	0.8	5.2					1.7	2.2	
QSRatio	0.4	0.5	0.2	0.3					0.4	0.5	
85th Percentile Output:											
fB%	1.5	1.6	1.7	1.5					1.6	1.6	
BOQ	10.3	2.5	1.1	6.4					2.2	2.8	
QSRatio	0.5	0.6	0.3	0.3					0.6	0.7	
90th Percentile Output:											
fB%	1.6	1.9	1.9	1.7					1.9	1.9	
BOQ	11.4	2.9	1.2	7.2					2.6	3.2	
QSRatio	0.6	0.7	0.3	0.4					0.6	0.8	
95th Percentile Output:											
fB%	1.8	2.3	2.5	2.0					2.4	2.3	
BOQ	12.9	3.6	1.6	8.5					3.2	3.9	
QSRatio	0.6	0.9	0.4	0.4					0.8	1.0	
98th Percentile Output:											
fB%	2.1	2.8	3.0	2.3					2.8	2.8	
BOQ	14.5	4.3	1.9	9.8					3.9	4.7	
QSRatio	0.7	1.1	0.5	0.5					1.0	1.2	

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

Courtney Lane
Hussey, Gay, Bell and DeYoung

Phone: Fax:
E-Mail:

OPERATIONAL ANALYSIS

Analyst: Courtney Lane
Agency/Co.: HGBD, Inc.
Date Performed: 1/12/2005
Analysis Time Period: PM Peak Hour
Intersection: Gwinnett & I16 Off/ W.Boundary
Area Type: All other areas
Jurisdiction: City of Savannah
Analysis Year: 2028
Project ID: Gwinnett Street Traffic Study
East/West Street: Gwinnett Street
North/South Street: I-16 Off / W. Boundary

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	100	730			605	90	100	25	60			
% Heavy Veh	0	0			0	0	0	0	0			
PHF	0.90	0.90			0.90	0.90	0.90	0.90	0.90			
PK 15 Vol	28	203			168	25	28	7	17			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat	1900	1900			1900	1900	1900	1900				
ParkExist												
NumPark												
No. Lanes	1	2	0	0	2	1	1	1	0	0	0	0
LGConfig	L	T			T	R	L	TR				
Lane Width	12.0	12.0			12.0	12.0	12.0	12.0				
RTOR Vol						0			0			
Adj Flow	111	811			672	100	111	95				
%InSharedLn												
Prop LTs	1.000	0.000			0.000			0.000				
Prop RTs		0.000		0.000	1.000		0.705					
Peds Bikes				0			0			0		
Buses	0	0			0	0	0	0				
%InProtPhase	0.0											
Duration	0.25											

Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0			0.0	0.0	0.0	0.0				
Arriv. Type	3	3			3	3	3	3				
Unit Ext.	3.0	3.0			3.0	3.0	3.0	3.0				
I Factor		1.000			1.000			1.000				
Lost Time	2.0	2.0			2.0	2.0	2.0	2.0				
Ext of g	2.0	2.0			2.0	2.0	2.0	2.0				
Ped Min g					3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P	P			NB Left	P		
Thru	P	P			Thru	P		
Right					Right	P		
Peds					Peds			
WB Left					SB Left			
Thru		P			Thru			
Right		P			Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	5.0	23.0			17.0			
Yellow	4.0	4.0			4.0			
All Red	1.0	1.0			1.0			

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	100	730			605	90	100	25	60			
PHF	0.90	0.90			0.90	0.90	0.90	0.90	0.90			
Adj flow	111	811			672	100	111	28	67			
No. Lanes	1	2	0	0	2	1	1	1	0	0	0	0
Lane group	L	T			T	R	L	TR				
Adj flow	111	811			672	100	111	95				
Prop LTs	1.000	0.000			0.000			0.000				
Prop RTs	0.000			0.000	1.000		0.705					

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)____

	Eastbound				Westbound		Northbound		Southbound			
LG	L	T			T	R	L	TR				
So	1900	1900			1900	1900	1900	1900				
Lanes	1	2	0	0	2	1	1	1	0	0	0	0
fW	1.000	1.000			1.000	1.000	1.000	1.000				
fHV	1.000	1.000			1.000	1.000	1.000	1.000				
fG	1.000	1.000			1.000	1.000	1.000	1.000				
fP	1.000	1.000			1.000	1.000	1.000	1.000				
fBB	1.000	1.000			1.000	1.000	1.000	1.000				
fA	1.000	1.000			1.000	1.000	1.000	1.000				
fLU	1.000	0.952			0.952	1.000	1.000	1.000				
fRT		1.000			1.000	0.850		0.894				
fLT	0.950	1.000			1.000		0.950	1.000				
Sec.	0.269											
fLpb	1.000	1.000			1.000		1.000	1.000				
fRpb		1.000			1.000	1.000		1.000				
S	1805	3618			3618	1615	1805	1699				
Sec.	511											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		111	1805	# 0.06	0.083	150	0.74
Perm		0	511	0.00	0.467	238	0.00
Left	L	111			0.55	388	0.29
Prot							
Perm							
Thru	T	811	3618	0.22	0.55	1990	0.41
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	672	3618	# 0.19	0.38	1387	0.48
Right	R	100	1615	0.06	0.38	619	0.16
Northbound							
Prot							
Perm							
Left	L	111	1805	# 0.06	0.28	511	0.22
Prot							
Perm							
Thru	TR	95	1699	0.06	0.28	481	0.20
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.31
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.41

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound												
L	0.29	0.55	7.3	1.000	388	0.50	1.8	0.0	9.1	A		
T	0.41	0.55	7.8	1.000	1990	0.50	0.6	0.0	8.5	A	8.5	A
Westbound												
T	0.48	0.38	14.0	1.000	1387	0.50	1.2	0.0	15.2	B	14.9	B
R	0.16	0.38	12.2	1.000	619	0.50	0.6	0.0	12.7	B		
Northbound												

```
L    0.22  0.28  16.4  1.000 511   0.50   1.0   0.0   17.4   B
TR   0.20  0.28  16.3  1.000 481   0.50   0.9   0.0   17.2   B    17.3   B

Southbound


_____________________________________________________________________________
         Intersection delay = 12.1  (sec/veh)   Intersection LOS = B


_______________________SUPPLEMENTAL PERMITTED LT WORKSHEET_______________________
                              for exclusive lefts
Input
                                                        EB    WB    NB    SB
Opposed by Single(S) or Multiple(M) lane approach       M
Cycle length, C                           60.0    sec
Total actual green time for LT lane group, G (s)        33.0
Effective permitted green time for LT lane group, g(s) 28.0
Opposing effective green time, go (s)                   23.0
Number of lanes in LT lane group, N                     1
Number of lanes in opposing approach, No                2
Adjusted LT flow rate, VLT (veh/h)                      111
Proportion of LT in LT lane group, PLT                  1.000
Proportion of LT in opposing flow, PLTo                 0.00
Adjusted opposing flow rate, Vo (veh/h)                 672
Lost time for LT lane group, tL                         5.00
Computation
LT volume per cycle, LTC=VLTC/3600                      1.85
Opposing lane util. factor, fLUo                        0.952 0.952       1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)     5.88
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g                   0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)       1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]            0.62
gq, (see Exhibit C16-4,5,6,7,8)                         9.02
gu=g-gq if gq>=gf, or = g-gf if gq<gf                   18.98
n=Max(gq-gf)/2,0)                                       4.51
PTHo=1-PLTo                                             1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]                      1.00
EL1 (refer to Exhibit C16-3)                            2.52
EL2=Max((1-Ptho**n)/Plto, 1.0)
fmin=2(1+PL)/g  or  fmin=2(1+Pl)/g                      0.14
gdiff=max(gq-gf,0)                                      0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)     0.27
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)
or flt=[fm+0.91(N-1)]/N**
Left-turn adjustment, fLT                               0.269

For special case of single-lane approach opposed by multilane approach,
see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
  left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when gf>gq, see text.

_______________________SUPPLEMENTAL PERMITTED LT WORKSHEET_______________________
                                for shared lefts
Input
                                                        EB    WB    NB    SB
Opposed by Single(S) or Multiple(M) lane approach
Cycle length, C                           60.0    sec
Total actual green time for LT lane group, G (s)
Effective permitted green time for LT lane group, g(s)
Opposing effective green time, go (s)
Number of lanes in LT lane group, N
Number of lanes in opposing approach, No
Adjusted LT flow rate, VLT (veh/h)
Proportion of LT in LT lane group, PLT                  0.000 0.000 0.000
Proportion of LT in opposing flow, PLTo
Adjusted opposing flow rate, Vo (veh/h)
Lost time for LT lane group, tL
Computation
LT volume per cycle, LTC=VLTC/3600
Opposing lane util. factor, fLUo                        0.952 0.952       1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g
Opposing platoon ratio, Rpo (refer Exhibit 16-11)
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]
gq, (see Exhibit C16-4,5,6,7,8)
gu=g-gq if gq>=gf, or = g-gf if gq<gf
n=Max(gq-gf)/2,0)
PTHo=1-PLTo
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]
EL1 (refer to Exhibit C16-3)
EL2=Max((1-Ptho**n)/Plto, 1.0)
fmin=2(1+PL)/g  or  fmin=2(1+Pl)/g
gdiff=max(gq-gf,0)
```

fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)
or flt=[fm+0.91(N-1)]/N**
Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach,
see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
  left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

		EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v		111			
v/c ratio from Capacity Worksheet, X		0.29			
Protected phase effective green interval, g (s)		5.0			
Opposing queue effective green interval, gq		9.02			
Unopposed green interval, gu		18.98			
Red time r=(C-g-gq-gu)		27.0			
Arrival rate, qa=v/(3600(max[X,1.0]))		0.03			
Protected ph. departure rate, Sp=s/3600		0.501			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)		0.21			
XPerm		0.22			
XProt		0.39			
Case		1			
Queue at beginning of green arrow, Qa		0.83			
Queue at beginning of unsaturated green, Qu		0.28			
Residual queue, Qr		0.00			
Uniform Delay, d1		7.3			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								

Southbound

Intersection Delay 12.1 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound				Westbound		Northbound			Southbound		
LaneGroup	L	T			T	R	L	TR				
Init Queue	0.0	0.0			0.0	0.0	0.0	0.0				
Flow Rate	111	425			352	100	111	95				
So	1900	1900			1900	1900	1900	1900				
No.Lanes	1	2	0	0	2	1	1	1	0	0	0	0
SL	707	1900			1900	1615	1805	1699				
LnCapacity	388	1045			728	619	511	481				
Flow Ratio	0.16	0.22			0.19	0.06	0.06	0.06				
v/c Ratio	0.29	0.41			0.48	0.16	0.22	0.20				
Grn Ratio	0.55	0.55			0.38	0.38	0.28	0.28				
I Factor		1.000			1.000			1.000				
AT or PVG	3	3			3	3	3	3				
Pltn Ratio	1.00	1.00			1.00	1.00	1.00	1.00				
PF2	1.00	1.00			1.00	1.00	1.00	1.00				
Q1	0.9	4.1			4.4	1.1	1.4	1.2				
kB	0.4	0.9			0.7	0.6	0.5	0.5				
Q2	0.2	0.6			0.6	0.1	0.1	0.1				
Q Average	1.0	4.7			5.1	1.2	1.6	1.3				
Q Spacing	25.0	25.0			25.0	25.0	25.0	25.0				
Q Storage	100	500			500	100	100	100				
Q S Ratio	0.3	0.2			0.3	0.3	0.4	0.3				
70th Percentile Output:												
fB%	1.3	1.2			1.2	1.3	1.3	1.3				
BOQ	1.3	5.8			6.3	1.6	2.0	1.7				
QSRatio	0.3	0.3			0.3	0.4	0.5	0.4				
85th Percentile Output:												
fB%	1.6	1.5			1.5	1.6	1.6	1.6				
BOQ	1.7	7.1			7.7	2.0	2.5	2.2				
QSRatio	0.4	0.4			0.4	0.5	0.6	0.5				
90th Percentile Output:												
fB%	1.9	1.7			1.7	1.9	1.9	1.9				
BOQ	2.0	8.0			8.5	2.3	2.9	2.5				
QSRatio	0.5	0.4			0.4	0.6	0.7	0.6				
95th Percentile Output:												
fB%	2.4	2.0			2.0	2.4	2.3	2.4				
BOQ	2.5	9.4			10.0	2.9	3.6	3.1				
QSRatio	0.6	0.5			0.5	0.7	0.9	0.8				
98th Percentile Output:												
fB%	2.9	2.3			2.2	2.9	2.8	2.8				
BOQ	3.0	10.8			11.4	3.5	4.4	3.8				
QSRatio	0.8	0.5			0.6	0.9	1.1	0.9				

ERROR MESSAGES

No errors to report.

Gwinnett Signalized Intersection Operational Analysis for Gwinnett Street and I-16 / West Boundary Street Intersection Proposed Conditions "Sell Out Event" (Analysis Year: 2028)

HCS2000: Signalized Intersections Release 4.1e

Analyst: Courtney Lane
Agency: HGBD, Inc.
Date: 1/12/2005
Period: PM Peak Hour w/ Event
Project ID: Gwinnett Street Traffic Study
E/W St: Gwinnett

Inter.: Gwinnett & I16 On/W.Boundary
Area Type: All other areas
Jurisd: City of Savannah
Year : 2028
N/S St: I-16 On / W. Boundary

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	1	1	2	0	0	0	0	1	1	0
LGConfig		T	R	L	T					L	TR	
Volume		740	115	60	1860					90	25	90
Lane Width		12.0	12.0	12.0	12.0					12.0	12.0	
RTOR Vol			0									0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4			5	6	7	8
EB Left					NB	Left				
Thru		P				Thru				
Right		P				Right				
Peds						Peds				
WB Left	P	P			SB	Left	P			
Thru	P	P				Thru	P			
Right						Right	P			
Peds						Peds				
NB Right					EB	Right				
SB Right					WB	Right				
Green	5.0	45.0					20.0			
Yellow	4.0	4.0					4.0			
All Red	1.0	1.0					1.0			

Cycle Length: 85.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
T	1878	3547	0.44	0.53	13.0	B	12.7	B
R	838	1583	0.15	0.53	10.6	B		
Westbound								
L	385	1770	0.17	0.65	7.5	A		
T	2295	3547	0.90	0.65	18.9	B	18.6	B
Northbound								
Southbound								
L	416	1770	0.24	0.24	27.7	C		
TR	387	1644	0.33	0.24	29.2	C	28.6	C

Intersection Delay = 17.6 (sec/veh) Intersection LOS = B

HCS2000: Signalized Intersections Release 4.1e

Analyst: Courtney Lane
Agency: HGBD, Inc.
Date: 1/12/2005
Period: PM Peak Hour w/ Event
Project ID: Gwinnett Street Traffic Study
E/W St: Gwinnett Street

Inter.: Gwinnett & I16 Off/ W.Boundary
Area Type: All other areas
Jurisd: City of Savannah
Year : 2028
N/S St: I-16 Off / W. Boundary

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	0	0	2	1	1	1	0	0	0	0
LGConfig	L	T			T	R	L	TR				
Volume	100	730		1020	90		900	25	60			
Lane Width	12.0	12.0		12.0	12.0		12.0	12.0				
RTOR Vol					0				0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	P	P			NB Left	P			
Thru	P	P			Thru	P			
Right					Right	P			
Peds					Peds				
WB Left					SB Left				
Thru		P			Thru				
Right		P			Right				
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	5.0	45.0				22.0			
Yellow	4.0	4.0				4.0			
All Red	1.0	1.0				1.0			

Cycle Length: 87.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	265	1805	0.42	0.63	14.3	B		
T	2287	3618	0.35	0.63	8.0	A	8.8	A
Westbound								
T	1871	3618	0.61	0.52	16.2	B	15.8	B
R	835	1615	0.12	0.52	11.1	B		
Northbound								
L	456	1805	2.19	0.25	576.5	F		
TR	430	1699	0.22	0.25	26.9	C	528.8	F
Southbound								

Intersection Delay = 186.7 (sec/veh) Intersection LOS = F

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst:	Courtney Lane
Agency/Co.:	HGBD, Inc.
Date Performed:	1/12/2005
Analysis Time Period:	PM Peak Hour w/ Event
Intersection:	Gwinnett & I16 On/W.Boundary
Area Type:	All other areas
Jurisdiction:	City of Savannah
Analysis Year:	2028

Project ID: Gwinnett Street Traffic Study
East/West Street: Gwinnett — North/South Street: I-16 On / W. Boundary

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		740	115	60	1860					90	25	90
% Heavy Veh		2	2	2	2					2	2	2
PHF		0.90	0.90	0.90	0.90					0.90	0.90	0.90
PK 15 Vol		206	32	17	517					25	7	25
Hi Ln Vol												
% Grade		0			0						0	
Ideal Sat		1900	1900	1900	1900					1900	1900	
ParkExist												
NumPark												
No. Lanes	0	2	1	1	2	0	0	0	0	1	1	0
LGConfig		T	R	L	T					L	TR	
Lane Width		12.0	12.0	12.0	12.0					12.0	12.0	
RTOR Vol			0									0
Adj Flow		822	128	67	2067					100	128	
%InSharedLn												
Prop LTs		0.000		1.000	0.000						0.000	
Prop RTs	0.000		1.000		0.000					0.781		
Peds Bikes	0						0			0		
Buses		0	0	0	0					0	0	
%InProtPhase				0.0								

Duration 0.25 Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0	0.0	0.0					0.0	0.0	
Arriv. Type		3	3	3	3					3	3	
Unit Ext.		3.0	3.0	3.0	3.0					3.0	3.0	
I Factor		1.000			1.000						1.000	
Lost Time		2.0	2.0	2.0	2.0					2.0	2.0	
Ext of g		2.0	2.0	2.0	2.0					2.0	2.0	
Ped Min g		3.2						3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru		P			Thru			
Right		P			Right			
Peds					Peds			
WB Left	P	P			SB Left	P		
Thru	P	P			Thru	P		
Right					Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	5.0	45.0			20.0			
Yellow	4.0	4.0			4.0			
All Red	1.0	1.0			1.0			

Cycle Length: 85.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		740	115	60	1860					90	25	90
PHF		0.90	0.90	0.90	0.90					0.90	0.90	0.90
Adj flow		822	128	67	2067					100	28	100
No. Lanes	0	2	1	1	2	0	0	0	0	1	1	0
Lane group		T	R	L	T					L	TR	
Adj flow		822	128	67	2067					100	128	
Prop LTs		0.000		1.000	0.000						0.000	
Prop RTs		0.000	1.000		0.000					0.781		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)____

	Eastbound		Westbound		Northbound				Southbound	
LG	T	R	L	T					L	TR
So	1900	1900	1900	1900					1900	1900
Lanes 0	2	1	1	2	0	0	0	0	1	1 0
fW	1.000	1.000	1.000	1.000					1.000	1.000
fHV	0.980	0.980	0.980	0.980					0.980	0.980
fG	1.000	1.000	1.000	1.000					1.000	1.000
fP	1.000	1.000	1.000	1.000					1.000	1.000
fBB	1.000	1.000	1.000	1.000					1.000	1.000
fA	1.000	1.000	1.000	1.000					1.000	1.000
fLU	0.952	1.000	1.000	0.952					1.000	1.000
fRT	1.000	0.850		1.000						0.883
fLT	1.000		0.950	1.000					0.950	1.000
Sec.			0.256							
fLpb	1.000		1.000	1.000					1.000	1.000
fRpb	1.000	1.000		1.000						1.000
S	3547	1583	1770	3547					1770	1644
Sec.			477							

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	822	3547	0.23	0.53	1878	0.44
Right	R	128	1583	0.08	0.53	838	0.15
Westbound							
Prot		67	1770	0.04	0.059	104	0.64
Perm		0	477	0.00	0.588	281	0.00
Left	L	67			0.65	385	0.17
Prot							
Perm							
Thru	T	2067	3547	# 0.58	0.65	2295	0.90
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Southbound							
Prot							
Perm							
Left	L	100	1770	0.06	0.24	416	0.24
Prot							
Perm							
Thru	TR	128	1644	# 0.08	0.24	387	0.33
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.66
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.75

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound												
T	0.44	0.53	12.3	1.000	1878	0.50	0.7	0.0	13.0	B	12.7	B
R	0.15	0.53	10.2	1.000	838	0.50	0.4	0.0	10.6	B		
Westbound												
L	0.17	0.65	6.5	1.000	385	0.50	1.0	0.0	7.5	A		
T	0.90	0.65	12.7	1.000	2295	0.50	6.2	0.0	18.9	B	18.6	B
Northbound												

```
Southbound
L    0.24  0.24  26.3  1.000 416   0.50   1.4   0.0   27.7   C
TR   0.33  0.24  27.0  1.000 387   0.50   2.3   0.0   29.2   C    28.6   C

_____________________________________________________________________________
         Intersection delay = 17.6  (sec/veh)   Intersection LOS = B


_______________________SUPPLEMENTAL PERMITTED LT WORKSHEET_______________________
                            for exclusive lefts
Input
                                                          EB    WB    NB    SB
Opposed by Single(S) or Multiple(M) lane approach               M
Cycle length, C                          85.0    sec
Total actual green time for LT lane group, G (s)                55.0
Effective permitted green time for LT lane group, g(s)          50.0
Opposing effective green time, go (s)                           45.0
Number of lanes in LT lane group, N                             1
Number of lanes in opposing approach, No                        2
Adjusted LT flow rate, VLT (veh/h)                              67
Proportion of LT in LT lane group, PLT                          1.000
Proportion of LT in opposing flow, PLTo                         0.00
Adjusted opposing flow rate, Vo (veh/h)                         822
Lost time for LT lane group, tL                                 5.00
Computation
LT volume per cycle, LTC=VLTC/3600                              1.58
Opposing lane util. factor, fLUo                          0.952 0.952 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)             10.19
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g                           0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)               1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]                    0.47
gq, (see Exhibit C16-4,5,6,7,8)                                 12.62
gu=g-gq if gq>=gf, or = g-gf if gq<gf                           37.38
n=Max(gq-gf)/2,0)                                               6.31
PTHo=1-PLTo                                                     1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]                              1.00
EL1 (refer to Exhibit C16-3)                                    2.92
EL2=Max((1-Ptho**n)/Plto, 1.0)
fmin=2(1+PL)/g  or  fmin=2(1+Pl)/g                              0.08
gdiff=max(gq-gf,0)                                              0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)             0.26
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)
or flt=[fm+0.91(N-1)]/N**
Left-turn adjustment, fLT                                       0.256

For special case of single-lane approach opposed by multilane approach,
see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
  left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when gf>gq, see text.

_______________________SUPPLEMENTAL PERMITTED LT WORKSHEET_______________________
                              for shared lefts
Input
                                                          EB    WB    NB    SB
Opposed by Single(S) or Multiple(M) lane approach
Cycle length, C                          85.0    sec
Total actual green time for LT lane group, G (s)
Effective permitted green time for LT lane group, g(s)
Opposing effective green time, go (s)
Number of lanes in LT lane group, N
Number of lanes in opposing approach, No
Adjusted LT flow rate, VLT (veh/h)
Proportion of LT in LT lane group, PLT                    0.000 0.000       0.000
Proportion of LT in opposing flow, PLTo
Adjusted opposing flow rate, Vo (veh/h)
Lost time for LT lane group, tL
Computation
LT volume per cycle, LTC=VLTC/3600
Opposing lane util. factor, fLUo                          0.952 0.952 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g
Opposing platoon ratio, Rpo (refer Exhibit 16-11)
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]
gq, (see Exhibit C16-4,5,6,7,8)
gu=g-gq if gq>=gf, or = g-gf if gq<gf
n=Max(gq-gf)/2,0)
PTHo=1-PLTo
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]
EL1 (refer to Exhibit C16-3)
EL2=Max((1-Ptho**n)/Plto, 1.0)
fmin=2(1+PL)/g  or  fmin=2(1+Pl)/g
gdiff=max(gq-gf,0)
```

fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)
or flt=[fm+0.91(N-1)]/N**
Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach,
see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
  left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

		EBLT	WBLT	NBLT	SBLT
Cycle length, C	85.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v			67		
v/c ratio from Capacity Worksheet, X			0.17		
Protected phase effective green interval, g (s)			5.0		
Opposing queue effective green interval, gq			12.62		
Unopposed green interval, gu			37.38		
Red time r=(C-g-gq-gu)			30.0		
Arrival rate, qa=v/(3600(max[X,1.0]))			0.02		
Protected ph. departure rate, Sp=s/3600			0.492		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)			0.18		
XPerm			0.14		
XProt			0.26		
Case			1		
Queue at beginning of green arrow, Qa			0.56		
Queue at beginning of unsaturated green, Qu			0.23		
Residual queue, Qr			0.00		
Uniform Delay, d1			6.5		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								

Southbound

Intersection Delay 17.6 sec/veh Intersection LOS B

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound			Southbound		
LaneGroup	T	R	L	T					L	TR	
Init Queue	0.0	0.0	0.0	0.0					0.0	0.0	
Flow Rate	431	128	67	1085					100	128	
So	1900	1900	1900	1900					1900	1900	
No.Lanes	0 2	1	1	2	0	0	0	0	1	1	0
SL	1862	1583	595	1862					1770	1644	
LnCapacity	986	838	385	1205					416	387	
Flow Ratio	0.23	0.08	0.11	0.58					0.06	0.08	
v/c Ratio	0.44	0.15	0.17	0.90					0.24	0.33	
Grn Ratio	0.53	0.53	0.65	0.65					0.24	0.24	
I Factor	1.000			1.000						1.000	
AT or PVG	3	3	3	3					3	3	
Pltn Ratio	1.00	1.00	1.00	1.00					1.00	1.00	
PF2	1.00	1.00	1.00	1.00					1.00	1.00	
Q1	6.2	1.5	0.6	21.7					1.9	2.5	
kB	1.1	1.0	0.6	1.3					0.6	0.6	
Q2	0.8	0.2	0.1	7.5					0.2	0.3	
Q Average	7.1	1.7	0.7	29.2					2.1	2.8	
Q Spacing	25.0	25.0	25.0	25.0					25.0	25.0	
Q Storage	500	100	100	500					100	100	
Q S Ratio	0.4	0.4	0.2	1.5					0.5	0.7	
70th Percentile Output:											
fB%	1.2	1.3	1.3	1.2					1.3	1.3	
BOQ	8.6	2.2	0.9	35.0					2.7	3.5	
QSRatio	0.4	0.5	0.2	1.8					0.7	0.9	
85th Percentile Output:											
fB%	1.5	1.6	1.7	1.4					1.6	1.6	
BOQ	10.4	2.8	1.1	40.9					3.4	4.4	
QSRatio	0.5	0.7	0.3	2.0					0.8	1.1	
90th Percentile Output:											
fB%	1.6	1.9	1.9	1.5					1.8	1.8	
BOQ	11.5	3.2	1.3	43.8					3.8	5.0	
QSRatio	0.6	0.8	0.3	2.2					1.0	1.2	
95th Percentile Output:											
fB%	1.8	2.3	2.5	1.6					2.3	2.2	
BOQ	13.0	4.0	1.7	46.8					4.7	6.0	
QSRatio	0.7	1.0	0.4	2.3					1.2	1.5	
98th Percentile Output:											
fB%	2.1	2.8	3.0	1.7					2.7	2.6	
BOQ	14.6	4.8	2.1	49.8					5.6	7.1	
QSRatio	0.7	1.2	0.5	2.5					1.4	1.8	

ERROR MESSAGES

No errors to report.

HCS2000: Signalized Intersections Release 4.1e

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OPERATIONAL ANALYSIS

Analyst:	Courtney Lane
Agency/Co.:	HGBD, Inc.
Date Performed:	1/12/2005
Analysis Time Period:	PM Peak Hour w/ Event
Intersection:	Gwinnett & I16 Off/ W.Boundary
Area Type:	All other areas
Jurisdiction:	City of Savannah
Analysis Year:	2028

Project ID: Gwinnett Street Traffic Study
East/West Street: Gwinnett Street
North/South Street: I-16 Off / W. Boundary

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	100	730			1020	90	900	25	60			
% Heavy Veh	0	0			0	0	0	0	0			
PHF	0.90	0.90			0.90	0.90	0.90	0.90	0.90			
PK 15 Vol	28	203			283	25	250	7	17			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat	1900	1900			1900	1900	1900	1900				
ParkExist												
NumPark												
No. Lanes	1	2	0	0	2	1	1	1	0	0	0	0
LGConfig	L	T			T	R	L	TR				
Lane Width	12.0	12.0			12.0	12.0	12.0	12.0				
RTOR Vol						0			0			
Adj Flow	111	811			1133	100	1000	95				
%InSharedLn												
Prop LTs	1.000	0.000			0.000			0.000				
Prop RTs		0.000		0.000	1.000		0.705					
Peds Bikes				0			0			0		
Buses	0	0			0	0	0	0				
%InProtPhase	0.0											
Duration	0.25											

Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0			0.0	0.0	0.0	0.0				
Arriv. Type	3	3			3	3	3	3				
Unit Ext.	3.0	3.0			3.0	3.0	3.0	3.0				
I Factor		1.000			1.000			1.000				
Lost Time	2.0	2.0			2.0	2.0	2.0	2.0				
Ext of g	2.0	2.0			2.0	2.0	2.0	2.0				
Ped Min g					3.2			3.2			3.2	

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P	P			NB Left	P		
Thru	P	P			Thru	P		
Right					Right	P		
Peds					Peds			
WB Left					SB Left			
Thru		P			Thru			
Right		P			Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	5.0	45.0			22.0			
Yellow	4.0	4.0			4.0			
All Red	1.0	1.0			1.0			

Cycle Length: 87.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	100	730			1020	90	900	25	60			
PHF	0.90	0.90			0.90	0.90	0.90	0.90	0.90			
Adj flow	111	811			1133	100	1000	28	67			
No. Lanes	1	2	0	0	2	1	1	1	0	0	0	0
Lane group	L	T			T	R	L	TR				
Adj flow	111	811			1133	100	1000	95				
Prop LTs	1.000	0.000			0.000			0.000				
Prop RTs	0.000			0.000	1.000		0.705					

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)____

	Eastbound				Westbound				Northbound				Southbound			
LG	L	T			T	R			L	TR						
So	1900	1900			1900	1900			1900	1900						
Lanes	1	2	0	0	2	1			1	1	0	0	0	0		
fW	1.000	1.000			1.000	1.000			1.000	1.000						
fHV	1.000	1.000			1.000	1.000			1.000	1.000						
fG	1.000	1.000			1.000	1.000			1.000	1.000						
fP	1.000	1.000			1.000	1.000			1.000	1.000						
fBB	1.000	1.000			1.000	1.000			1.000	1.000						
fA	1.000	1.000			1.000	1.000			1.000	1.000						
fLU	1.000	0.952			0.952	1.000			1.000	1.000						
fRT		1.000			1.000	0.850				0.894						
fLT	0.950	1.000			1.000				0.950	1.000						
Sec.	0.147															
fLpb	1.000	1.000			1.000				1.000	1.000						
fRpb		1.000			1.000	1.000				1.000						
S	1805	3618			3618	1615			1805	1699						
Sec.	280															

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		104	1805	# 0.06	0.057	104	1.00
Perm		7	280	0.03	0.575	161	0.04
Left	L	111			0.63	265	0.42
Prot							
Perm							
Thru	T	811	3618	0.22	0.63	2287	0.35
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	1133	3618	# 0.31	0.52	1871	0.61
Right	R	100	1615	0.06	0.52	835	0.12
Northbound							
Prot							
Perm							
Left	L	1000	1805	# 0.55	0.25	456	2.19
Prot							
Perm							
Thru	TR	95	1699	0.06	0.25	430	0.22
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.92
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.12

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	g/C	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group Delay	LOS	Approach Delay	LOS
Eastbound												
L	0.42	0.63	9.5	1.000	265	0.50	4.8	0.0	14.3	B		
T	0.35	0.63	7.6	1.000	2287	0.50	0.4	0.0	8.0	A	8.8	A
Westbound												
T	0.61	0.52	14.8	1.000	1871	0.50	1.5	0.0	16.2	B	15.8	B
R	0.12	0.52	10.8	1.000	835	0.50	0.3	0.0	11.1	B		
Northbound												

```
L    2.19  0.25  32.5  1.000 456   0.50   544.0 0.0   576.5  F
TR   0.22  0.25  25.7  1.000 430   0.50   1.2   0.0   26.9   C    528.8  F

Southbound
```

Intersection delay = 186.7 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET
for exclusive lefts

```
Input
                                                        EB    WB    NB    SB
Opposed by Single(S) or Multiple(M) lane approach       M
Cycle length, C                          87.0    sec
Total actual green time for LT lane group, G (s)        55.0
Effective permitted green time for LT lane group, g(s)  50.0
Opposing effective green time, go (s)                   45.0
Number of lanes in LT lane group, N                     1
Number of lanes in opposing approach, No                2
Adjusted LT flow rate, VLT (veh/h)                      111
Proportion of LT in LT lane group, PLT                  1.000
Proportion of LT in opposing flow, PLTo                 0.00
Adjusted opposing flow rate, Vo (veh/h)                 1133
Lost time for LT lane group, tL                         5.00
Computation
LT volume per cycle, LTC=VLTC/3600                      2.68
Opposing lane util. factor, fLUo                        0.952 0.952       1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)     14.38
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g                   0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)       1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]            0.48
gq, (see Exhibit C16-4,5,6,7,8)                         20.74
gu=g-gq if gq>=gf, or = g-gf if gq<gf                   29.26
n=Max(gq-gf)/2,0)                                       10.37
PTHo=1-PLTo                                             1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]                      1.00
EL1 (refer to Exhibit C16-3)                            3.97
EL2=Max((1-Ptho**n)/Plto, 1.0)
fmin=2(1+PL)/g  or  fmin=2(1+Pl)/g                      0.08
gdiff=max(gq-gf,0)                                      0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)     0.15
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)
or flt=[fm+0.91(N-1)]/N**
Left-turn adjustment, fLT                               0.147

For special case of single-lane approach opposed by multilane approach,
see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
  left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when gf>gq, see text.
```

SUPPLEMENTAL PERMITTED LT WORKSHEET
for shared lefts

```
Input
                                                        EB    WB    NB    SB
Opposed by Single(S) or Multiple(M) lane approach
Cycle length, C                          87.0    sec
Total actual green time for LT lane group, G (s)
Effective permitted green time for LT lane group, g(s)
Opposing effective green time, go (s)
Number of lanes in LT lane group, N
Number of lanes in opposing approach, No
Adjusted LT flow rate, VLT (veh/h)
Proportion of LT in LT lane group, PLT                  0.000 0.000 0.000
Proportion of LT in opposing flow, PLTo
Adjusted opposing flow rate, Vo (veh/h)
Lost time for LT lane group, tL
Computation
LT volume per cycle, LTC=VLTC/3600
Opposing lane util. factor, fLUo                        0.952 0.952       1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
gf=G[exp(- a * (LTC ** b))]-tl, gf<=g
Opposing platoon ratio, Rpo (refer Exhibit 16-11)
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]
gq, (see Exhibit C16-4,5,6,7,8)
gu=g-gq if gq>=gf, or = g-gf if gq<gf
n=Max(gq-gf)/2,0)
PTHo=1-PLTo
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]
EL1 (refer to Exhibit C16-3)
EL2=Max((1-Ptho**n)/Plto, 1.0)
fmin=2(1+PL)/g  or  fmin=2(1+Pl)/g
gdiff=max(gq-gf,0)
```

fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)],(fmin<=fm<=1.00)
or flt=[fm+0.91(N-1)]/N**
Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach,
see text.
* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
  left-turn lane and redo calculations.
** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				
OCCbicg				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion right-turns, PRT				
Proportion right-turns using protected phase, PRTA				
Right turn adjustment, fRpb				

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

		EBLT	WBLT	NBLT	SBLT
Cycle length, C	87.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v		111			
v/c ratio from Capacity Worksheet, X		0.42			
Protected phase effective green interval, g (s)		5.0			
Opposing queue effective green interval, gq		20.74			
Unopposed green interval, gu		29.26			
Red time r=(C-g-gq-gu)		32.0			
Arrival rate, qa=v/(3600(max[X,1.0]))		0.03			
Protected ph. departure rate, Sp=s/3600		0.501			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)		0.13			
XPerm		0.40			
XProt		0.46			
Case		1			
Queue at beginning of green arrow, Qa		0.99			
Queue at beginning of unsaturated green, Qu		0.64			
Residual queue, Qr		0.00			
Uniform Delay, d1		9.5			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay Unadj. ds	Uniform Delay Adj. d1 sec	Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
Eastbound								
Westbound								
Northbound								

Southbound

Intersection Delay 186.7 sec/veh Intersection LOS F

BACK OF QUEUE WORKSHEET

	Eastbound				Westbound		Northbound			Southbound		
LaneGroup	L	T			T	R	L	TR				
Init Queue	0.0	0.0			0.0	0.0	0.0	0.0				
Flow Rate	111	425			595	100	1000	95				
So	1900	1900			1900	1900	1900	1900				
No.Lanes	1	2	0	0	2	1	1	1	0	0	0	0
SL	419	1900			1900	1615	1805	1699				
LnCapacity	265	1201			982	835	456	430				
Flow Ratio	0.26	0.22			0.31	0.06	0.55	0.06				
v/c Ratio	0.42	0.35			0.61	0.12	2.19	0.22				
Grn Ratio	0.63	0.63			0.52	0.52	0.25	0.25				
I Factor		1.000			1.000			1.000				
AT or PVG	3	3			3	3	3	3				
Pltn Ratio	1.00	1.00			1.00	1.00	1.00	1.00				
PF2	1.00	1.00			1.00	1.00	1.00	1.00				
Q1	1.0	4.9			10.1	1.2	24.2	1.8				
kB	0.4	1.3			1.1	1.0	0.6	0.6				
Q2	0.3	0.7			1.6	0.1	69.2	0.2				
Q Average	1.3	5.6			11.7	1.4	93.3	2.0				
Q Spacing	25.0	25.0			25.0	25.0	25.0	25.0				
Q Storage	100	500			500	100	100	100				
Q S Ratio	0.3	0.3			0.6	0.3	23.3	0.5				
70th Percentile Output:												
fB%	1.3	1.2			1.2	1.3	1.2	1.3				
BOQ	1.7	6.9			14.2	1.8	112	2.5				
QSRatio	0.4	0.3			0.7	0.4	28.0	0.6				
85th Percentile Output:												
fB%	1.6	1.5			1.4	1.6	1.4	1.6				
BOQ	2.2	8.3			16.8	2.2	131	3.2				
QSRatio	0.5	0.4			0.8	0.6	32.7	0.8				
90th Percentile Output:												
fB%	1.9	1.7			1.5	1.9	1.5	1.8				
BOQ	2.5	9.2			18.2	2.6	140	3.7				
QSRatio	0.6	0.5			0.9	0.6	35.0	0.9				
95th Percentile Output:												
fB%	2.4	1.9			1.7	2.4	1.6	2.3				
BOQ	3.1	10.7			19.9	3.2	149	4.5				
QSRatio	0.8	0.5			1.0	0.8	37.3	1.1				
98th Percentile Output:												
fB%	2.9	2.2			1.8	2.8	1.7	2.7				
BOQ	3.8	12.2			21.7	3.9	159	5.4				
QSRatio	0.9	0.6			1.1	1.0	39.7	1.3				

ERROR MESSAGES

No errors to report.

Gwinnett Signalized Intersection Operational Analysis for Gwinnett Street and Proposed Development Main Entrance Intersection Proposed Conditions (Analysis Year: 2028)

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: Courtney Lane
Agency/Co.: HGBD, Inc.
Date Performed: 1/13/2005
Analysis Time Period: PM Peak Hour
Intersection: Gwinnett & Main Entrance
Jurisdiction: City of Savannah
Units: U. S. Customary
Analysis Year: 2028
Project ID: Gwinnett Street Traffic Study
East/West Street: Gwinnett Street
North/South Street: Main Entrance
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	5	740			725	5
Peak-Hour Factor, PHF	1.00	1.00			1.00	1.00
Hourly Flow Rate, HFR	5	740			725	5
Percent Heavy Vehicles	2	--	--		--	--
Median Type/Storage	Raised curb			/ 1		
RT Channelized?						No
Lanes	1	2			2	1
Configuration	L	T			T	R
Upstream Signal?		Yes			Yes	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				110		30
Peak Hour Factor, PHF				1.00		1.00
Hourly Flow Rate, HFR				110		30
Percent Heavy Vehicles				2		2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
Lanes				1		1
Configuration				L		R

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L					L		R
v (vph)	5					110		30
C(m) (vph)	1001					396		952
v/c	0.00					0.28		0.03
95% queue length	0.02					1.12		0.10
Control Delay	8.6					17.6		8.9
LOS	A					C		A
Approach Delay							15.7	
Approach LOS							C	

HCS2000: Unsignalized Intersections Release 4.1d

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E-Mail: clane@hgbd.com

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: Courtney Lane
Agency/Co.: HGBD, Inc.
Date Performed: 1/13/2005
Analysis Time Period: PM Peak Hour
Intersection: Gwinnett & Main Entrance
Jurisdiction: City of Savannah
Units: U. S. Customary
Analysis Year: 2028
Project ID: Gwinnett Street Traffic Study
East/West Street: Gwinnett Street
North/South Street: Main Entrance
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	5	740			725	5
Peak-Hour Factor, PHF	1.00	1.00			1.00	1.00
Peak-15 Minute Volume	1	185			181	1
Hourly Flow Rate, HFR	5	740			725	5
Percent Heavy Vehicles	2	--	--		--	--
Median Type/Storage	Raised curb			/ 1		
RT Channelized?						No
Lanes	1	2			2	1
Configuration	L	T			T	R
Upstream Signal?		Yes			Yes	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				110		30
Peak Hour Factor, PHF				1.00		1.00
Peak-15 Minute Volume				28		8
Hourly Flow Rate, HFR				110		30
Percent Heavy Vehicles				2		2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?						No
Lanes				1		1
Configuration				L		R

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0
Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn	260	1700	3	25	60	35	1550
	Through	170	1700	3	25	60	35	1550
S5	Left-Turn	0	1700	3	0	60	35	400
	Through	630	1700	3	25	60	35	400

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)	4.1					7.5		6.9
t(c,hv)	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)	2					2		2
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Grade/100			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)	0.00					0.70		0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage	4.1					6.8		6.9
2-stage	4.1					5.8		6.9

Follow-Up Time Calculations

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)	2.20					3.50		3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	2					2		2
t(f)	2.2					3.5		3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog	170	260	630	0
Total Saturation Flow Rate, s (vph)	3400	3400	3400	3400
Arrival Type	3	3	3	3
Effective Green, g (sec)	25	25	25	0
Cycle Length, C (sec)	60	60	60	60
Rp (from Exhibit 16-11)	1.000	1.000	1.000	1.000
Proportion vehicles arriving on green P	0.417	0.417	0.417	0.000
g(q1)	1.8	2.7	6.5	0.0
g(q2)	0.1	0.2	1.5	0.0
g(q)	1.8	2.9	8.0	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha	0.400		0.400	
beta	0.714		0.714	
Travel time, t(a) (sec)	30.126		7.775	
Smoothing Factor, F	0.104		0.310	
Proportion of conflicting flow, f	1.000	1.000	1.000	1.000
Max platooned flow, V(c,max)	623	927	3224	0
Min platooned flow, V(c,min)	2000	2000	2000	2000
Duration of blocked period, t(p)	0.0	0.0	7.3	0.0
Proportion time blocked, p	0.000		0.122	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.122
p(dom)	0.122
p(subo)	0.000
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)	0.878		
p(4)			
p(7)			
p(8)			
p(9)			
p(10)	0.878	0.878	1.000
p(11)			
p(12)	0.878		

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x	730					1105		362
s	3000					3000		3000
Px	0.878					0.878		0.878
V c,u,x	416					843		0
C r,x	1139					303		1084
C plat,x	1001					266		952

Two-Stage Process

	7		8		10		11	
	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)					725	380		
s					3000	3000		
P(x)					0.878	1.000		
V(c,u,x)					410	380		
C(r,x)					638	661		
C(plat,x)					560	661		

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		362
Potential Capacity		952
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		952
Probability of Queue free St.	1.00	0.97

Step 2: LT from Major St.	4	1
Conflicting Flows		730
Potential Capacity		1001
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		1001
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows		1105
Potential Capacity		266
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.96	1.00
Movement Capacity		265

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	422	526
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	420	526
Probability of Queue free St.	1.00	1.00
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	523	422
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	523	420
Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		725

Potential Capacity	427	560
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	425	560
Part 2 - Second Stage		
Conflicting Flows		380
Potential Capacity	899	661
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.97	1.00
Movement Capacity	871	658
Part 3 - Single Stage		
Conflicting Flows		1105
Potential Capacity		266
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.96	1.00
Movement Capacity		265
Results for Two-stage process:		
a	0.91	0.91
y		0.75
C t		396

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)				110		30
Movement Capacity (vph)				396		952
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep				396		952
Volume				110		30
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L					L		R
v (vph)	5					110		30
C(m) (vph)	1001					396		952
v/c	0.00					0.28		0.03
95% queue length	0.02					1.12		0.10
Control Delay	8.6					17.6		8.9
LOS	A					C		A
Approach Delay							15.7	
Approach LOS							C	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	8.6	
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

Gwinnett Unsignalized Intersection Operational Analysis for Gwinnett Street and Proposed Development Main Entrance Intersection Proposed Conditions "Sell Out Event" (Analysis Year: 2028)

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: Courtney Lane
Agency/Co.: HGBD, Inc.
Date Performed: 1/13/2005
Analysis Time Period: PM Peak Hour w/ Event
Intersection: Gwinnett & Main Entrance
Jurisdiction: City of Savannah
Units: U. S. Customary
Analysis Year: 2028
Project ID: Gwinnett Street Traffic Study
East/West Street: Gwinnett Street
North/South Street: Main Entrance
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	0	745			725	1225
Peak-Hour Factor, PHF	1.00	1.00			1.00	1.00
Hourly Flow Rate, HFR	0	745			725	1225
Percent Heavy Vehicles	2	--	--		--	--
Median Type/Storage	Raised curb			/ 1		
RT Channelized?						No
Lanes	1	2			2	1
Configuration	L	T			T	R
Upstream Signal?		Yes			Yes	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				110		30
Peak Hour Factor, PHF				1.00		1.00
Hourly Flow Rate, HFR				110		30
Percent Heavy Vehicles				2		2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			/
Lanes				1		1
Configuration				L		R

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L					L		R
v (vph)	0					110		30
C(m) (vph)	325					0		675
v/c	0.00							0.04
95% queue length	0.00							0.14
Control Delay	16.1							10.6
LOS	C					F		B
Approach Delay								
Approach LOS								

HCS2000: Unsignalized Intersections Release 4.1d

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: Courtney Lane
Agency/Co.: HGBD, Inc.
Date Performed: 1/13/2005
Analysis Time Period: PM Peak Hour w/ Event
Intersection: Gwinnett & Main Entrance
Jurisdiction: City of Savannah
Units: U. S. Customary
Analysis Year: 2028
Project ID: Gwinnett Street Traffic Study
East/West Street: Gwinnett Street
North/South Street: Main Entrance
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	0	745			725	1225
Peak-Hour Factor, PHF	1.00	1.00			1.00	1.00
Peak-15 Minute Volume	0	186			181	306
Hourly Flow Rate, HFR	0	745			725	1225
Percent Heavy Vehicles	2	--	--		--	--
Median Type/Storage	Raised curb			/ 1		
RT Channelized?						No
Lanes	1	2			2	1
Configuration	L	T			T	R
Upstream Signal?		Yes			Yes	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				110		30
Peak Hour Factor, PHF				1.00		1.00
Peak-15 Minute Volume				28		8
Hourly Flow Rate, HFR				110		30
Percent Heavy Vehicles				2		2
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?						No
Lanes				1		1
Configuration				L		R

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0
Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn	270	1700	3	25	60	35	1550
	Through	175	1700	3	25	60	35	1550
S5	Left-Turn	0	1700	3	0	60	35	400
	Through	1860	1700	3	25	60	35	400

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)	4.1					7.5		6.9
t(c,hv)	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
P(hv)	2					2		2
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Grade/100			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)	0.00					0.70		0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage	4.1					6.8		6.9
2-stage	4.1					5.8		6.9

Follow-Up Time Calculations

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)	2.20					3.50		3.30
t(f,HV)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(HV)	2					2		2
t(f)	2.2					3.5		3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog	175	270	1860	0
Total Saturation Flow Rate, s (vph)	3400	3400	3400	3400
Arrival Type	3	3	3	3
Effective Green, g (sec)	25	25	25	0
Cycle Length, C (sec)	60	60	60	60
Rp (from Exhibit 16-11)	1.000	1.000	1.000	1.000
Proportion vehicles arriving on green P	0.417	0.417	0.417	0.000
g(q1)	1.8	2.8	19.1	0.0
g(q2)	0.1	0.2	23.1	0.0
g(q)	1.9	3.0	42.3	0.0

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha	0.400		0.400	
beta	0.714		0.714	
Travel time, t(a) (sec)	30.126		7.775	
Smoothing Factor, F	0.104		0.310	
Proportion of conflicting flow, f	1.000	1.000	1.000	1.000
Max platooned flow, V(c,max)	641	960	3400	0
Min platooned flow, V(c,min)	2000	2000	2000	2000
Duration of blocked period, t(p)	0.0	0.0	22.6	0.0
Proportion time blocked, p	0.000		0.377	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.377
p(dom)	0.377
p(subo)	0.000
Constrained or unconstrained?	U

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)	0.623		
p(4)			
p(7)			
p(8)			
p(9)			
p(10)	0.623	0.623	1.000
p(11)			
p(12)	0.623		

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x	1950					1097		362
s	3000					3000		3000
Px	0.623					0.623		0.623
V c,u,x	1315					0		0
C r,x	522					1023		1084
C plat,x	325					637		675

Two-Stage Process

	7		8		10		11	
	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)					725	372		
s					3000	3000		
P(x)					0.623	1.000		
V(c,u,x)					0	372		
C(r,x)					1023	667		
C(plat,x)					637	667		

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		362
Potential Capacity		675
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		675
Probability of Queue free St.	1.00	0.96

Step 2: LT from Major St.	4	1
Conflicting Flows		1950
Potential Capacity		325
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		325
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows		1097
Potential Capacity		637
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.96	1.00
Movement Capacity		637

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	424	561
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	424	561
Probability of Queue free St.	1.00	1.00
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	143	424
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	143	424
Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		725

Potential Capacity	430	637
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	430	637
Part 2 - Second Stage		
Conflicting Flows		372
Potential Capacity	637	667
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.96	1.00
Movement Capacity	609	667
Part 3 - Single Stage		
Conflicting Flows		1097
Potential Capacity		637
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.96	1.00
Movement Capacity		637
Results for Two-stage process:		
a	0.91	0.91
y		0.00
C t		0

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)				110		30
Movement Capacity (vph)				0		675
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

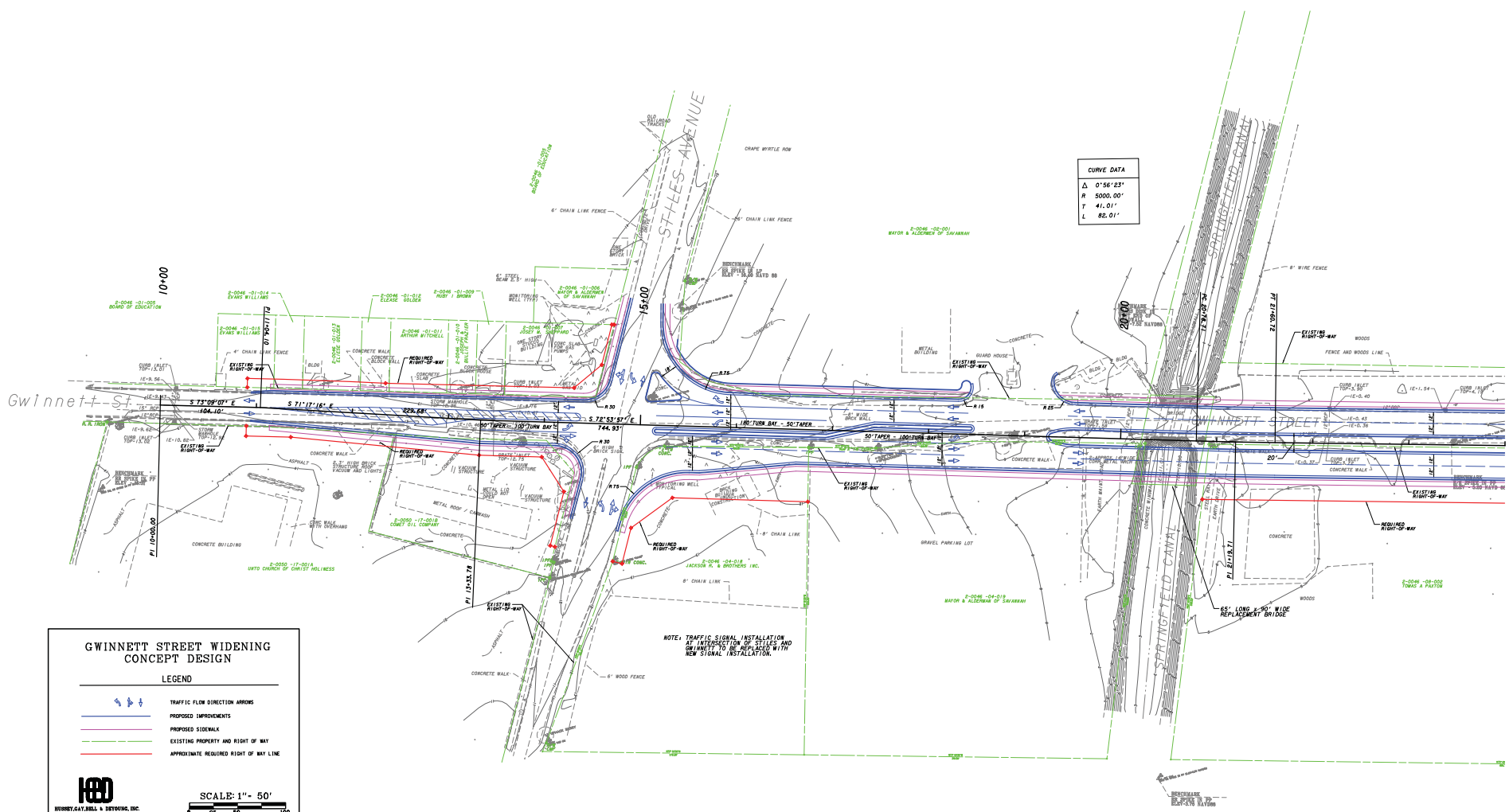
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep				0		675
Volume				110		30
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L					L		R
v (vph)	0					110		30
C(m) (vph)	325					0		675
v/c	0.00							0.04
95% queue length	0.00							0.14
Control Delay	16.1							10.6
LOS	C					F		B
Approach Delay								
Approach LOS								

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4	16.1	
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		



GWINNETT STREET WIDENING CONCEPT DESIGN

LEGEND

- TRAFFIC FLOW DIRECTION ARROWS
- PROPOSED IMPROVEMENTS
- PROPOSED SIDEWALK
- EXISTING PROPERTY AND RIGHT OF WAY
- APPROXIMATE REQUIRED RIGHT OF WAY LINE

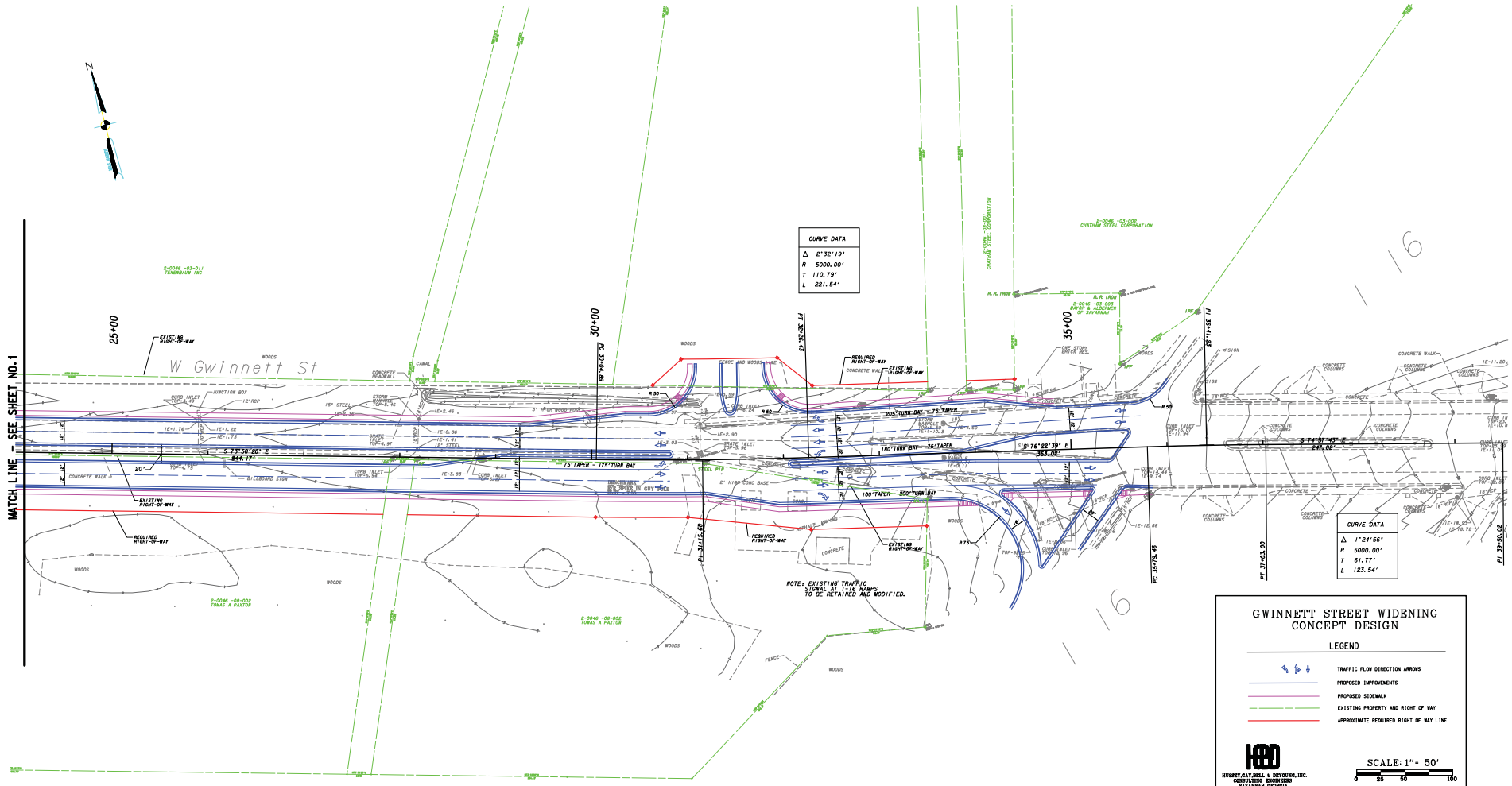
HUSSEY, GAY, BELL & DEYOUNG, INC.
CONSULTING ENGINEERS
SAVANNAH, GEORGIA

SCALE: 1" = 50'

0 25 50 100

LAST REVISED ON MARCH 14, 2006

SHEET 1



LAST REVISED ON MARCH 14, 2006

SHEET 2