Report of Findings of the Concept Development

for the

HOV Interim Project on I-75

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Contents

1. Executive Summary of Interim Concept Development Process

The concept development of the Interim Project on I-75 sought to establish the feasibility of extending the HOV system on I-75 north from Akers Mill Road to Wade Green Road. The goal was to have the project under construction and in operation as quickly as possible. The effort was undertaken with an eye toward addressing the full range of needs for the Atlanta regional HOV system in the corridor. A table of the minimum criteria used for the concept development is included in Appendix A.

The Interim Project Concepts
Three interim concepts were considered. Concept A would use a combination concurrent, reversible and contraflow configuration. Concurrent throughout, Concept B would require an extended ramp system through the bridge end spans from Windy Hill to South Marietta Pkwy since constrictions at the bridges do not allow widening of the I-75 mainline for the new HOV lanes. Also concurrent throughout, Concept C would replace the bridges at Delk and South Marietta Pkwy with structures compatible with the proposed Ultimate HOV project on the corridor. A detailed description of each concept is included in the main body of this document.

The cost estimates for the concepts are as follows:

Concept	Construction Cost	Right-of-Way Cost	Total	Early Implementation Cost
A	$83,732,535	$2,400,000	$86,132,535	$76,064,317
B	$71,409,728	$9,696,000	$81,105,728	$63,737,143
C	$85,296,583	$9,840,000	$95,136,583	$62,297,264

The detailed costs estimates are included in Appendix B.2.1. As shown in the table, an early implementation cost is included in the total cost for each concept. This cost is associated with placing the project in operation quickly. The cost is for items that are not required or that will need to be modified or discarded as part of the Ultimate HOV project. Details of the items included in the estimate are included in Appendix B.2.2.

Concept C was selected as the most desirable interim project since it implements concurrent flow throughout the corridor limits and is operationally sound. A table of pros and cons associated with each concept used in the decision process is presented in Appendix B.3.

The Ultimate Project
The concept development process for the Ultimate Project initially included two basic approaches to implementation of HOV. The traffic analysis indicated that two lanes in each direction are required to accommodate potential HOV traffic volumes on I-75 between I-285 and I-575 at the design year. The first concept proposed a widening of the I-75 corridor to place the new HOV lanes adjacent to the median. The second approach would place the HOV system on the outside of the corridor in each direction. On the I-575 and I-75 corridors north of the I-75/I-575 Interchange, the most cost effective

approach is to place the new HOV lanes in the median since space is available with minimal structure modifications and right-of-way acquisitions. A detailed description of the initial Ultimate Concepts is included in this report. At the request of GRTA a third alternate will also be examined. This alternate places the HOV lanes adjacent to each other in the same corridor on one side of the Interstate. This alternate will be further studied and included in the concept development for the Ultimate Project design.

The cost estimates for the Ultimate HOV concepts are as follows:

Concept	Construction Cost	Right-of-Way Cost	Total
HOV in Median	$328,676,704	$114,080,000	$442,753,704
HOV Outside	$416,626,460	$159,551,600	$576,188,060

The detailed cost analysis for each of the Ultimate Concepts is attached.

Benefit/Cost Analysis

To establish the parameters associated with the benefit/cost analysis, several assumptions for implementation of the Interim and Ultimate Projects were made. These are detailed in the body of this report. Summarizing, the Interim Project would be opened to traffic in 2007 while the Ultimate Project could be in operation in 2010 if the Outside Concept is selected. There will be a period of approximately two years beginning in 2010 after the new HOV system is in place during which the Interim HOV and SOV lane markings will be removed by milling, the project overlaid and the SOV lanes restriped to increase shoulder and lane widths. Selecting the Median Concept for the Ultimate Project would extend the construction period to 2011 with a similar restriping time frame required.

Based on the assumed schedule, soon after the Interim Project is placed into operation, construction for the Ultimate Project could begin. The Interim Project would be in operation for three years until the Ultimate Project becomes operational in 2010. The impact on the capacity of the Interim HOV Project and the existing SOV system associated with the construction of the Ultimate Project during this period and the restriping required has been developed based on the information presented in the body of this Report. The annual cost streams associated with the schedule based on the no-build, the Interim only, the Interim with the Ultimate and the Ultimate with and without the Interim were developed. Comparing the cost data differences over the time frame being analyzed indicates negative benefits in all but two scenarios; the Interim Only and the Outside Concept with the Interim.

The present worth values of the cost streams between 2005 and 2030 for the Interim and Ultimate Projects together based on year 2005 dollars using a 7% interest rate are presented in the following table. The benefit of the Interim Project alone is the difference between the No-Build and the Interim Only scenarios. Comparing this to the total construction cost for the Interim Project yields the benefit-cost ratios as shown. All costs are expressed in millions of dollars.

Concept	Cost with Interim	Cost w/o Interim	Benefit	Const Cost	Benefit/Cost Ratios
Inside Concept	$7,512	$7,356	-$156	$95.1	N/A
Outside Concept	$6,735	$6,817	$82	$95.1	0.86

Conclusions

For this analysis a benefit/cost ratio of greater than one would indicate a cost effective solution. Due to the extended period of disruption during construction, the Inside Concept analysis yields negative benefits and does not appear cost-effective. While the Outside Concept with the Interim Project is marginally cost-effective, this only occurs if a conservative approach is used to develop the cost stream data modified to consider weekends, holidays and other factors. In summary, implementation of the Interim Project is only marginally beneficial and only if implemented with the outside Ultimate Project concept. In addition, if the Concept C Interim Project, which is the recommended Interim Concept, is used, the early implementation goal may not be met.

2. General

The limits of the Interim Project on I-75 are Kennedy Interchange on the south and Wade Green Road on the north. The current HOV system on I-75 actually terminates at Akers Mill Road. While improvements south to the Kennedy Interchange were considered during the concept development process, it was determined that simply connecting to the end of the current HOV lanes and extending them to the north would be appropriate.

The concept development process for the Interim Project on I-75 sought to establish the feasibility of extending the HOV system on I-75 north from Akers Mill Road to Wade Green Road and have it under construction and in operation as quickly as possible. A table of minimum criteria used for the concept development is included in Appendix A. The existing conditions on the corridor are such that developing full desirable lane and shoulder widths for the Interim Project is not feasible. The criteria list was developed with these restrictions in mind.

The primary objectives for the Interim HOV project on I-75 that were established during discussions with GDOT staff members to guide the development of an acceptable solution were as follows:

- Start construction in FY 2003 and complete by 2005
- Develop acceptable design deviation criteria to meet existing constraints
- Environmental documentation level expected will be Categorical Exclusion
- No additional right of way will be required
- The Project should provide realistic travel time savings
- No significant impacts to existing bridge structures
- No negative operational impact on existing general use lanes
- The facility should function properly from an operational standpoint
- Minimize "early implementation costs" as much as possible
- The Project must be compatible with the existing market for HOV
- The Project must address public acceptability

The most significant physical constraints on the corridor were identified from actual filed measurements. They are:

- I-285 Mainline Bridge
- I-285 Westbound CD Bridge
- Windy Hill Road Bridge (Southbound Lanes)
- Delk Road Bridge
- South Marietta Parkway Bridge

While the other locations noted present problems with shoulder widths, the most serious constraints exist at Windy Hill Road (on the southbound side), Delk Road (in both directions) and South Marietta Parkway (on the northbound side). The distance between piers is not adequate for the existing configuration at these bridges. Some of the existing lanes are 11 feet wide in these areas and existing shoulder widths are substandard. Therefore, adding an additional lane for HOV is not a viable option in these areas leaving contraflow as the only option without considering bridge modifications.

Actual physical measurements between piers at each bridge on the corridor from Akers Mill Road to South Marietta Parkway are provided in Appendix A. The included sections depict the existing lane configuration and shoulder widths along with the proposed section information for each alternate.

Four concepts were actually considered for the Interim Project. Ramp metering and HOV bypass was discussed in general. Given the physical constraints at several of the ramp gores with existing walls and limited right-of-way, this technique presents several problems with implementation. Additionally, ramp metering, while limiting the volume of traffic on the mainline of I-75, creates congestion on the cross streets. For these reasons this technique was not pursued.

3. The Interim Project Concepts

The concepts under consideration are described as follows:

Concept A

- Akers Mill to Windy Hill Road – concurrent flow
- Windy Hill Road to Delk Road – new reversible lane
- Delk Road to South Marietta Parkway – contraflow – take a general use lane from the off-peak direction
- South Marietta Parkway to Wade Green Road – concurrent flow

The additional width required to implement a reversible lane under the existing Windy Hill bridge would be obtained by shifting the northbound lanes to the east under the bridge and constructing a tie-back wall at the eastern end bent, if required. The median barrier would be removed for a sufficient distance to allow use of a movable barrier. The exposed center pier in the southbound direction would be protected with an appropriate attenuator.

The machinery required to move the barriers would be stored in the existing median that widens to approximately 45 feet north of the Windy Hill Road bridge. A storage area would need to be created north of the South Marietta Parkway bridge by shifting the mainline out both northbound and southbound in the vicinity of the Banberry Road bridge. This could possibly require additional right-of-way and create environmental issues that could eliminate the possibility of a CE.

The cost for this concept has been estimated at $83.7 mil. The majority (90.8%) of this would be early implementation cost. Early implementation costs are costs for facility improvements that will be modified or removed when the ultimate HOV design for the corridor is implemented.

Concept B

- Akers Mill to Windy Hill Road – concurrent flow
- Vicinity of Windy Hill Road– shift the center barrier to the east to add concurrent flow lanes
- Windy Hill Road to South Marietta Parkway – concurrent flow - Add an extended ramp system northbound and southbound from Windy Hill Road to South Marietta Parkway under the end spans of Delk and South Marietta Parkway bridges.
- South Marietta Parkway to Wade Green Road – concurrent flow

There is enough room under the southbound South Marietta Parkway bridge to add the additional HOV lane and buffer without having to utilize the end span of this bridge. This will require reduced lane and shoulder widths, however.

This concept would provide for continuous concurrent flow for the entire length of the I-75 study corridor. In order to avoid replacing or extensively modifying the bridges at Delk Road and South Marietta Parkway while compensating for the conversion of a general purpose lane in the center to a HOV lane it is proposed to add a lane on the outside in each direction through this area and direct it through the end spans of the bridges. Some of the end spans are already open while others will require the addition of a tieback wall at the end bents and passing at least two lanes through the end span. The additional lane in each direction will function as an extended ramp so that traffic approaching the area from either direction would use it to access any of the three interchange ramps from Windy Hill Road to South Marietta Parkway.

The cost for this approach has been estimated to be $71.4 mil. Approximately 89.3% of this total is expected to be early implementation cost when the ultimate design is implemented.

Concept C

- Akers Mill to Windy Hill Road – concurrent flow
- Windy Hill Road to Delk Road – shift the center barrier to the east to add concurrent flow lanes
- Delk Road to Wade Green Road – concurrent flow

The most costly of all the concepts considered, this approach would require the replacement of the Delk Road and South Marietta Parkway bridges and the addition of a lane in each direction to compensate for the conversion of the center lanes in each direction to HOV use. Ideally, the new bridges would be the structures required to accommodate the Ultimate HOV project on the I-75 corridor. This would, of course, require additional right-of-way and could result in environmental impacts that would lengthen the preconstruction process well beyond the desired time frame.

The concept cost estimate for this approach has been placed at $85.3 mil. Since this concept would use a design for the new bridges compatible with the ultimate HOV design, early implementation costs would be minimized at 73.0%.

4. Ultimate Project Concepts

Concepts for the Ultimate Projects on I-75 and I-575

The concepts under consideration are described as follows:

The Ultimate HOV concepts propose a barrier separated approach. Two HOV lanes in each direction on I-75 are proposed from the vicinity of I-285 to the I-75/I-575 Interchange.

North of the I-75/I-575 Interchange to Wade Green Road one HOV lane in each direction is proposed for I-75. One HOV lane in each direction is also proposed on I-575 from I-75 to Sixes Road. The median in these corridors will be modified to be wide enough to accommodate two HOV lanes in each direction but only one lane will be constructed.

Regardless of the Ultimate Concept selected, it is proposed to separate HOV and SOV traffic access points on the corridors. This presents a workable solution to the operational concerns of installing a new signal (or signals) within the SOV interchanges where overlapping of left turn queues and other operational problems could be introduced.

The traffic modeling to date for barrier separated HOV has indicated that the separation of SOV and HOV access points has little impact on the magnitude of HOV traffic on the barrier separated lanes.

To be operationally acceptable the HOV access points would be spaced no more than 3 to 4 miles apart. They would also be located to adequately serve the HOV access requirements on the corridors. A graphic depicting HOV trip ends prepared based on the ARC traffic model has been developed to aid in determining where the HOV interchanges should be located. The graphic indicates the density of HOV trips along the corridors. A copy of this map is attached. The densities suggest desirable locations for HOV only interchanges. They are:

I-75

- Terrell Mill Road

- A new access point to Franklin Rd between Delk Road and South Marietta Parkway. This is suggested not to meet the spacing criterion but to service the relatively heavy HOV traffic expected west of I-75 in this area.
- Roswell Road (SR 120)
- Allgood Road
- Bells Ferry Road
- A new access south of Chastain Road to serve the new CCT Park and Ride facility under construction behind Town Center Mall on the southwest corner of George Busbee Parkway and South Busbee Drive

I-575
- Big Shanty Road for access to the Park and Ride facility behind the Mall
- Shallowford Road
- Dupree Road
- Rope Mill Road

The study limit on I-75 is Wade Green Road. If signals are added at the ramp termini in this interchange in the future, there will be four signals within 2,000 feet on Wade Green located at Shiloh Road, the two ramp termini and George Busbee Parkway. The introduction of a fifth signal for a center HOV access on the bridge does not appear to be a workable solution. In addition, the westbound left turning queue for traffic on Wade Green to the southbound I-75 HOV system could extend across the eastern ramp terminus intersection and result in operational difficulties. For these reasons it may be appropriate to eliminate HOV access at Wade Green altogether and extend the HOV system approximately 6000 feet north on I-75 to a proposed access point at Hickory Grove Road as recently suggested by Cobb County DOT. Hickory Grove does not currently have SOV access to I-75. The northern study limit on I-575 at Sixes Road could present similar operation problems. The traffic analysis to be completed on both corridors will establish the viability of the center access at each location.

It was noted that some of the HOV access points could require extensive construction to tie the access to major roadways in the area. The Dupree Road access on I-575 is notable in this regard. The express bus study prepared by GRTA suggests this location for a park and ride facility but Dupree Road does not tie directly to SR 92 to the south or Towne Lake Parkway to the north on the west side of I-575. It does tie to Main Street in Woodstock east of I-575 through a residential area. In order for the access at Dupree to be viable, one or the other of the north and south ties, if not both, may need to be established or improved.

As part of the concept development process, other access points were investigated and rejected. Hawkins Store Road does not have the desirable access east and west of I-575 and the spacing from Big Shanty is too close (1400 ft). Shallowford Road had only light HOV trip density in the vicinity and would not serve the development densities in the area as well as the other proposed access points.

However, the viability of establishing these access points has been demonstrated graphically if one or the other of the preferred access sites proves unworkable.

As noted above, the traffic data gathered to this point and the ARC traffic model indicate that two HOV lanes in each direction on I-75 between I-285 and the I-575 split would be adequate to accommodate the project HOV traffic at the design year and provide sufficient additional capacity to consider a High Occupancy Toll facility in the future.

The existing median width and the bridge configurations along the I-575 corridor are such that the additional paving required for one HOV lane in each direction could be accommodated with limited structure modifications, if any, relatively minor additional paving and minor additional right-way in selected locations. The additional right-of-way would only be required at the HOV access points. It appears that any other approach would be prohibitively expensive by comparison. Therefore, it is the opinion of the PB Team that the most practical location of the Ultimate HOV system on I-575 is in the center.

There are two basic approaches to implementation of the Ultimate HOV system on I-75. The first is the conventional location of the HOV lanes in the median and at-grade. The second is the location of the HOV lanes on the outside of the SOV system with flyover bridge systems at the interchanges to isolate the HOV system from the SOV system.

In general, for the median concept, the approach would be to accommodate the required footprint by maximizing the use of retaining walls to minimize ROW impacts. The Team looked at the current traffic analysis and the 2027 design year forecasts to determine an ultimate SOV and HOV lane configuration. The required additional general purpose lanes based on the design year traffic were depicted to the extent that their influence on the overall HOV design could be determined. Additional SOV lanes are not intended as part of the design for the implementation of the Ultimate HOV system on either corridor.

For the at-grade center concept, the basic SOV interchange configurations would be retained with a new bridge structure to allow for the expansion of the mainline for the HOV lanes and new ramp alignments to accommodate the new ramp tie points off the ends of the proposed new bridges. It was noted that eliminating loops and going to a tight diamond configuration could reduce ROW costs. However, the loops help with accommodating high left turn volumes in some locations and should be selectively retained. Again, the traffic analysis will determine how best to handle these issues.

. A new possible location of an access point for exclusive HOV access was identified approximately midway between Delk Road and South Marietta Parkway. The new roadway would tie to Franklin Road west of the I-75 mainline. If required, access from the east could also be accommodated as well with a tie to

Powers Ferry Road. The viability of this access point will be established as part of the traffic analysis for the corridor. The planimetrics of this and other possible HOV only access points are available for both the I-75 and I-575 corridors.

It will likely be necessary to provide both on and off access at all HOV interchanges to accommodate Bus Rapid Transit type operations.

The I-75 mainline may need to be shifted to the west to avoid two grave sites located on the southeast corner of I-75 and Gresham Road and in the northeast quadrant of the interchange on I-75 at North Marietta Parkway. Photos of the grave sites at Gresham Road are available, if required. The graves are immediately adjacent to the right-of-way fence at Gresham. The grave sites at the North Marietta Parkway interchange are to be defined by field review. The mainline shift to avoid both grave sites is depicted on the available plans prepared as part of the concept development process. The archeological investigation needed to determine the details of this cemetery will be part of the environmental process to be conducted.

The approach used for the concept development process was to conduct a fatal flaw analysis of the environmental issues to support preliminary concept development. A screening of the corridors was conducted to determine if environmental elements exist that could result in making a concept impossible or impractical. If found, the concepts were developed to avoid the element or elements.

The Canton Connector Interchange on I-75 would require extensive replacement of the existing bridges to accommodate the HOV system. The bridges to be replaced would include Canton Road, the railroad bridge and the ramp bridges. The rail line is critical and cannot simply be shut down. It is a siding, but there is significant traffic. The construction would need to be staged with a new bridge constructed while the old one remains in operation. This same approach to staging the bridge construction is feasible throughout the interchange with slight realignments allowing new bridges to be constructed while the existing one remains in operation.

A new HOV access at Roswell Road (SR 120) was considered, and a feasible design is possible as indicated on the plans. However, there are grade and traffic issues to be addressed. The clearance under the bridges will be a significant issue when the mainline of I-75 is widened at its current grade and cross slope in the future. Either I-75 must be raised or Rowell Road lowered to obtain the proper clearance. Concept development will identify and develop a feasible layout considering these issues.

A new HOV access at Allgood Road appears feasible as depicted on the concept plans. With the current five-lane section and proximity of major collector roadways, there is excellent access to the east and west at this location to serve the HOV traffic expected.

Bells Ferry is a potential HOV site, but roadway widening has been historically opposed by local residents, and residential access opportunities are limited. While access is feasible, there are also historical resource constraints.

At the I-75/ I-575 Interchange, the HOV ramps to I-575 northbound would be placed on an adequate grade to cross the I-75 northbound lanes on a bridge structure and continue north as a single lane in each direction on I-575 in the existing median. The I-75 HOV lanes would continue through the Interchange in the median as a single lane in each direction north of the Interchange.

SOV ramps were investigated at the I-75/I-575 Interchange to add the missing southbound to northbound movements on each corridor to make sure they could be accommodated with the proposed HOV system. The issue for adding the SOV ramps will be the extensive rock excavation that would be required since rock outcroppings in the vicinity are extensive and directly in the path of the logical location for the ramps.

The new access on I-75 south of Chastain Road is proposed for access to the new Park and Ride facility under construction in the vicinity. There is a very wide (approximately 300 feet) median at the proposed location of the new HOV interchange. It is proposed to configure the interchange with I-75 over the new roadway so that the access can connect with Barrett Lakes Blvd on the west side of I-75 as well as George Busbee Parkway on the east. This would serve the HOV traffic both east and west of I-75. Staging would be simplified with the wide median by realigning I-75 north and southbound inside the median while the existing north and southbound lanes remain in operation. It has been suggested that the realignment could remain in place to further simplify the process.

The Wade Green interchange can accommodate the new HOV lanes and access in the existing median. However, the previously noted operation problems need to be addressed. One method of doing this consists of eliminating the HOV access at Wade Green and extending the HOV lanes to a new HOV interchange in the median at Hickory Grove Road.

As previously noted, Cobb DOT and the cities of Acworth and Kennesaw commissioned a study by Carter-Burgess to locate a park and ride facility at Hickory Grove with HOV access in the center and SOV ramps in various configurations. The PB Team may eliminate the SOV access at this location to simplify operation and minimize impacts.

. The proposed interchange at Hickory Grove is complicated by the existing northbound on- ramp from Wade Green which extends to and under Hickory Grove. This extended ramp system was constructed in the past to accommodate a movable truck weigh station. If SOV ramps were added at Hickory Grove it would mean signing the northbound exit to Hickory grove south of Wade Green. It may also be appropriate to stripe concurrent HOV between Wade Green and Hickory Grove and begin the barrier separation at Wade Green in the southbound direction. This could simplify operations.

Basically, the addition of a single HOV lane in each direction does not present major problems on I-575. The existing median is 64 feet wide for almost the entire length of the corridor. Existing Bridges typically have two-span arrangements with a center pier in the median and end bents located well outside the existing pavement. This configuration allows widening in the median to add the HOV lane as well as any shifting of the mainline that may be required to accommodate the new HOV lanes by the inclusion of tie-back walls at the end bents. The proposed HOV access points would be as discussed above.

. The elevated HOV concept on I-75 may more appropriately be termed the outside HOV alternate since the HOV system is proposed outside of the general-purpose lanes. In general, the HOV system would consist of two lanes in each direction and barrier separated from the general purpose lanes. At the interchanges the HOV system will be on structure to avoid impacts to the operation of the SOV systems. All SOV ramps could remain in their basic existing configurations with the HOV lanes and structures located in such a way as to avoid precluding any SOV improvements that may be required in the future to accommodate the design year traffic. GDOT has suggested that for this approach it would be appropriate to locate the barrier at the clear zone requirement for all existing and proposed SOV lanes.

The HOV system in general would be appropriately designed for expressway speeds, i.e., 60 mph with maximum grades of 4%.

The configuration of the transition to concurrent flow south of I-285 is important so that HOV users can access Cumberland or Akers Mill. The westbound CD and the mainline bridges on I-285 over I-75 present real problems with horizontal clearances. Until these bridges are replaced in a future interchange modification, it will be difficult to add the north-facing HOV ramps at Akers Mill Road to mirror the existing south-facing access and maintain the AASHTO design criteria on grades and shoulder widths.

The approach for the I-75 HOV system from I-285 through the Windy Hill area was to develop a layout that avoids existing major structures insofar as possible. If the HOV system were proposed at-grade, every structure would need to be either modified extensively or rebuilt from scratch. At this point while a number of scenarios have been developed by others to accommodate the future traffic in the I-285/I-75 Interchange through the Windy Hill Interchange, none has been approved. It may be some time before all of the SOV issues are addressed adequately. The Team feels that since implementation of HOV on the corridor is the primary goal, it is prudent to develop HOV systems that avoid having to solve the SOV issues before HOV can even be considered. At the same time it is appropriate to allow maximum flexibility for the future SOV improvements in the area.

The HOV system-to-system connection at I-285 was studied to the point that, when appropriate, the proposed HOV system developed as part of this study could accommodate the I-285 HOV system.

The ARC Traffic Demand Model indicates the following for the design year 2025 for the HOV system to system connection:

HOV Ramp Description	AM Peak	PM Peak	VPD
I-75 SB to I-285 WB	250	645	4530
I-75 SB to I-285 EB	716	660	7080
I-75 NB to I-285 WB	59	309	1850
I-75 NB to I-285 EB	237	543	3880
I-285 EB to I-75 NB	491	546	5130
I-285 EB to I-75 SB	201	186	1910
I-285 WB to I-75 NB	422	771	5460
I-285 WB to I-75 SB	382	393	3870

In order to implement the HOV interconnection, it was assumed that the HOV system on I-285 would be in the median. To make room for it the I-285 westbound mainline would need to be shifted to the north through the I-285/I-75 Interchange. The longitudinal extent of the shift is difficult to establish without a detailed development of the HOV system that would be appropriate for several miles in each direction on I-285 which is beyond the scope of this study. Note that it is not necessary to provide the HOV system-to-system connections to implement the Ultimate HOV system on I-75; all that is required is to assure that the HOV system on I-75 will accommodate the HOV system and connections on I-285 when required.

The shift of the eastbound I-285 mainline would need to be adequate to accommodate the new flyover HOV ramps depicted on the layouts provided that it would tie into I-285 eastbound and westbound as well as I-75 northbound and southbound.

It should be noted that the HOV movements northbound on I-75 to I-285 eastbound and westbound and I-285 eastbound and westbound to I-75 southbound and the movements on I-285 eastbound and westbound to southbound I-75 were eliminated from consideration based on the analysis of the HOV traffic data. The volume of these movements is considered insignificant while the cost of providing ramps to accommodate them is extensive. If the ramps are determined to be required in the future, they are not precluded but could be added. However, the cost is not included in the Ultimate Project on I-75.

The southernmost HOV access for the outside concept proposed would be located at Terrell Mill Road. The location of the HOV system on the outside simplifies the access ramp configurations and minimizes impacts. However the issue associated with widening Terrell Mill to accommodate the required left turns is the same as with the other alternate. Again, the traffic analysis may indicate that it is not an issue. If it is determined that a left turn lane needs to be added in either direction or both, then the Terrell Mill bridges will need to be replaced unless another scheme proves appropriate to minimize cost

The next interchange is Delk Road. At this point the HOV system will be elevated in both directions to avoid disturbing the existing bridge and SOV interchange. This allows maximum flexibility in the future SOV changes that may be required while the HOV system is constructed and placed into operation. Since the existing bridge at this location is currently inadequate to accommodate the current number of SOV lanes in either direction, it would be appropriate to replace the bridge with a span arrangement to accommodate full width shoulders and lanes that would be 12 feet wide.

As expected, the outside HOV concept does have ROW requirements at several locations when compared to the center concept. However, the extent of the required right-of-way is similar to the median concept.

The next HOV interchange would be located at between Delk Road and South Marietta Parkway. It would be a new access as discussed in the previous concept to serve the Franklin Road area. The issues are similar to the center concept but the required right-of-way would be different since the mainline of I-75 does not need to be shifted for the center access ramps. Right-of-way would still be required for the ramps but the total requirement would be less. An additional bridge over the northbound lane on I-75 would be required, however.

The HOV interchange at Roswell would require the removal of several local commercial buildings, but the concept is very simple. One advantage over the center concept is that the clearance issues associated with widening the existing bridges over Roswell Road would be avoided since the current I-75 bridges would not need to be modified until SOV traffic warrants. The HOV bridges over Roswell would be independent structures slightly higher than the mainline. The HOV system would be placed to allow future SOV expansion.

GDOT has suggested that a split diamond be considered between Roswell Road and Gresham Road or access at Gresham Rd instead of Roswell. The split diamond would require mixed flow one-way roads between the two crossroads along existing roadways on each side of I-75.

The HOV access at Allgood Road would require a new bridge for additional turn lanes and to allow future SOV lanes on I-75. However, the concept is simple and appears to provide excellent access to local arterials to deliver the HOV traffic to the I-75 corridor.

Through the SR 5 Connector Interchange, the two elevated HOV lanes would need to be on a long structure. The existing bridges could remain in place, however.

Again no interchange is proposed at Bells Ferry as discussed above.

At the I-75/I-575 Interchange the HOV system will transition to the center on I-75 as depicted in the plans using straddle bent bridges. North of I-575 on I-75 the concept becomes identical to the pervious concept. Similarly on I-575 north of the Interchange, the concept is again identical to the previous discussion.

The outside HOV concept has tremendous maintenance of traffic advantages during construction over the at-grade concept. The Interim HOV concept could be implemented in the center of I-75 in the short term while the outside HOV system could be constructed in the future leaving the Interim HOV system in place. After the outside HOV system is in place and in operation, the Interim HOV system could be removed by restriping the mainline.

5. Benefit/Cost Analysis

Introduction

As traffic volumes grow on I-75, congestion levels will increase and this will increase the cost incurred by users of the facility. By investing in limited capacity improvements – such as HOV lanes or auxiliary lanes - at least some of the traffic congestion will be mitigated, and roadway users will experience a net savings in transportation costs. The general theory that justifies the cost of roadway improvements considers whether the present worth of these user cost savings are greater than the cost to implement the improvement and maintain it over the service life of the facility. This technical memorandum discusses the factors considered in quantifying user benefits, the process of converting these benefits to monetary units, and computation of the present value of these benefits for use in estimating benefit-cost ratios for the project. Project limits are along I-75 from Cumberland Road to Wade Green Road in Cobb County, Georgia.

The purpose of this analysis is to assess the incremental benefits of constructing interim HOV lanes on I-75 before the more elaborate ultimate facilities can be funded, designed and constructed. Therefore, this analysis compares the additional benefits of providing interim HOV lanes on a near-term basis, versus having roadway users wait until the ultimate improvements are completed before drawing benefits. A major issue in this analysis is the cost to users due to disruption during construction of these facilities, and – for the case of the interim lanes - the removal of these facilities. These construction impact costs play a key role in determining whether the benefits of the interim HOV lanes are worth the cost.

The analysis was conducted using four different ultimate HOV implementation scenarios:

1. Base (or "No Build") condition in which no improvements are made to I-75.
2. Interim condition only, in which case the interim HOV lanes are constructed, but no ultimate HOV facilities are built.
3. Ultimate (or "Build") condition where the ultimate facility consists of inside median barrier separated HOV lanes.
4. Ultimate (or "Build") condition where the ultimate facility generally consists of an elevated (and therefore barrier separated) facility outside the existing traveled way.

Roadway User Impacts of Traffic Congestion

Traffic congestion results in the following impacts to travelers:

- Personal time is wasted during congestion delays
- Traffic accident rates increase with congestion
- Delays associated with traffic accidents and other incidents (such as disabled vehicles) further increase congestion for other travelers
- Fuel consumption rates increase
- More pollutants are emitted into the atmosphere
- Vehicular operating costs associated with wear and tear (other than fuel) are increased

The impacts consist of reduced personal productivity, additional wear and tear on vehicles, more pollution, wasted fuel, higher accident costs (insurance rates and other out-of-pocket accident costs), and secondary health impacts due to additional pollution. By applying unit costs per hour of delay, per gallon of fuel, per kilogram of emissions, or per accident event, these impacts are converted into costs that can be accumulated over time and compared to the construction cost in the base year. An annual discount rate of 7%, as typically recommended by FHWA, was used to convert user costs in future years to present day costs.

Methodology for Estimating Congestion Impacts to Roadway Users

A traffic analytical framework was used to estimate levels of traffic congestion, accidents, incidents, fuel consumption, pollutant emissions and other user costs on I-75 under various scenarios. Traffic forecasts were based on daily volumes from the Atlanta Regional Commission (ARC) travel demand forecasting model. An annual analysis of user costs was conducted for the years 2005, 2010 and 2025. Growth rates were computed between 2005 and 2010, and between 2010 and 2025 to interpolate the growth in annual user costs each year, and to extrapolate benefits to the year 2030. The different scenarios are described below:

A. Base (Existing) Conditions – I-75 has 3 to 5 general use lanes in each direction with 1 to 3 auxiliary lanes on various sections. Full shoulders are available to handle incidents and minor accidents. The roadway operating speed is 70 miles per hour with no geometric restrictions.

B. Base with Construction of Interim HOV – All lanes in Base Condition remain open, but construction activity eliminates shoulders. The net result is a 3% reduction in lane capacity and more severe delay and accident impacts due to the lack of shoulders. High quality transitions enable normal operation speeds at 70 miles per hour. Two years are required to construct the interim facility.

C. Interim Concurrent Flow HOV Lanes – All lanes in the Base Condition are open with shoulders, but a concurrent flow HOV lane increases the capacity of each freeway section by 10 percent. Full capacity of other lanes, and 70 mile per hour operating speeds are in place.

D. Interim HOV with Construction of Inside Concept Median HOV– All general use lanes and the Interim HOV lane remain open, but all shoulders are closed. Roadway operating speeds are reduced to 60 miles per hour due to construction zone transitions. The inside median HOV lanes are presumed to require 5 years of construction activity.

E. Construction of Inside Median HOV without the Interim HOV Lanes – Same as with interim, except that no interim HOV lane is in operation.

F. Interim HOV with Construction of Outside Elevated HOV – All general use lanes and the Interim HOV lane remain open, but all shoulders are closed. Roadway operating speeds remain at 70 miles per hour since construction activity is to the outside. The outside elevated HOV lanes are presumed to require 4 years of construction activity.

G. Construction of Outside Elevated HOV without the Interim HOV Lanes – Same as with interim, except that no interim HOV lane is in operation.

H. Ultimate HOV with Removal of Interim HOV Lanes – All general use lanes are open, but are being milled and paved to accommodate restriping to eliminate the concurrent flow HOV lanes. Shoulders are closed, but a new barrier-separated HOV freeway (either inside median or outside elevated) with 2 lanes in each direction is open to carry HOV traffic.

I. Ultimate HOV – All general use lanes and shoulders are open, but carry mostly SOV traffic. A new barrier-separated HOV freeway (either inside median or outside elevated) with 2 lanes in each direction carries HOV traffic.

The above conditions are assumed to occur during different years depending on whether an interim facility is included, and which type of barrier separated HOV facility is built. The table below summarizes the year in which each activity is assumed to occur in the time series benefit analysis.

Table 1
Range of Years associated with Construction and Operations
I-75 Interim and Ultimate HOV Lanes

	No Build	Interim HOV Only	Inside Median with Interim	Inside Median without Interim	Outside Elevated with Interim	Outside Elevated without Interim
Construct Interim	N/A (A)	2005-2006 (B)	2005-2006 (B)	N/A	2005-2006 (B)	N/A
Operate Interim	N/A (A)	2007-2030 (C)	2007-2011 (D)	N/A	2007-2010 (F)	N/A
Construct Ultimate	N/A (A)	N/A	2007-2011 (D)	2007-2011 (E)	2007-2010 (F)	2007-2010 (G)
Remove Interim	N/A (A)	N/A	2012-2013 (H)	N/A	2011-2012 (H)	N/A
Operate Ultimate	N/A (A)	N/A	2014-2030 (I)	2012-2030 (I)	2013-2030 (I)	2011-2030 (I)

The tables and graphs in Appendix D.3 of this document summarize the time-series total user costs for the base condition versus the other scenarios. Present value costs are computed using a discount rate of 7%. Construction activity increases costs for users. Therefore, the longer the construction activity occurs, the longer these costs are incurred and the higher the present worth. Construction benefits are generally negative. When new capacity is completed, there is a reduction in congestion impact costs. The benefits of a completed facility are generally positive. The big issue with the interim facility is whether the added cost of constructing the interim HOV lanes is worth the change in user benefits while the interim lanes are open. Since the interim lanes can be completed in two years, they have the potential to provide benefits during the construction of the ultimate facility. However, as soon as the ultimate facility is opened, the interim lanes must be removed, and this imposes an additional cost on users.

Analysis Results

The table below summarizes the results of the analysis of user benefits for the four different HOV implementation scenarios. For scenarios 1 and 2, benefits are compared against the “no build” scenario. Therefore, the benefits of the base scenario are zero, and those of the interim facility only are $498,000,000 when compared against “no build”. However, this is academic since the Interim Project alone will not meet the system-wide HOV needs. The benefits of the interim facility alone are highest since benefits occur for all years between 2007 and 2030, while construction impacts only occur from 2005 to 2006.

Table 2
Year 2005 Present Cost User Benefits
I-75 Interim and Ultimate HOV Lanes

No.	I-75 HOV Lane Scenario	Present Cost Benefit (2005) Millions of Dollars
1.	Base with No Interim or Ultimate	$0
2.	Interim HOV Only without Ultimate	$498
3.	Inside Median Ultimate with Interim	-$531
	Inside Median Ultimate without Interim	-$375
	Net Benefit of Interim HOV Lanes	-$156
4.	Outside Elevated Ultimate with Interim	$246
	Outside Elevated Ultimate without Interim	$164
	Net Benefit of Interim HOV Lanes	$82

As can be seen by the latter two scenarios, the impacts of construction activity are very severe. For scenario 3 (Inside Median HOV), the impact of inside median construction activity is so severe that even the ultimate project alone does not produce a positive user benefit by 2030. In other words, roadway users experience $375,000,000 in additional costs due to construction-related impacts that are not recovered by 2030. By adding the construction and removal impacts of the interim HOV lanes, users experience $531,000,000 in additional costs that are not recovered by 2030. This means that the impacts of constructing the interim facility in 2005 and 2006, and removing the interim facility in 2012 and 2013 are worse than the benefits of having the interim HOV lanes in operation during construction of the ultimate facility between 2007 and 2011. Therefore, the benefits of the interim facility with the inside-median construction activity are negative $156,000,000.

On the other hand, the less-severe construction impacts of the elevated outside HOV lanes result in a net savings of $82,000,000 in user benefits if the interim HOV lanes are built. Without the interim HOV lanes, the outside-elevated HOV lanes will produce $164,000,000 in user benefits through 2030. Total benefits increase to $246,000,000 when the interim lanes are added.

6. Conclusions and Recommendations

The benefits to roadway users under the four scenarios considered in this user costs analysis result in different conclusions and recommendations for each.

- No Build – This is the base condition, which produces no benefits or burdens.

- Interim Only (No Ultimate Facility) – This scenario produces $498 million in user benefits through the year 2030. An interim facility could be recommended under this scenario, and could be very cost effective when compared to construction costs. However, this scenario does not meet system needs and does not consider other long term factors such as substandard design features and loss of enforcement capabilities.

- Inside-Median HOV Lanes with Interim HOV Lanes – This scenario results in an increase in user costs (i.e., a burden) of $156 million through 2030. Construction of interim HOV lanes is not recommended under this scenario, since no benefits are expected.

- Outside-Elevated HOV Lanes with Interim HOV Lanes – This scenario results in a user savings of $82 million. If the interim HOV lanes can be constructed for this amount or less, this scenario can be considered viable. Therefore, under this scenario, interim HOV lanes should be considered if the benefits match or exceed the cost of constructing these lanes.

It should be noted that the above conclusions are based on rather conservative assumptions regarding user impacts of congestion. For example, the user costs and benefits only consider commuter weekday traffic conditions (250 days of the year) and exclude weekend and holiday operations (115 days of the year). Full consideration of weekend and holiday benefits could increase the cost effectiveness of the "Interim Only" or "Outside-Elevated HOV Lanes with Interim HOV Lanes" scenarios. However, positive benefits would not be expected for the "Inside-Median HOV Lanes with Interim HOV Lanes" scenario.

Appendix A

The Interim Project

Appendix A.1

Interim Project Design Criteria

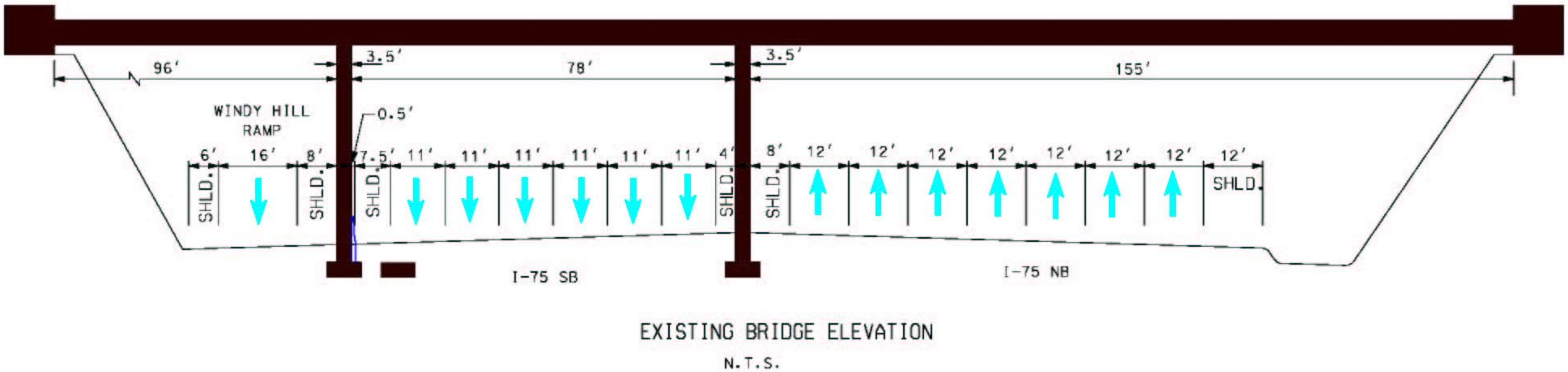
Interim Project Minimum Design Criteria

Number of HOV lanes required in each direction:	1
Minimum HOV lane width:	11 ft
Minimum SOV lane with for cars:	11 ft
Minimum SOV lane width for trucks: (Two outside lanes to be designated for truck traffic)	12 ft
Minimum inside shoulder width:	2 ft
Minimum outside shoulder width:	2 ft
Painted buffer between HOV and SOV lanes	2 ft

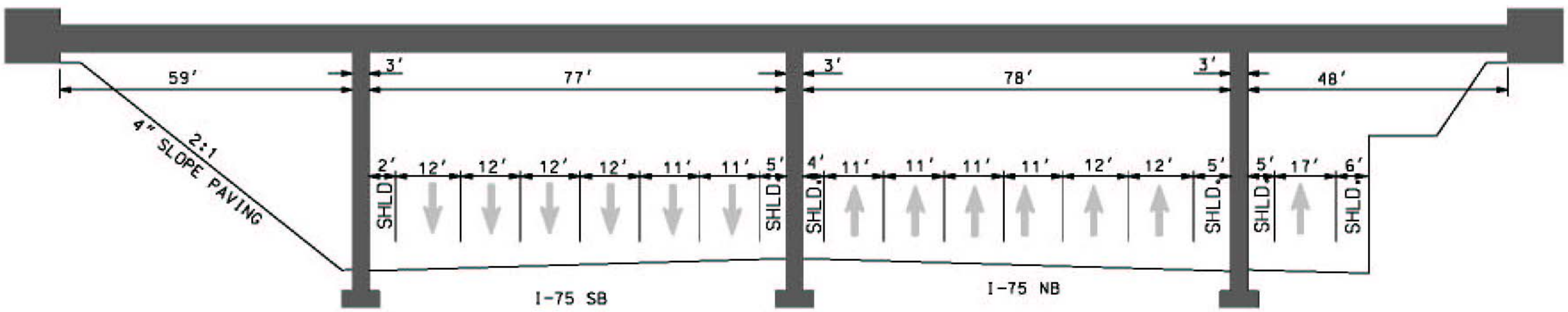
Appendix A.2

Sections Depicting Existing Conditions at Key Locations

Section at Windy Hill Road



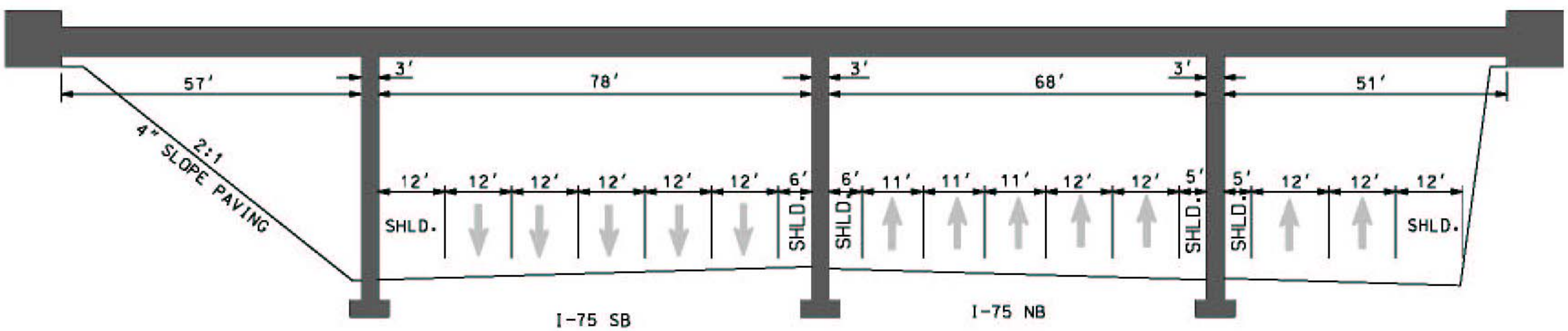
Section at Delk Road



EXISTING BRIDGE ELEVATION

N.T.S.

Section at South Marietta Pkwy



EXISTING BRIDGE ELEVATION

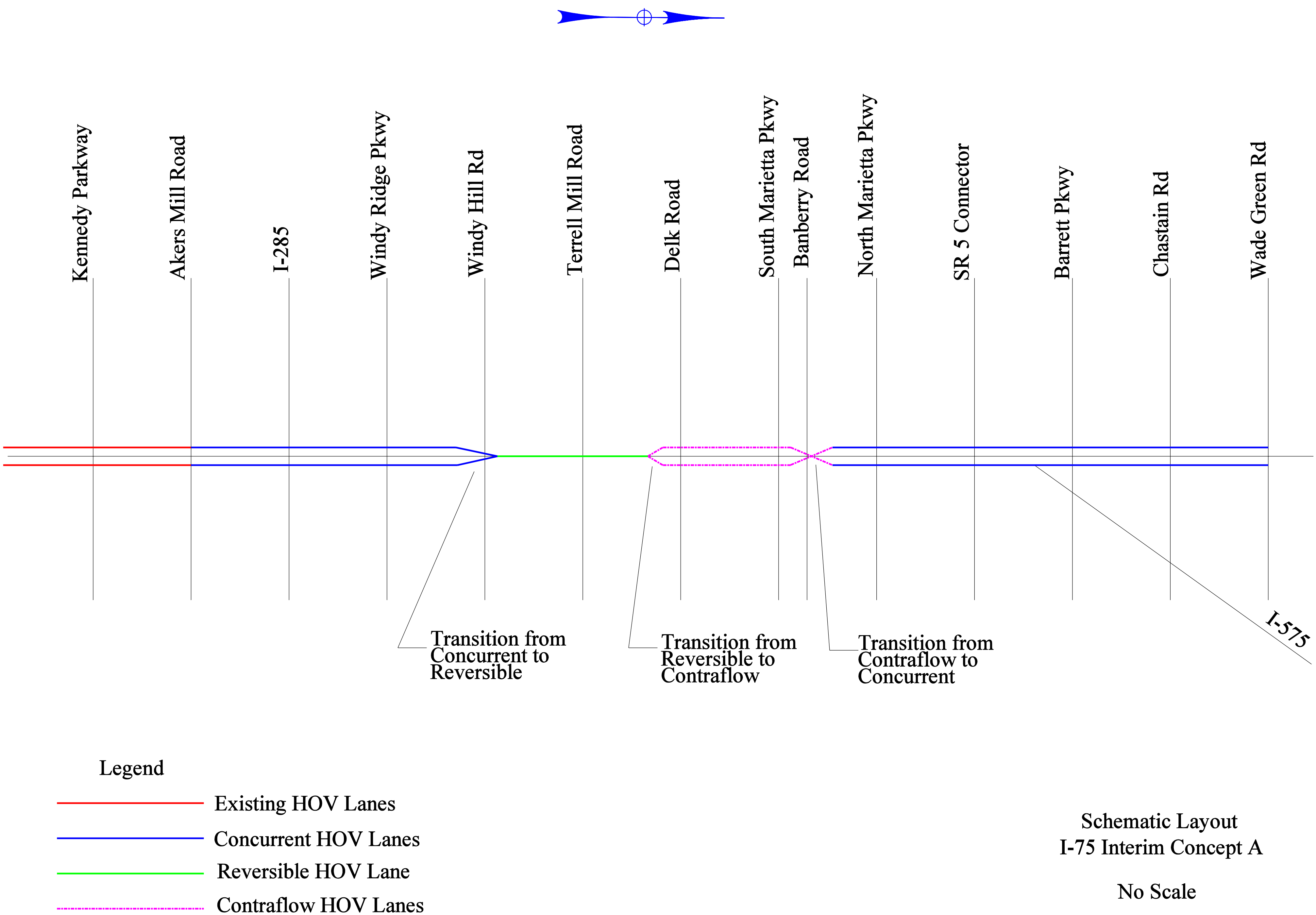
N.T.S.

Appendix B

Interim Concepts

Appendix B.1

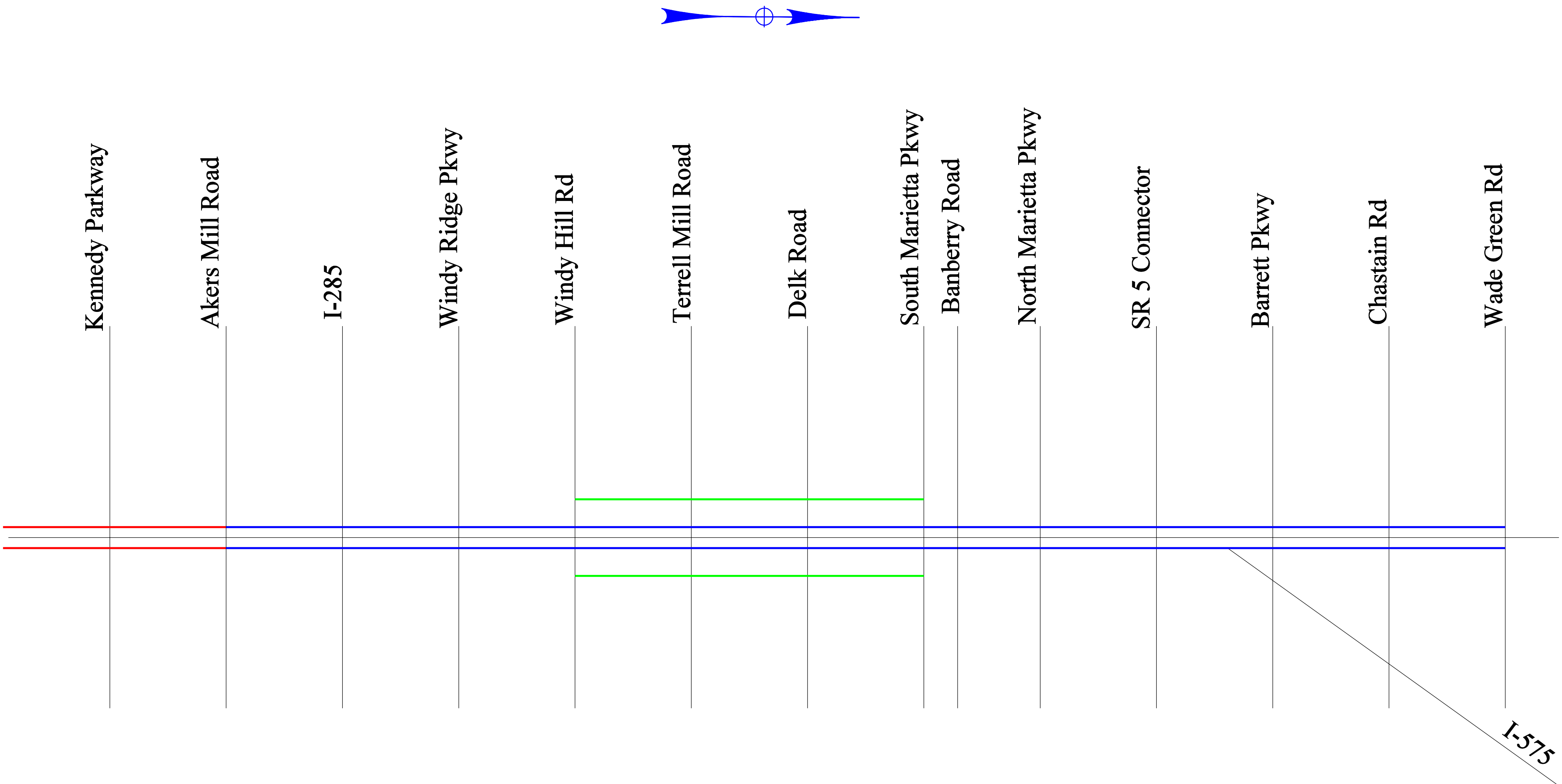
Concept Schematics



Schematic Layout
I-75 Interim Concept A

No Scale

June 24, 2002



Legend

Existing HOV Lanes

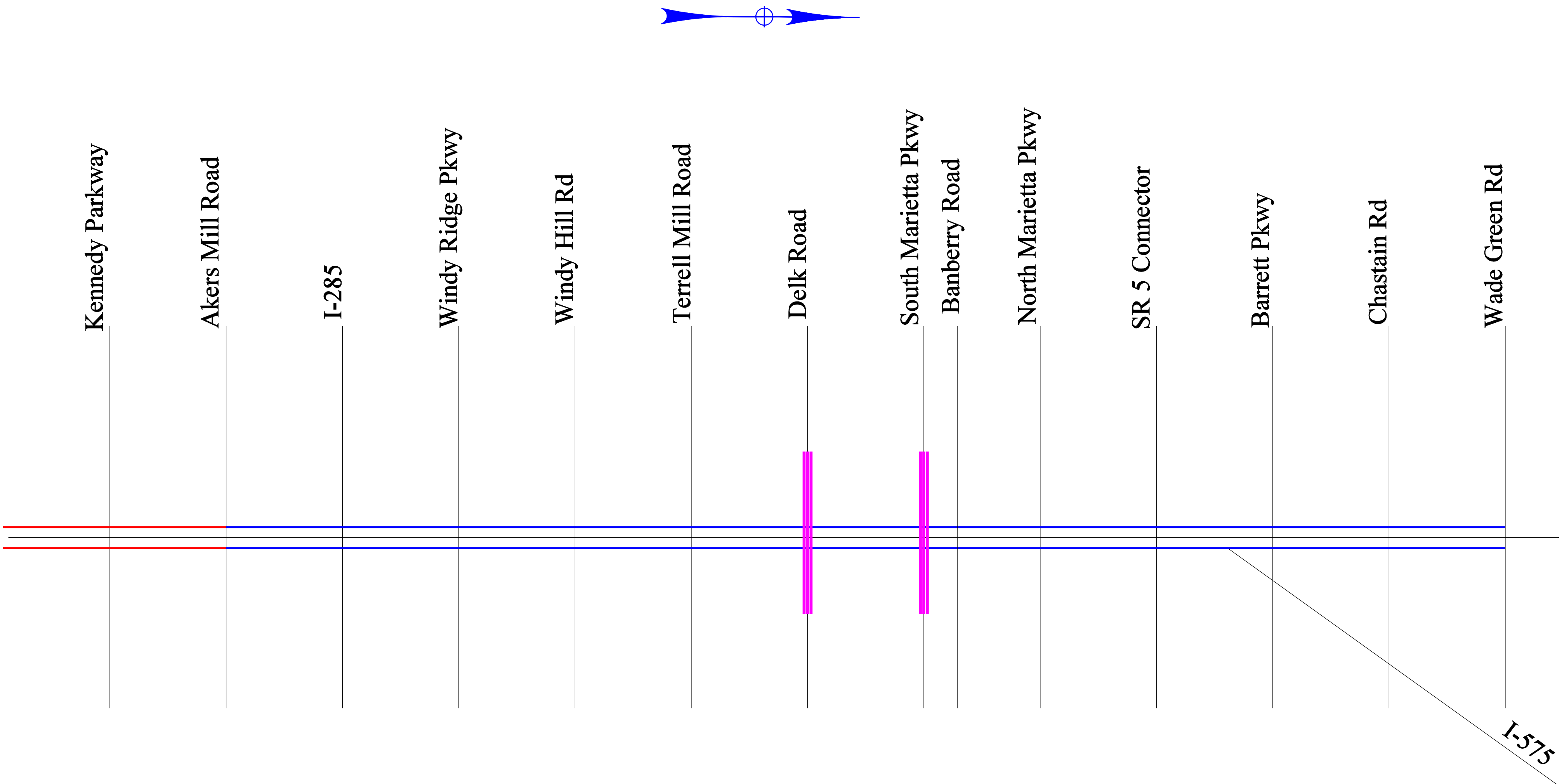
Concurrent HOV Lanes

Extended Ramp System

Schematic Layout
I-75 Interim Concept B

No Scale

June 24, 2002



Legend

Existing HOV Lanes

Concurrent HOV Lanes

Bridges to be Replaced

Schematic Layout
I-75 Interim Concept C

No Scale

June 24, 2002

Appendix B.2.1

Construction and Right-of-Way Cost Estimates

PRELIMINARY COST ESTIMATE

PROJECT NUMBER: NHS-0002-00(39) (HOV Interim Alternate A) COUNTY: Cobb

DATE: 6-24-02 ESTIMATED LETTING DATE:

PREPARED BY: Parsons Brinckerhoff PROJECT LENGTH: 14.53 Miles

( )PROGRAMMING PROCESS (X)CONCEPT DEVELOPMENT ( )DURING PROJECT DEV.

PROJECT COST	
A. RIGHT-OF-WAY:	
1. PROPERTY (LAND & EASEMENT)	$ 1,500,000
2. DISPLACEMENTS; RES:0 BUS;0, M.H.:0	$ 0
3. OTHER COST (ADM./COST, INFLATION)	$ 900,000
SUBTOTAL:A	$ 2,400,000
B. REIMBURSABLE UTILITIES:	
1. RAILROAD	$ 0
2. TRANSMISSION LINES-	$ 0
3. SERVICES-	$ 0
SUBTOTAL:B	$ 0
C. CONSTRUCTION:	
1. MAJOR STRUCTURES	
a. Bridges- Widening existing bridges at Terrell Mill Rd & Banberry Rd	$ 985,400
b. Retaining walls Windy Hill Rd to Delk Rd 75,000 SF @ $30/SF = $ 2,250,000 Concrete barrier Windy Hill Rd to Dell Rd 8400 LF @ $140/LF = $ 1,176,000	$ 3,426,000
SUBTOTAL:C-1	$ 4,411,400
2. GRADING AND DRAINAGE:	
a. EARTHWORK- Uncl. Exc. 400,000CY @ $2.25/CY = $ 900,000 Borrow 820,000CY @ $2.25/CY = $ 1,845,000	$ 2,745,000
b. DRAINAGE:	
1) Metal drain inlets 75ea @ $960; 4000 LF 15” Slope Drain Pipe @ $25/LF	$ 172,000

PROJECT NUMBER: NHS-0002-00(39) (HOV Interim Alternate A) COUNTY: Cobb

PROJECT COST		
2) Med. Drainage- Adjust 180 D.I.s @ $845 ea		$ 152,100
.		
SUBTOTAL:C-2		$ 3,069,100
3. BASE AND PAVING:		
a. AGGREGATE BASE- 261,400 TN@ $15/TN		$ 3,921,000
b. ASPHALT PAVING: Surface- 141,000 TN. @$55/TN Bit. Tack Coat 87,400 gal $1/gal	$ 7,755,000 $ 87.400	$ 7,842,400
Binder—114,500 TN-@$36/TN		$ 4,122,000
Base— 191,800TN @$36/TN		$ 6,904,800
SUBTOTAL:C-3.b		$18,869,200
c. CONCRETE PAVING-		$ 0
d. OTHER- Rumble Strip 14.53 Mi @$3500/Mi; Grinding Conc. Pvmt 125,400 SY@$2.15/SY		$ 320,465
SUBTOTAL:C-3		$23,110,665
4. LUMP ITEMS:		
a. GRASSING- 100 Acs @ $1000/Acs		$ 100,000
b. CLEARING AND GRUBBING- 100 Acs @ $3000/Acs		$ 300,000
c. LANDSCAPING		$ 0
EROSION CONTROL- Silt Fence Ty A 20,000 LF @$1.50, Sediment Basins 8 ea@$8500, 40,000 SY Erosion Mats @$1.30/SY, 15,000 SY PSRM @$4.60, 15,000 SY BTGF @$2.40, 5000 SY Conc. Dit. Pav. @$27/SY; Rip rap ditch checks 150 ea @ $300		$ 435,000
e. TRAFFIC CONTROL- I-75 14.53 Mi @ $260,000/Mi.; Windy Hill Rd $200,000		$ 3,977,800
SUBTOTAL:C-4		$ 4,812,800
5. MISCELLANEOUS:		
a. LIGHTING		$ 0
b. SIGNING - MARKING : Striping $272,000; 15 Overhead signs @ $400,000; 15 ea Cantilever signs @ $200,000; Misc. info signs $145,000		$ 9,417,000

PROJECT COST	
c. GUARDRAIL – 15,000LF @$11/LF, 12 ea Type 12 Anch @$1335 ea, 12 ea Type 1 Anch. @$485 ea	$ 186,840
SUBTOTAL:C-5	$ 9,603,400
6. SPECIAL FEATURES-	
a. Field Engineers Office Type 3 @ $60,000	$ 60,000
b. Bridge Jacking (Windy Hill Rd) $500,000	$ 500,000
c. Moveable barrier 19644 LF@$230/LF (S. of Delk to N. of S. Loop)	$ 4,518,120
d. 3 Barrier moving vehicles @$900,000 ea	$ 2,700,000
e. Operational cost for 5 years- $600,000/yr @ 5% (Present worth)	$ 5,800,000
f. Sound wall (Windy Hill Rd to So. Marietta Pkwy-Lt.& Rt.) 550,400 SF @$19/SF	$10,457,600
SUBTOTAL:C-6	$24,035,720

PROJECT NUMBER: NHS-0002-00(39) (HOV Interim Alternate A) COUNTY: Cobb

ESTIMATE SUMMARY		
A. RIGHT-OF-WAY		$ 2,400,000
B. REIMBURSABLE UTILITIES		$ 0
C. CONSTRUCTION		
1. MAJOR STRUCTURES	$ 4,411,400	
2. GRADING AND DRAINAGE	$ 3,069,100	
3. BASE AND PAVING	$ 23,110,665	
4. LUMP ITEMS	$ 4,812,800	
5. MISCELLANEOUS	$ 9,603,400	
6. SPECIAL FEATURES	$ 24,035,720	
SUBTOTAL CONSTRUCTION COST		$ 69,043,525
E. & C. (10%)		$ 6,904,353
INFLATION (5% PER YEAR for 2 YEARS)		$ 7,784,657
TOTAL CONSTRUCTION COST		**$ 83,732,535**
GRAND TOTAL PROJECT COST		**$ 86,132,535**

PRELIMINARY COST ESTIMATE

PROJECT NUMBER: NHS-0002-00(39) (HOV Interim Alternate B) COUNTY: Cobb

DATE: 6-24-02 ESTIMATED LETTING DATE:

PREPARED BY: Parsons Brinckerhoff PROJECT LENGTH: 14.53 Miles

( )PROGRAMMING PROCESS (X)CONCEPT DEVELOPMENT ( )DURING PROJECT DEV.

PROJECT COST	
A. RIGHT-OF-WAY:	
1. PROPERTY (LAND & EASEMENT)	$ 6,060,000
2. DISPLACEMENTS; RES:0 BUS;0, M.H.:0	$ 0
3. OTHER COST (ADM./COST, INFLATION)	$ 3,636,000
SUBTOTAL:A	$ 9,696,000
B. REIMBURSABLE UTILITIES:	
1. RAILROAD	$ 0
2. TRANSMISSION LINES-	$ 0
3. SERVICES-	$ 0
SUBTOTAL:B	$ 0
C. CONSTRUCTION:	
1. MAJOR STRUCTURES	
a. Bridges Widening existing bridges at Terrell Mill Rd & Banberry Rd	$ 985,400
b. Retaining walls- Windy Hill Rd to Delk Rd 100,300 SF @ 30/SF; Walls Under End spans at Delk Rd 6400 SF @ $50/SF; Wall under End Spans at SMP 6400 SF @ $50/SF; Concrete barrier- 3000 LF @ $140/LF	$ 5,054,000
SUBTOTAL:C-1	$ 6,039,400
2. GRADING AND DRAINAGE:	
a. EARTHWORK- Uncl. Exc. 450,000 CY @ $2.25/CY Borrow 850,000 CY @ $2.25/CY	$ 2,745,000
b. DRAINAGE:	
1) Metal drain inlets- 75 ea @ $960 ea; 4000 LF 15" Slope drain pipe @ $25/LF	$ 172,000
2) Med. Drainage- Adjust 180 D.I.s @ $845 ea	$ 152,100

PROJECT NUMBER: NHS-0002-00(39) (HOV Interim Alternate B) COUNTY: Cobb

PROJECT COST		
SUBTOTAL:C-2		$ 3,249,100
3. BASE AND PAVING:		
a. AGGREGATE BASE- 297,200 TN@ $15/TN		$ 4,458,000
b. ASPHALT PAVING: Surface- 144,900 TN. @$55/TN Bit. Tack Coat 96,900 gal $1/gal	$ 7,969,500 $ 96,900	$ 8,066,400
Binder—130,140 TN-@$36/TN		$ 4,685,040
Base— 217,900 TN @$36/TN		$ 7,844,400
SUBTOTAL:C-3.b		$20,595,840
c. CONCRETE PAVING-		$ 0
d. OTHER- Rumble Strip 14.53 Mi @$3500/Mi; Grinding Conc. Pvmt 126,000 SY@$2.15/SY		$ 321,755
SUBTOTAL:C-3		$25,375,595
4. LUMP ITEMS:		
a. GRASSING- 100 Acs @ $1000/Acs		$ 100,000
b. CLEARING AND GRUBBING- 100Acs @ $3000/Acs		$ 300,000
c. LANDSCAPING		$ 0
EROSION CONTROL- Silt Fence Ty A 20,000 LF @$1.50, Sediment Basins 8 ea @$8500, 40,000 SY Erosion Mats @$1.30/SY, 15,000 SY PSRM @$4.60, 15,000 SY BTGF @$2.40, 5000 SY Conc. Dit. Pav. @$27/SY; Rip rap ditch checks 150 ea @ $300		$ 435,000
e. TRAFFIC CONTROL- I-75 14.53 Mi @ $260,000/Mi.; Windy Hill Rd $200,000		$ 3,977,800
SUBTOTAL:C-4		$ 4,812,800
5. MISCELLANEOUS:		
a. LIGHTING		$ 0
b. SIGNING - MARKING : Striping $272,000; 15 Overhead signs @ $400,000; 15 ea Cantilever signs @ $200,000; Misc. information signs $145,000		$ 9,417,000
c. GUARDRAIL – 15,000 LF @$11/LF, 12 ea Type 12 Anch @$1335ea, 12 Type 1 Anch. @$485 ea		$ 186,840

PROJECT NUMBER: NHS-0002-00(39) (HOV Interim Alternate B) COUNTY: Cobb

PROJECT COST	
SUBTOTAL:C-5	$ 9,603,840
6. SPECIAL FEATURES- Field Engineers Office Type 3 @ $60,000 Bridge Jacking (Windy Hill Rd) $500,000. Sound wall (Windy Hill Rd to So. Marietta Pkwy-Lt. & Rt.) 550,400 SF @ $19/SF	$11,017,600

ESTIMATE SUMMARY		
A. RIGHT-OF-WAY		$ 9,696,000
B. REIMBURSABLE UTILITIES		$ 0
C. CONSTRUCTION		
1. MAJOR STRUCTURES	$ 6,039,400	
2. GRADING AND DRAINAGE	$ 3,069,100	
3. BASE AND PAVING	$ 25,324,740	
4. LUMP ITEMS	$ 4,812,800	
5. MISCELLANEOUS	$ 9,603,840	
6. SPECIAL FEATURES	$ 11,017,600	
SUBTOTAL CONSTRUCTION COST		$ 58,882,480
E. & C. (10%)		$ 5,888,248
INFLATION (5% PER YEAR for 2 YEARS)		$ 6,639,000
TOTAL CONSTRUCTION COST		**$ 71,409,728**
GRAND TOTAL PROJECT COST		**$ 81,105,728**

PRELIMINARY COST ESTIMATE

PROJECT NUMBER: NHS-0002-00(39) (HOV Interim Alternate C) COUNTY: Cobb

DATE: 6-24-02

PREPARED BY: Parsons Brinckerhoff PROJECT LENGTH: 14.53 Miles

( )PROGRAMMING PROCESS (X)CONCEPT DEVELOPMENT ( )DURING PROJECT DEV.

PROJECT COST	
A. RIGHT-OF-WAY:	
1. PROPERTY (LAND & EASEMENT)	$ 6,150,000
2. DISPLACEMENTS; RES:0 BUS;0, M.H.:0	$ 0
3. OTHER COST (ADM./COST, INFLATION)	$ 3,690,000
SUBTOTAL:A	$ 9,840,000
B. REIMBURSABLE UTILITIES:	
1. RAILROAD	$ 0
2. TRANSMISSION LINES-	$ 0
3. SERVICES-	$ 0
SUBTOTAL:B	$ 0
C. CONSTRUCTION:	
1. MAJOR STRUCTURES	
a. Bridges Delk Rd (390’x140’)@$100/SF = $ 5,460,000 So. Marietta Pkwy (365’x150’)@$100/SF = $ 5,475,000 Temp. bridge at Delk Rd 17,000 SF @ $65/SF = $ 1,105,000 Temp. bridge at So. Marietta Pkwy 13,600 SF @ $65/SF = $ 804,000	$ 12,924,000
b. Retaining walls Windy Hill Rd to Delk Rd 100,300 SF @ 30/SF = $ 3,009,000 Wall at Delk Rd 6400 SF @ $50/SF = $320,000 Concrete barrier- 3000 LF @ $140/LF = $ 420,000	$ 3,749,000
SUBTOTAL:C-1	$ 16,673,000
2. GRADING AND DRAINAGE:	
a. EARTHWORK- Uncl. Exc. 450,000 CY @ $2.25/CY = $ 1,012,500 Borrow 850,000 CY @ $2.25/CY = $ 1,912,500	$ 2,925,000
b. DRAINAGE:	

PROJECT COST	
1.) Metal drain inlets 75 ea @ $960 ea = $ 72,000 4000 LF 15" Slope Drain Pipe @ $25 = $ 100,000	$ 172,000
2) Med. Drainage- Adjust 180 D.I.s @ $845 ea	$ 152,100
SUBTOTAL:C-2	$ 3,249,100
3. BASE AND PAVING:	
a. AGGREGATE BASE- 278,250 TN @ $15/TN = $ 4,173,750 ASPHALT PAVING: Surface- 142,840 TN. @ $55/TN = $ 7,856,200 Bit. Tack Coat 91,880 gal $1/gal = $ 91,880 Binder—121,860 TN-@$36/TN = $ 4,386,960 Base— 204,100 TN @$36/TN = $ 7,347,600	$ 23,856,390
b. CONCRETE PAVING-	$ 0
c. OTHER Rumble Strip 14.53 Mi @$3500/Mi = $ 50,855 Grinding Conc. Pvmt 125,400 SY@$2.15/SY $ 269,610	$ 320,465
SUBTOTAL:C-3	$ 24,176,855
4. LUMP ITEMS:	
a. GRASSING- 100 Acs @ $1000/Acs	$ 100,000
b. CLEARING AND GRUBBING- 100 Acs @ $3000/Acs	$ 300,000
c. LANDSCAPING	$ 0
d. EROSION CONTROL Silt Fence Ty A 20,000LF @$1.50 = $ 30,000 Sediment Basins 8 ea @ $8500 = $ 68,000 40,000 SY Erosion Mats @$1.30/SY = $ 52,000 15,000 SY PSRM @ $4.60 = $ 69,000 15,000 SY BTGF @ $2.40 = $ 36,000 5000 SY Conc. Ditch. Paving @$27/SY = $ 135,000 Rip rap ditch checks 150 ea @$300 ea = $ 45,000	$ 435,000
e. TRAFFIC CONTROL I-75 14.53 Mi @ $260,000/Mi.= $ 3,777,800 Windy Hill Rd $200,000	$ 3,977,800

PROJECT COST		
	SUBTOTAL:C-4	$ 4,812,800
5. MISCELLANEOUS:		
a. LIGHTING		$
b. SIGNING – MARKING		$ 9,417,000
Striping	$272,000	
15 ea Overhead signs @ $400,000 =	$ 6,000,000	
15 ea Cantilever signs @ $200,000 =	$ 3,000,000	
Misc. information signs	$145,000	
c. GUARDRAIL		$ 186,840
15,000 LF @$11/LF =	$ 165,000	
12 ea Type 12 Anch @ $1335 ea =	$ 16,020	
12 Type 1 Anch. @ $485 ea =	$ 5,820	
	SUBTOTAL:C-5	$ 9,603,840
6. SPECIAL FEATURES-		
a. Field Engineers Office Type 3 @ $60,000 =	$ 60,000	
b. Bridge Jacking (Windy Hill Rd)	$500,000	
c. Signals at Delk Rd & So. Marietta Pkwy (temp & perm)	$ 600,000	
d. Remove exist. Bridges at Delk Rd & So. Marietta Pkwy	$200,000	
e. Sound wall (Windy Hill Rd to So. Marietta Pkwy-Lt.& Rt.)		
550,400 SF @ $19/SF =	$ 10,457,600	
	SUBTOTAL:C-6	$ 11,817,600

PROJECT NUMBER NHS-0002-00(39) (HOV Interim Alternate C) COUNTY: Cobb

ESTIMATE SUMMARY		
A. RIGHT-OF-WAY		$ 9,840,000
B. REIMBURSABLE UTILITIES		$ 0
C. CONSTRUCTION		
1. MAJOR STRUCTURES	$ 16,673,000	
2. GRADING AND DRAINAGE	$ 3,249,100	
3. BASE AND PAVING	$ 24,176,855	
4. LUMP ITEMS	$ 4,812,800	
5. MISCELLANEOUS	$ 9,603,840	
6. SPECIAL FEATURES	$ 11,817,600	
SUBTOTAL CONSTRUCTION COST		$ 70,333,195
E. & C. (10%)		$ 7,033,320
INFLATION (5% PER YEAR for 2 YEARS)		$ 7,930,068
TOTAL CONSTRUCTION COST		**$ 85,296,583**
GRAND TOTAL PROJECT COST		**$ 95,136,583**

Appendix B.2.2

Early Implementation Cost Estimates

Preliminary Cost Estimate Summary and Early Implementation Cost Estimate

I-75 Interim Project

Date: 9/13/2002

Project Number: NHS-0002-00(39)
PI No. 0002039

Prepared by Parsons Brinckerhoff

	Summary Item	Concept A			Concept B			Concept C		
		Estimated Cost	% Early Implementation Cost	Early Implementation Cost	Estimated Cost	% Early Implementation Cost	Early Implementation Cost	Estimated Cost	% Early Implementation Cost	Early Implementation Cost
A	Right-of-Way	N/A	0.00%	$0	N/A	0.00%	$0	N/A	0.00%	$0
B	Reimbursable Utilities	$0	0.00%	$0	$0	0.00%	$0	$0	0.00%	$0
C	Construction Cost									
1	Major Structures	$4,411,400	22.34%	$985,400	$5,054,400	32.16%	$1,625,400	$16,673,000	5.91%	$985,400
2	Grading and Drainage	$3,069,100	5.61%	$172,100	$3,069,100	5.61%	$172,100	$3,249,100	5.30%	$172,100
3	Base and Paving	$23,110,665	100.00%	$23,110,665	$25,324,740	100.00%	$25,324,740	$24,176,855	100.00%	$24,176,855
4	Lump Sum Items	$4,812,800	100.00%	$4,812,800	$4,812,800	100.00%	$4,812,800	$4,812,800	100.00%	$4,812,800
5	Miscellaneous	$9,603,840	100.00%	$9,603,840	$9,603,840	100.00%	$9,603,840	$9,603,840	100.00%	$9,603,840
6	Special Features	$24,035,720	100.00%	$24,035,720	$11,017,600	99.99%	$11,017,000	$11,817,600	98.31%	$11,617,600
	E & C Cost	$6,904,353	90.84%	$6,272,053	$5,888,248	89.26%	$5,255,588	$7,033,320	73.04%	$5,136,860
	Inflation	$7,784,657	90.84%	$7,071,739	$6,639,000	89.26%	$5,925,675	$7,930,068	73.04%	$5,791,809
	Totals	$83,732,535	90.84%	$76,064,317	$71,409,728	89.26%	$63,737,143	$85,296,583	73.04%	$62,297,264

Appendix B.3

Pros and Cons for the Interim Concepts

Pros and Cons

I-75 Interim HOV Project
Kennedy Parkway to Wade Green Road

Issue	Concept A		Concept B		Concept C	
	Pro	Con	Pro	Con	Pro	Con
HOV Type		Reversible and Contra-Flow	Continuous Concurrent Flow		Continuous Concurrent Flow	
Operation	Acceptable in Peak Direction	Undesirable in the Offpeak Direction		Questionable Effectiveness of Extended Ramp System	Best	
Travel Time Savings AM Peak *	42%	Off-Peak --3%	17%		39%	
Travel Time Savings PM Peak *	17%	Off-Peak --2%	57%		61%	
Incident Management		Worst	Acceptable		Best	
Environmental Documentation	CE. (Estimate 12 Months to Complete)		CE. (Estimate 12 Months to Complete)			EA. (Estimate 24 Months to Complete)
Right of Way Impacts	Least		Acceptable		Acceptable	
Design	12 Months		18 Months			24 Months
Complete Preconstruction Process **	2004		Mid 2005		2005	
Right-of-Way Cost	$2.4 mil		$3.6 mil			$9.8 mil
Construction Cost		$70.7 mil ***	$71.4 mil			$85.1 mil
Construction Time	Quickest. Estimate 12 Months		Acceptable. Estimate 18 months			Longest. Estimate 24 months
Early Implementation Cost		$48.0 mil	$33.0 mil		$33.0 mil	
Operation Year	2005		2006			2007
Equipment Cost		$2.7 mil	No Additional Cost		No Additional Cost	
Annual Operation and Equipment Maintenance Cost		$4.2 mil	No Additional Cost		No Additional Cost	

* Southern Section from I-285 to South Marietta Parkway
** Assumes Approval of Concept and Design Start by July 2002
*** Excludes Equipment and Operation Costs

Appendix C

Cost Estimates for the Ultimate Concepts

PRELIMINARY COST ESTIMATE

PROJECT NUMBER: NH-73-3(242) (HOV Median Ultimate I-285 to Wade Green Rd) COUNTY: Cobb

DATE: August 8, 2002

PREPARED BY: Parsons Brinckerhoff PROJECT LENGTH: 14.53 Miles

( )PROGRAMMING PROCESS (X)CONCEPT DEVELOPMENT ( )DURING PROJECT DEV.

PROJECT COST	
A. RIGHT-OF-WAY:	
1. PROPERTY (LAND & EASEMENT) 60.7 Acres	$ 48,100,000
2. DISPLACEMENTS; RES:11 BUS;8, APARTMENTS: 6	$ 20,300,000
3. OTHER COST (ADM./COST, INFLATION)	$ 41,040,000
SUBTOTAL:A	$109,440,000
B. REIMBURSABLE UTILITIES:	
1. RAILROAD	$ 0
2. TRANSMISSION LINES-	$ 0
3. SERVICES-	$ 0
SUBTOTAL:B	$ 0
C. CONSTRUCTION:	
1. MAJOR STRUCTURES	
a. Bridges: 264,100 SF@$90/SF= $23,769,000 498,700 SF @$65/SF= $32,415,500 15,000 SF @$150/SF= $ 2,250,000 Detour bridges 48,800SF@$65/SF= $ 3,953,500	$ 61,606,500
b. Concrete barrier- 153,000 LF @$140/LF= $21,420,000 c. Retaining walls- 298,450 SF @$30/SF= $ 8,953,500	$ 30,373,500
SUBTOTAL:C-1	$ 91,980,000
2. GRADING AND DRAINAGE:	
a. EARTHWORK- Uncl. Exc. 500,000 CY @ $2.25/CY = $ 1,125,000 Borrow 900,000 CY @ $2.25/CY = $ 2,025,000	$ 3,150,000
b. DRAINAGE:	
1) Metal drain inlets 75 ea @ $960 ea = $ 72,000 4000 LF 15” Slope Drain Pipe @ $25 = $ 100,000	$ 172,000

PROJECT NUMBER: NH-73-3(242) (HOV Median Ultimate I-285 to Wade Green Rd) COUNTY: Cobb

PROJECT COST		
2) Drainage- 200 Drop inlets @ $1200 each= 5000 LF 18 " pipe @$30/LF=	$240,000 $150,000	$ 390,000
	SUBTOTAL:C-2	$ 3,712,000
3. BASE AND PAVING:		
a. AGGREGATE BASE- 280,000 TN @ $18/TN = ASPHALT PAVING: Surface- 297,500 TN. @ $67/TN = Bit. Tack Coat 124,000 gal $1/gal = Binder—122,000 TN-@$37/TN = Base— 205,000 TN @$35/TN =	$ 5,040,000 $19,932,500 $ 124,000 $ 4,514,000 $ 7,175,000	$ 36,785,500
b. CONCRETE PAVING-		$ 0
c. OTHER- Asph. Leveling 94,500 TN @$37/TN= Rumble Strip 14.53 Mi(2) @$3500/Mi = Milling Asph. Pvmt 1,642,000 SY@$3.00/SY=	$3,213,000 $ 101,710 $ 4,926,000	$ 8,240,710
	SUBTOTAL:C-3	$ 45,026,210
4. LUMP ITEMS:		
a. GRASSING- 100 Acs @ $1000/Acs		$ 100,000
b. CLEARING AND GRUBBING- 100 Acs @ $3000/Acs		$ 300,000
c. LANDSCAPING		$ 0
d. EROSION CONTROL Silt Fence Ty A 20,000LF @$1.50 = Sediment Basins 10 ea @ $9000 = 40,000 SY Erosion Mats @$1.30/SY = 15,000 SY PSRM @ $4.60 = 15,000 SY BTGF @ $2.40 = 5000 SY Conc. Ditch. Paving @$27/SY = Rip rap ditch checks 150 ea @$300 ea =	 $ 30,000 $ 90,000 $ 52,000 $ 69,000 $ 36,000 $ 135,000 $ 45,000	$ 457,000
e. TRAFFIC CONTROL I-75 14.53 Mi @ $260,000/Mi.=	 $ 3,777,800	$ 3,777,800
	SUBTOTAL:C-4	$ 4,634,800
5. MISCELLANEOUS:		

PROJECT NUMBER: NH-73-3(242) (HOV Median Ultimate I-285 to Wade Green Rd) COUNTY: Cobb

PROJECT COST		
a. LIGHTING		$
b. SIGNING – MARKING Striping 15 ea Overhead signs @ $400,000 = 15 ea Cantilever signs @ $200,000 = Misc. information signs	 $272,000 $ 6,000,000 $ 3,000,000 $145,000	$ 9,417,000
c. GUARDRAIL 15,000 LF @$11/LF = 12 ea Type 12 Anch @ $1335 ea = 12 Type 1 Anch. @ $485 ea =	 $ 165,000 $ 16,020 $ 5,820	$ 186,840
	SUBTOTAL:C-5	$ 9,603,840
6. SPECIAL FEATURES- a. Field Engineers Office Type 3 @ $60,000 = b. Sound wall (Windy Hill Rd to So. Marietta Pkwy-Lt.& Rt.) 550,400 SF @ $19/SF = c. Railroad relocation- 2000 ft.@$200/ft= d. Remove existing RR bridge- 15,000 SF@$10/SF e. Rem. Exist. Roadway bridges-157,000SF@$15/SF=	 $ 60,000 $ 10,457,600 $ 400,000 $ 150,000 $ 2,355,000	
	SUBTOTAL:C-6	$ 13,422,600

PROJECT NUMBER: NH-73-3(242) (HOV Median Ultimate I-285 to Wade Green Rd) COUNTY: Cobb

ESTIMATE SUMMARY		
A. RIGHT-OF-WAY		$109,440,000
B. REIMBURSABLE UTILITIES		$ 0
C. CONSTRUCTION		
1. MAJOR STRUCTURES	$ 91,980,000	
2. GRADING AND DRAINAGE	$ 3,712,000	
3. BASE AND PAVING	$ 45,026,210	
4. LUMP ITEMS	$ 4,634,800	
5. MISCELLANEOUS	$ 9,603,840	
6. SPECIAL FEATURES	$ 13,422,600	
SUBTOTAL CONSTRUCTION COST		$168,379,450
E. & C. (10%)		$ 16,837,945
INFLATION (5% PER YEAR for 4 YEARS)		$ 37,043,479
TOTAL CONSTRUCTION COST		**$222,260,874**
GRAND TOTAL PROJECT COST		**$331,700,874**

PRELIMINARY COST ESTIMATE

PROJECT NUMBER: NH-73-3(242) (HOV Outside Ultimate I-285 to Wade Green Rd) COUNTY: Cobb

DATE: August 8, 2002

PREPARED BY: Parsons Brinckerhoff PROJECT LENGTH: 14.53 Miles

( )PROGRAMMING PROCESS (X)CONCEPT DEVELOPMENT ( )DURING PROJECT DEV.

PROJECT COST	
A. RIGHT-OF-WAY:	
1. PROPERTY (LAND & EASEMENT) 82.6 Acres	$ 66,266,000
2. DISPLACEMENTS; RES:11 BUS;12, M.H.:0	$ 29,700,000
3. OTHER COST (ADM./COST, INFLATION)	$ 57,579,600
SUBTOTAL:A	$153,545,600
B. REIMBURSABLE UTILITIES:	
1. RAILROAD	$ 0
2. TRANSMISSION LINES-	$ 0
3. SERVICES-	$ 0
SUBTOTAL:B	$ 0
C. CONSTRUCTION:	
1. MAJOR STRUCTURES	
a. Bridges 1,442,200 SF @$65/SF= $93,743,000 277,600 SF @$90/SF= $24,984,000	$ 118,727,000
b. Concrete barrier- 153,000 LF @$140/LF= $21,420,000 c. Retaining walls- 362,200 SF @$30/SF= $10,866,000	$ 32,286,000
SUBTOTAL:C-1	$151,013,000
2. GRADING AND DRAINAGE:	
a. EARTHWORK- Uncl. Exc. 500,000 CY @ $2.25/CY = $ 1,125,000 Borrow 900,000 CY @ $2.25/CY = $ 2,025,000	$ 3,150,000
b. DRAINAGE:	
1) Metal drain inlets 75 ea @ $960 ea = $ 72,000 4000 LF 15” Slope Drain Pipe @ $25 = $ 100,000	$ 172,000

PROJECT NUMBER: NH-73-3(242) (HOV Outside Ultimate I-285 to Wade Green Rd) COUNTY: Cobb

PROJECT COST		
2) Drainage- 200 Drop inlets @ $1200 each= 5000 LF 18 » pipe @$30/LF=	$240,000 $150,000	$ 390,000
	SUBTOTAL:C-2	$ 3,712,000
3. BASE AND PAVING:		
a. AGGREGATE BASE- 280,000 TN @ $18/TN = ASPHALT PAVING: Surface- 297,500 TN. @ $67/TN = Bit. Tack Coat 124,000 gal $1/gal = Binder—122,000 TN-@$37/TN = Base— 205,000 TN @$35/TN =	$ 5,040,000 $19,932,500 $ 124,000 $ 4,514,000 $ 7,175,000	$ 36,785,500
b. CONCRETE PAVING-		$ 0
c. OTHER- Asph. Leveling 94,500 TN @$37/TN= Rumble Strip 14.53 Mi(2) @$3500/Mi = Milling Asph. Pvmt 1,642,000 SY@$3.00/SY=	$3,213,000 $ 101,710 $ 4,926,000	$ 8,240,710
	SUBTOTAL:C-3	$ 45,026,210
4. LUMP ITEMS:		
a. GRASSING- 100 Acs @ $1000/Acs		$ 100,000
b. CLEARING AND GRUBBING- 100 Acs @ $3000/Acs		$ 300,000
c. LANDSCAPING		$ 0
d. EROSION CONTROL Silt Fence Ty A 20,000LF @$1.50 = Sediment Basins 10 ea @ $9000 = 40,000 SY Erosion Mats @$1.30/SY = 15,000 SY PSRM @ $4.60 = 15,000 SY BTGF @ $2.40 = 5000 SY Conc. Ditch. Paving @$27/SY = Rip rap ditch checks 150 ea @$300 ea =	 $ 30,000 $ 90,000 $ 52,000 $ 69,000 $ 36,000 $ 135,000 $ 45,000	$ 457,000
e. TRAFFIC CONTROL I-75 14.53 Mi @ $200,000/Mi.=	 $ 2,906,000	$ 2,906,000
	SUBTOTAL:C-4	$ 3,763,000
5. MISCELLANEOUS:		

PROJECT NUMBER: NH-73-3(242) (HOV Outside Ultimate I-285 to Wade Green Rd) COUNTY: Cobb

PROJECT COST		
a. LIGHTING		$
b. SIGNING – MARKING		$ 9,417,000
Striping	$272,000	
15 ea Overhead signs @ $400,000 =	$ 6,000,000	
15 ea Cantilever signs @ $200,000 =	$ 3,000,000	
Misc. information signs	$145,000	
c. GUARDRAIL		$ 186,840
15,000 LF @$11/LF =	$ 165,000	
12 ea Type 12 Anch @ $1335 ea =	$ 16,020	
12 Type 1 Anch. @ $485 ea =	$ 5,820	
	SUBTOTAL:C-5	$ 9,603,840
6. SPECIAL FEATURES-		
a. Field Engineers Office Type 3 @ $60,000 =	$ 60,000	
b. Sound wall (Windy Hill Rd to So. Marietta Pkwy-Lt.& Rt.)		
550,400 SF @ $19/SF =	$ 10,457,600	
	SUBTOTAL:C-6	$ 10,517,600

PROJECT NUMBER: NH-73-3(242) (HOV Outside Ultimate I-285 to Wade Green Rd) COUNTY: Cobb

ESTIMATE SUMMARY		
A. RIGHT-OF-WAY		$153,545,600
B. REIMBURSABLE UTILITIES		$ 0
C. CONSTRUCTION		
1. MAJOR STRUCTURES	$151,013,000	
2. GRADING AND DRAINAGE	$ 3,712,000	
3. BASE AND PAVING	$ 45,026,210	
4. LUMP ITEMS	$ 3,763,000	
5. MISCELLANEOUS	$ 9,603,840	
6. SPECIAL FEATURES	$ 10,517,600	
SUBTOTAL CONSTRUCTION COST		$223,635,650
E. & C. (10%)		$ 22,363,565
INFLATION (5% PER YEAR for 4 YEARS)		$ 49,254,443
TOTAL CONSTRUCTION COST		**$295,253,658**
GRAND TOTAL PROJECT COST		**$448,799,258**

PRELIMINARY COST ESTIMATE

PROJECT NUMBER: NHS-000-001(919) (HOV Median Ultimate I-75/I-575 Inter. COUNTY:Cobb/Cherokee

DATE: August 8, 2002

PREPARED BY: Parsons Brinckerhoff PROJECT LENGTH: 0.72 Miles

( )PROGRAMMING PROCESS (X)CONCEPT DEVELOPMENT ( )DURING PROJECT DEV.

PROJECT COST	
A. RIGHT-OF-WAY:	
1. PROPERTY (LAND & EASEMENT) 40,000 SF (0.92 Acs) @$10/SF	$ 400,000
2. DISPLACEMENTS; RES:0 BUS;0, M.H.:0	$
3. OTHER COST (ADM./COST, INFLATION)	$ 240,000
SUBTOTAL:A	$ 640,000
B. REIMBURSABLE UTILITIES:	
1. RAILROAD	$ 0
2. TRANSMISSION LINES-	$ 0
3. SERVICES-	$ 0
SUBTOTAL:B	$ 0
C. CONSTRUCTION:	
1. MAJOR STRUCTURES	
a. Bridges 65,000 SF @$100/SF	$ 6,500,000
b. Concrete barrier- 4000 LF @$140/LF= $560,000 c. Retaining walls- 48,000 SF @ $30/SF= $1,440,000	$ 2,000,000
SUBTOTAL:C-1	$ 8,500,000
2. GRADING AND DRAINAGE:	
a. EARTHWORK- Uncl. Exc. 75,000 CY @ $2.25/CY	$ 168,750
b. DRAINAGE:	
1) Metal drain inlets 10 ea @ $960 ea = $ 9,600 500 LF 15" Slope Drain Pipe @ $25 = $ 12,500	$ 22,100
2) Drainage- 10 Drop inlets @ $1200 ea	$ 12,000

PROJECT NUMBER: NHS-000-001(919) (HOV Median Ultimate I-75/I-575 Inter. COUNTY:Cobb/Cherokee

PROJECT COST		
SUBTOTAL:C-2		$ 202,850
3. BASE AND PAVING:		
a. AGGREGATE BASE- 44,940 TN @ $18/TN = ASPHALT PAVING: Surface- 6,910 TN. @ $67/TN = Bit. Tack Coat 12,000 gal $1/gal = Binder—19,640 TN-@$37/TN = Base— 32,720 TN @$35/TN =	$ 808,920 $ 462,970 $ 12,000 $ 726,680 $ 1,145,200	$ 3,155,770
b. CONCRETE PAVING-		$ 0
c. OTHER- Asph. Leveling 1350 TN @$37/TN= Rumble Strip 0.72 Mi(4) @$3500/Mi = Milling Asph. Pvmt 23,000 SY@$3.00/SY=	$ 49,950 $ 10,080 $ 69,000	$ 129,030
SUBTOTAL:C-3		$ 3,284,800
4. LUMP ITEMS:		
a. GRASSING- 15 Acs @ $1000/Acs		$ 15,000
b. CLEARING AND GRUBBING-15 Acs @ $3000/Acs		$ 45,000
c. LANDSCAPING		$ 0
d. EROSION CONTROL Silt Fence Ty A 5,000 LF @$1.50 = Sediment Basins 2 ea @ $9000 = 5,000 SY Erosion Mats @$1.30/SY = 1,000 SY PSRM @ $4.60 = 1,000 SY BTGF @ $2.40 = 500 SY Conc. Ditch. Paving @$27/SY = Rip rap ditch checks 20 ea @$300 ea =	 $ 7,500 $ 18,000 $ 6,500 $ 4,600 $ 2,400 $ 13,500 $ 6,000	$ 58,500
e. TRAFFIC CONTROL I-75 0.72 Mi @ $260,000/Mi.		$ 187,200
SUBTOTAL:C-4		$ 325,200
5. MISCELLANEOUS:		
a. LIGHTING		$
b. SIGNING – MARKING		$ 833,000

PROJECT NUMBER: NHS-000-001(919) (HOV Median Ultimate I-75/I-575 Inter. COUNTY:Cobb/Cherokee

PROJECT COST		
Striping 2 ea Overhead signs @ $400,000 = Misc. information signs	$ 25,000 $ 800,000 $ 8,000	
c. GUARDRAIL 1,000 LF @$11/LF = 4 ea Type 12 Anch @ $1335 ea = 4 Type 1 Anch. @ $485 ea =	$ 11,000 $ 5,340 $ 1,940	$ 18,280
	SUBTOTAL:C-5	$ 851,280
6. SPECIAL FEATURES- Remove existing bridge 20,000 SF @$20/SF		
	SUBTOTAL:C-6	$ 400,000

PROJECT NUMBER: NHS-000-001(919) (HOV Median Ultimate I-75/I-575 Inter. COUNTY:Cobb/Cherokee

ESTIMATE SUMMARY		
A. RIGHT-OF-WAY		$ 640,000
B. REIMBURSABLE UTILITIES		$ 0
C. CONSTRUCTION		
1. MAJOR STRUCTURES	$ 8,500,000	
2. GRADING AND DRAINAGE	$ 202,850	
3. BASE AND PAVING	$ 3,284,800	
4. LUMP ITEMS	$ 325,700	
5. MISCELLANEOUS	$ 851,280	
6. SPECIAL FEATURES	$ 400,000	
SUBTOTAL CONSTRUCTION COST		$ 13,564,630
E. & C. (10%)		$ 1,356,463
INFLATION (5% PER YEAR for 4 YEARS)		$ 2,984,219
TOTAL CONSTRUCTION COST		**$ 17,905,312**
GRAND TOTAL PROJECT COST		**$ 18,545,312**

PRELIMINARY COST ESTIMATE

PROJECT NUMBER: NHS-000-001(919) (HOV Outside Ultimate I-75/I-575 Inter. COUNTY:Cobb/Cherokee

DATE: August 8, 2002

PREPARED BY: Parsons Brinckerhoff PROJECT LENGTH: 0.72 Miles

( )PROGRAMMING PROCESS (X)CONCEPT DEVELOPMENT ( )DURING PROJECT DEV.

PROJECT COST	
A. RIGHT-OF-WAY:	
1. PROPERTY (LAND & EASEMENT) 126,000 SF (2.89 Acs) @$10/SF	$ 1,260,000
2. DISPLACEMENTS; RES:0 BUS;0, M.H.:0	$
3. OTHER COST (ADM./COST, INFLATION)	$ 756,000
SUBTOTAL:A	$ 2,016,000
B. REIMBURSABLE UTILITIES:	
1. RAILROAD	$ 0
2. TRANSMISSION LINES-	$ 0
3. SERVICES-	$ 0
SUBTOTAL:B	$ 0
C. CONSTRUCTION:	
1. MAJOR STRUCTURES	
a. Bridges 158,150 @$100/SF	$ 15,815,000
b. Concrete barrier- 4000 LF @$140/LF= $560,000 c. Retaining walls- 36,750 SF @ $30/SF= $1,102,500	$ 1,662,500
SUBTOTAL:C-1	$ 17,477,500
2. GRADING AND DRAINAGE:	
a. EARTHWORK- Uncl. Exc. 100,00 CY @ $2.25/CY	$ 225,000
b. DRAINAGE:	
1) Metal drain inlets 10 ea @ $960 ea = $ 9,600 500 LF 15" Slope Drain Pipe @ $25 = $ 12,500	$ 22,100
2) Drainage- 10 Drop inlets @ $1200 ea	$ 12,000

PROJECT NUMBER: NHS-000-001(919) (HOV Outside Ultimate I-75/I-575 Inter. COUNTY:Cobb/Cherokee

PROJECT COST		
SUBTOTAL:C-2		$ 259,100
3. BASE AND PAVING:		
a. AGGREGATE BASE- 62,400 TN @ $18/TN = ASPHALT PAVING: Surface- 8,800 TN. @ $67/TN = Bit. Tack Coat 16,590 gal $1/gal = Binder—27,260 TN-@$37/TN = Base— 45,430 TN @$35/TN =	$ 1,123,200 $ 589,600 $ 16,590 $ 1,008,620 $ 1,590,050	$ 4,328,060
b. CONCRETE PAVING-		$ 0
c. OTHER- Asph. Leveling 1350 TN @$37/TN= Rumble Strip 0.72 Mi(4) @$3500/Mi = Milling Asph. Pvmt 23,000 SY@$3.00/SY=	$49,950 $ 10,080 $ 69,000	$ 129,030
SUBTOTAL:C-3		$ 4,457,090
4. LUMP ITEMS:		
a. GRASSING- 20 Acs @ $1000/Acs		$ 20,000
b. CLEARING AND GRUBBING- 20 Acs @ $3000/Acs		$ 60,000
c. LANDSCAPING		$ 0
d. EROSION CONTROL Silt Fence Ty A 5,000 LF @$1.50 = Sediment Basins 2 ea @ $9000 = 5,000 SY Erosion Mats @$1.30/SY = 1,000 SY PSRM @ $4.60 = 1,000 SY BTGF @ $2.40 = 500 SY Conc. Ditch. Paving @$27/SY = Rip rap ditch checks 20 ea @$300 ea =	 $ 7,500 $ 18,000 $ 6,500 $ 4,600 $ 2,400 $ 13,500 $ 6,000	$ 58,500
e. TRAFFIC CONTROL I-75 0.72 Mi @ $260,000/Mi.		$ 187,200
SUBTOTAL:C-4		$ 325,200
5. MISCELLANEOUS:		
a. LIGHTING		$
b. SIGNING – MARKING		$ 833,000

PROJECT NUMBER: NHS-000-001(919) (HOV Outside Ultimate I-75/I-575 Inter. COUNTY:Cobb/Cherokee

PROJECT COST		
Striping 2 ea Overhead signs @ $400,000 = Misc. information signs	$ 25,000 $ 800,000 $ 8,000	
c. GUARDRAIL 1,000 LF @$11/LF = 4 ea Type 12 Anch @ $1335 ea = 4 Type 1 Anch. @ $485 ea =	 $ 11,000 $ 5,340 $ 1,940	$ 18,280
	SUBTOTAL:C-5	$ 851,280
6. SPECIAL FEATURES-		
	SUBTOTAL:C-6	$ 0

PROJECT NUMBER: NHS-000-001(919) (HOV Outside Ultimate I-75/I-575 Inter. COUNTY:Cobb/Cherokee

ESTIMATE SUMMARY		
A. RIGHT-OF-WAY		$ 2,016,000
B. REIMBURSABLE UTILITIES		$ 0
C. CONSTRUCTION		
1. MAJOR STRUCTURES	$ 17,477,500	
2. GRADING AND DRAINAGE	$ 259,100	
3. BASE AND PAVING	$ 4,457,090	
4. LUMP ITEMS	$ 325,700	
5. MISCELLANEOUS	$ 851,280	
6. SPECIAL FEATURES	$ 0	
SUBTOTAL CONSTRUCTION COST		$ 23,370,670
E. & C. (10%)		$ 2,337,067
INFLATION (5% PER YEAR for 4 YEARS)		$ 5,141,547
TOTAL CONSTRUCTION COST		**$ 30,849,284**
GRAND TOTAL PROJECT COST		**$ 32,865,284**

PRELIMINARY COST ESTIMATE

PROJECT NUMBER: NH-575-1(28) (HOV Median Ultimate I-75 to Sixes Rd) COUNTY: Cobb/Cherokee

DATE: August 8, 2002

PREPARED BY: Parsons Brinckerhoff PROJECT LENGTH: 11.2 Miles

( )PROGRAMMING PROCESS (X)CONCEPT DEVELOPMENT ( )DURING PROJECT DEV.

PROJECT COST	
A. RIGHT-OF-WAY:	
1. PROPERTY (LAND & EASEMENT) 250,000 SF (5.74 Acs) @$10/SF	$ 2,500,000
2. DISPLACEMENTS; RES:0 BUS;0, M.H.:0	$
3. OTHER COST (ADM./COST, INFLATION)	$ 1,500,000
SUBTOTAL:A	$ 4,000,000
B. REIMBURSABLE UTILITIES:	
1. RAILROAD	$ 0
2. TRANSMISSION LINES-	$ 0
3. SERVICES-	$ 0
SUBTOTAL:B	$ 0
C. CONSTRUCTION:	
1. MAJOR STRUCTURES	
a. Bridges 185,000 SF @$65/SF= $12,025,000	$ 12,025,000
b. Concrete barrier- 118,000 LF @$140/LF= $16,520,000 c. Retaining walls- 147,200 SF @$30/SF= $ 4,416,000	$ 20,936,000
SUBTOTAL:C-1	$ 32,961,000
2. GRADING AND DRAINAGE:	
a. EARTHWORK- Uncl. Exc. 1,705,000 CY @ $2.25/CY = $ 3,836,250 Borrow 220,000 CY @ $2.25/CY = $ 495,000	$ 4,331,250
b. DRAINAGE:	
1) Metal drain inlets 70 ea @ $960 ea = $ 67,200 4000 LF 15" Slope Drain Pipe @ $25 = $ 100,000	$ 167,200

PROJECT NUMBER: NH-575-1(28) (HOV Median Ultimate I-75 to Sixes Rd) COUNTY: Cobb/Cherokee

PROJECT COST	
2) Drainage- 150 Drop inlets @ $1200 each= $ 180,000 4000 LF 18' pipe @$30/LF= $ 120,000	$ 300,000
SUBTOTAL:C-2	$ 4,798,450
3. BASE AND PAVING:	
a. AGGREGATE BASE- 238,700 TN @ $18/TN = $ 4,296,600 ASPHALT PAVING: Surface- 53,300 TN. @ $67/TN = $ 3,571,100 Bit. Tack Coat 74,500 gal $1/gal = $ 74,500 Binder—104,200 TN-@$37/TN = $ 3,855,400 Base— 173,500 TN @$35/TN = $ 6,072,500	$ 17,870,100
b. CONCRETE PAVING-	$ 0
c. OTHER- Asph. Leveling 18,200 TN @$37/TN= $ 673,400 Rumble Strip 11.2 Mi(2) @$3500/Mi = $ 78,400 Milling Asph. Pvmt 315,200 SY@$3.00/SY= $ 945,600	$ 1,697,400
SUBTOTAL:C-3	$ 19,567,500
4. LUMP ITEMS:	
a. GRASSING- 75 Acs @ $1000/Acs	$ 75,000
b. CLEARING AND GRUBBING- 75 Acs @ $3000/Acs	$ 225,000
c. LANDSCAPING	$ 0
d. EROSION CONTROL Silt Fence Ty A 20,000LF @$1.50 = $ 30,000 Sediment Basins 10 ea @ $9000 = $ 90,000 40,000 SY Erosion Mats @$1.30/SY = $ 52,000 15,000 SY PSRM @ $4.60 = $ 69,000 15,000 SY BTGF @ $2.40 = $ 36,000 5000 SY Conc. Ditch. Paving @$27/SY = $135,000 Rip rap ditch checks 150 ea @$300 ea = $ 45,000	$ 457,000
e. TRAFFIC CONTROL I-75 11.2 Mi @ $260,000/Mi.= $ 2,912,000	$ 2,912,000
SUBTOTAL:C-4	$ 3,669,000
5. MISCELLANEOUS:	
a. LIGHTING	$

PROJECT NUMBER: NH-575-1(28) (HOV Median Ultimate I-75 to Sixes Rd) COUNTY: Cobb/Cherokee

PROJECT COST		
b. SIGNING – MARKING		$ 5,812,000
Striping	$ 100,000	
14 ea Overhead signs @ $400,000 =	$ 5,600,000	
Misc. information signs	$ 112,000	
c. GUARDRAIL		$ 183,200
15,000 LF @$11/LF =	$ 165,000	
10 ea Type 12 Anch @ $1335 ea =	$ 13,350	
10 Type 1 Anch. @ $485 ea =	$ 4,850	
	SUBTOTAL:C-5	$ 5,995,200
6. SPECIAL FEATURES-		
Field Engineers Office Type 3 @ $60,000 =	$ 60,000	
	SUBTOTAL:C-6	$ 60,000

PROJECT NUMBER: NH-575-1(28) (HOV Median Ultimate I-75 to Sixes Rd) COUNTY: Cobb/Cherokee

ESTIMATE SUMMARY		
A. RIGHT-OF-WAY		$ 4,000,000
B. REIMBURSABLE UTILITIES		$ 0
C. CONSTRUCTION		
1. MAJOR STRUCTURES	$ 32,961,000	
2. GRADING AND DRAINAGE	$ 4,798,450	
3. BASE AND PAVING	$ 19,567,500	
4. LUMP ITEMS	$ 3,669,000	
5. MISCELLANEOUS	$ 5,995,200	
6. SPECIAL FEATURES	$ 60,000	
SUBTOTAL CONSTRUCTION COST		$ 67,051,150
E. & C. (10%)		$ 6,705,115
INFLATION (5% PER YEAR for 4 YEARS)		$ 14,751,253
TOTAL CONSTRUCTION COST		**$ 88,507,518**
GRAND TOTAL PROJECT COST		**$ 92,507,518**

<u>**PRELIMINARY COST ESTIMATE**</u>

PROJECT NUMBER: NH-575-1(28) (HOV Outside Ultimate I-75 to Sixes Rd) COUNTY: Cobb/Cherokee

DATE: August 8, 2002

PREPARED BY: Parsons Brinckerhoff PROJECT LENGTH: 11.2 Miles

( )PROGRAMMING PROCESS (X)CONCEPT DEVELOPMENT ( )DURING PROJECT DEV.

PROJECT COST	
A. RIGHT-OF-WAY:	
1. PROPERTY (LAND & EASEMENT) 250,000 SF (5.74 Acs) @$10/SF	$ 2,500,000
2. DISPLACEMENTS; RES:0 BUS;0, M.H.:0	$
3. OTHER COST (ADM./COST, INFLATION)	$ 1,500,000
SUBTOTAL:A	$ 4,000,000
B. REIMBURSABLE UTILITIES:	
1. RAILROAD	$ 0
2. TRANSMISSION LINES-	$ 0
3. SERVICES-	$ 0
SUBTOTAL:B	$ 0
C. CONSTRUCTION:	
1. MAJOR STRUCTURES	
a. Bridges 185,000 SF @$65/SF= $12,025,000	$ 12,025,000
b. Concrete barrier- 118,000 LF @$140/LF= $16,520,000 c. Retaining walls- 147,200 SF @$30/SF= $ 4,416,000	$ 20,936,000
SUBTOTAL:C-1	$ 32,961,000
2. GRADING AND DRAINAGE:	
a. EARTHWORK- Uncl. Exc. 1,705,000 CY @ $2.25/CY = $ 3,836,250 Borrow 220,000 CY @ $2.25/CY = $ 495,000	$ 4,331,250
b. DRAINAGE:	
1) Metal drain inlets 70 ea @ $960 ea = $ 67,200 4000 LF 15" Slope Drain Pipe @ $25 = $ 100,000	$ 167,200

PROJECT NUMBER: NH-575-1(28) (HOV Outside Ultimate I-75 to Sixes Rd) COUNTY: Cobb/Cherokee

PROJECT COST	
2) Drainage- 150 Drop inlets @ $1200 each= $ 180,000 4000 LF 18' pipe @$30/LF= $ 120,000	$ 300,000
SUBTOTAL:C-2	$ 4,798,450
3. BASE AND PAVING:	
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b. CONCRETE PAVING-	$ 0
c. OTHER- Asph. Leveling 18,200 TN @$37/TN= $ 673,400 Rumble Strip 11.2 Mi(2) @$3500/Mi = $ 78,400 Milling Asph. Pvmt 315,200 SY@$3.00/SY= $ 945,600	$ 1,697,400
SUBTOTAL:C-3	$ 19,567,500
4. LUMP ITEMS:	
a. GRASSING- 75 Acs @ $1000/Acs	$ 75,000
b. CLEARING AND GRUBBING- 75 Acs @ $3000/Acs	$ 225,000
c. LANDSCAPING	$ 0
d. EROSION CONTROL Silt Fence Ty A 20,000LF @$1.50 = $ 30,000 Sediment Basins 10 ea @ $9000 = $ 90,000 40,000 SY Erosion Mats @$1.30/SY = $ 52,000 15,000 SY PSRM @ $4.60 = $ 69,000 15,000 SY BTGF @ $2.40 = $ 36,000 5000 SY Conc. Ditch. Paving @$27/SY = $135,000 Rip rap ditch checks 150 ea @$300 ea = $ 45,000	$ 457,000
e. TRAFFIC CONTROL I-75 11.2 Mi @ $260,000/Mi.= $ 2,912,000	$ 2,912,000
SUBTOTAL:C-4	$ 3,669,000
5. MISCELLANEOUS:	
a. LIGHTING	$

PROJECT NUMBER: NH-575-1(28) (HOV Outside Ultimate I-75 to Sixes Rd) COUNTY: Cobb/Cherokee

PROJECT COST		
b. SIGNING – MARKING		$ 5,812,000
Striping	$ 100,000	
14 ea Overhead signs @ $400,000 =	$ 5,600,000	
Misc. information signs	$ 112,000	
c. GUARDRAIL		$ 183,200
15,000 LF @$11/LF =	$ 165,000	
10 ea Type 12 Anch @ $1335 ea =	$ 13,350	
10 Type 1 Anch. @ $485 ea =	$ 4,850	
	SUBTOTAL:C-5	$ 5,995,200
6. SPECIAL FEATURES-		
Field Engineers Office Type 3 @ $60,000 =	$ 60,000	
	SUBTOTAL:C-6	$ 60,000

PROJECT NUMBER: NH-575-1(28) (HOV Outside Ultimate I-75 to Sixes Rd) COUNTY: Cobb/Cherokee

ESTIMATE SUMMARY		
A. RIGHT-OF-WAY		$ 4,000,000
B. REIMBURSABLE UTILITIES		$ 0
C. CONSTRUCTION		
1. MAJOR STRUCTURES	$ 32,961,000	
2. GRADING AND DRAINAGE	$ 4,798,450	
3. BASE AND PAVING	$ 19,567,500	
4. LUMP ITEMS	$ 3,669,000	
5. MISCELLANEOUS	$ 5,995,200	
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TOTAL CONSTRUCTION COST		**$ 88,507,518**
GRAND TOTAL PROJECT COST		**$ 92,507,518**

Appendix D

Benefit/Cost Analysis

Appendix D.1

Assumptions for the Benefit/Cost Analysis

Assumptions for the Benefit/Cost Analysis

To establish the parameters associated with the benefit/cost analysis, the following schedule items were assumed:

Interim Project		Ultimate Project	
Activity	**Fiscal Year**	**Activity**	**Fiscal Year**
Start Design	2003	Start Design	2003
Start Construction	2005	Start Construction	2007
Facility in Operation	2007	Facility in Operation	2010

There is difference of opinion at the Office of Environment/Location that the environmental documentation for the Interim and Ultimate Projects can be prepared in the time frame these schedules indicate. Their opinion is that both documents will be Environmental Assessments while the original assumption was that the Interim Project would be a Categorical Exclusion while the Ultimate would be an EA.

Phasing of the construction of the Ultimate Project is assumed to be similar to the following:

Phase	Description
1	The I-285/I-75 Interchange through Windy Hill Road
2	Windy Hill Road through the SR 5 Connector Interchange
3	SR 5 Connector to Wade Green Road
4	I-575 from the I-75/I-575 Interchange to Sixes Road

It was assumed that the construction of the Ultimate Project would require that Phases 1 through 3 be let to construction simultaneously since neither section could stand alone without additional temporary construction to tie the HOV system to the Interim facility in the median. Simultaneous construction also provides the shortest time to operation on the I-75 corridor which is beneficial when considering the cost associated with reduced capacity during construction. The Team believes that the time to construct the Ultimate Project should possibly be longer but to meet the ARC Model the operation year was retained at 2010.

After the Ultimate HOV Project is placed into operation, the Interim HOV lanes in the median will be restriped to exclude their use as general purpose lanes.

Interest Rate
The interest rate for establishing the present worth of the various benefit cost streams as discussed in the benefit cost analysis was estimated at 7% based on typical FHWA requirements.

Appendix D.2

Analytical Techniques used to Quantify Performance Measures

Analytical Techniques used to Quantify Freeway Performance Measures for an Annualized Assessment of User Benefits

The analytical models used to estimate performance measures for the study are classified as macroscopic traffic operations models. Several specific traffic operations models were assembled into a modeling framework. This framework is significantly different from other traffic operations models such as CORSIM or TRANSYT-7F in that it can directly produce annualized estimates of the primary and secondary performance measures based on macroscopic algorithms with only minimal data requirements and processing time. The analytical elements of the model were developed using Monte-Carlo simulation techniques, which account for variability in traffic flow patterns due to seasonal, day of week and peak spreading effects. The benefit of using these procedures is that they estimate operational impacts for a 24 hour day, not just a peak hour. Therefore, operational benefits can be assessed and extrapolated to represent an annual condition for purposes of developing benefit cost ratios.

For purposes of estimating annualized user costs for operating a freeway corridor, the traffic analytical framework estimates costs based on the following factors.

- Person Delay Costs (based on both recurring congestion and incident-related congestion)
- Societal Cost of Traffic Accidents
- Fuel Consumption
- Impact Cost of Pollutant Emissions
- Vehicle Operating Costs (other than fuel)

The individual models in the framework operate at the roadway link level. Therefore, the effects of "nodal" operational problem occurring at intersections, ramp junctions and weaving sections are not directly modeled. This simplification is appropriate for this level of analysis because major investment studies are intended to assess the need for expensive corridor-level improvements (hence the term "major investment"), as opposed to localized, less-expensive spot improvements. The following sections describe the sources for individual models used to estimate primary performance measures in the framework.

<u>Average Weekday Traffic Volume Forecasts</u>
Forecast of average weekday freeway mainline volumes between intersections were based on results of the Atlanta Regional Commission travel demand forecasting model. ARC provides forecasts in five year increments between 1995 (for validation) and 2025. Forecasts for the years 2005, 2010 and 2025 were used to conduct the benefits analysis for these specific years. Interpolation or extrapolation were used to determine benefits for each other year between 2003 and 2030.

<u>Freeway Section Capacity</u>
The hourly capacity of each segment of I-75 between interchanges is a key element of the modeling framework. Section capacities are determined using Highway Capacity

Manual procedures that include the impact of terrain, lane width, lateral clearance and the percentage of trucks. Initial lane capacities were based on a free flow speed of 70 miles per hour. Ideal lane width and lateral clearance were used (12 feet each). However, lateral clearances were reduced to zero for construction scenarios. To be conservative, level terrain was used, even though sections of I-75 quality for rolling terrain characteristics. A daily truck percentage of 8 percent was used.

The determination of freeway mainline section capacity incorporated conservative assumptions regarding the capacity benefits of concurrent flow HOV lanes and auxiliary lanes. Both are assumed to increase the section capacity by 10 percent per lane (which is significantly less than the full capacity of a lane). Where barrier separated HOV lanes are included in an alternative, the HOV traffic is assigned to a separate freeway facility with either two or four lanes in each direction. Full shoulders are assumed for barrier separated HOV lanes. SOV lanes are analyzed separately, except that HOV traffic is removed from these lanes. Therefore, a net reduction in SOV lane congestion is also accounted for in the analysis results.

Estimation of 24-hour Weekday Level of Service Profiles

Estimates of 24-hour level of service profiles were based on equations that estimate the portion of daily traffic using a roadway while the volume to capacity ratio is less than a particular level. These equations were obtained from the study "Roadway Usage Patterns: Urban Case Studies" prepared for FHWA et.al. in June, 1994. The equations were evaluated for each v/c ratio separating different levels of service based on v/c break-points reported in the Highway Capacity Manual. The equations are a function of the daily traffic volume, the hourly section capacity, and the v/c ratio of interest.

The equations estimate the portion of daily traffic using the roadway while the volume to capacity ratio is below a user-defined level. By setting the volume to capacity ratios to the maximum allowable value for each level of service, the equations estimate the percentage of traffic using the facility while the level of service is better than or equal to the desired level. The difference between the percentages for each level of service is the percentage of traffic using the facility while it operates at each level of service. The ranges used are summarized in the table on the following page.

The equations are based on an index ratio X that is defined as:

$$X = v/c_{(LOS\ N)} / (AADT/C)$$

Where $v/c_{(LOS\ N)}$ is the maximum v/c ratio for a given level of service (N)
AADT is the annual average daily traffic volume
C is the hourly capacity of the roadway.

Ranges of Volume to Capacity Ratios for Each Level of Service

Level of Service	Range of Volume to Capacity Ratios
A	0.00 - 0.25
B	0.26 - 0.40
C	0.41 - 0.60
D	0.61 - 0.80
E	0.81 - 1.00
F	> 1.00

If X is less than 0.117, then the portion of daily traffic using the facility while the v/c ratio is equal to or better than "N" is:

$$P(N) = 225.8 * X^2 - 1259 * X^3 - 2809 * X^4 + 20610 * X^5$$

Otherwise:

$$P(N) = 1.00$$

By multiplying the portion of traffic at each level of service times the AADT and the length of the roadway segment, a 24-hour distribution of traffic at each level of service (as opposed to only a a peak hour assessment) is produced. This distribution accounts for the impacts of peak spreading resulting from congestion during peak periods.

<u>Recurring Congestion</u>
Recurring delay is the normal day-to-day delays associated with traffic congestion resulting from roadway operational problems and capacity-constrained bottlenecks. These bottlenecks generate queues of traffic that effectively reduce the section capacity of upstream segments of roadway, thus propagating the congestion impacts of the bottleneck.

Estimates of 24-hour, peak period and peak hour recurring delay were based on equations developed for the HPMS modeling process from the study "Speed Determination Models for the Highway Performance Monitoring System" prepared for FHWA in October, 1993, and the subsequent study "Development of Diurnal Traffic Distribution and Daily, Peak and Off-Peak Vehicle Speed Estimation Procedures for Air Quality Planning" prepared for FHWA in April, 1996. These models predict daily, peak period and peak hour recurring delay for typical weekend and weekday traffic patterns as a function of daily traffic volume, hourly section capacity and effective traffic signal spacing. The results from these delay models can also be used to estimate average travel speeds for daily, peak period and peak hour conditions.

The equations used to estimate recurring delay estimate the rate of delay in vehicle hours per 1,000 vehicle miles of travel. The equations are a function of the AADT/C ratio (X).

For AADT/C <= 8.00 $D = 0.0797 * X + 0.00385 * X^2$
For 8.00 < AADT/C <= 12.0 $D = 12.1 - 2.95 * X + 0.193 * X^2$
For AADT/C > 12.0 $D = 19.6 - 5.36 * X + 0.342 * X^2$

Total delay for a weekday is estimated by multiplying the delay rate from the equations by the vehicle miles of weekday travel on the subject freeway segment. Annual delays account for weekday traffic delays only assuming 250 days per year of "normal weekday traffic". Weekend recurring delays are excluded to be conservative.

Accidents and Accident Rates

Accident rates for the study were based on a non-linear regression equation that is sensitive to the traffic loading level on each roadway link. Since the assessment of project benefits is dependent on the change in accident behavior, rather than the absolute number of accidents for a given alternative, it was important to make use of an accident estimation process sensitive to the effect of congestion, rather than be concerned over matching existing accident rates. Accidents are estimated using an equation as a function of the annual average daily traffic to peak hour section capacity (AADT/C) ratio based freeway accident data. The equations used were developed based on research conducted on 75 miles of Interstate Highway at different congestion levels. The relationship below predicts the annual accident rate as a function of the AADT/C ratio (X). Higher levels of congestion were found to increase accident rates, and the equation accounts for this behavior.

Annual Accidents per Hundred Million Vehicle Miles =
135.1192 - (1.05566 * X) + (0.22641 * X2) - 0.00000046 * X5

The absolute number of accidents for one alternative is obtained by multiplying the above rate by the vehicle miles of travel in units of 100 million miles. The number of incidents is dependent on vehicle miles of travel. The average rate for all incidents is 9.336 incidents per million vehicle miles of travel. However, 10 percent of these incidents are typically accidents, which are already accounted for. Disablement incidents are 80 percent of the predicted incidents, and other incidents (such as debris spills and roadway failures) are 10 percent of incidents. Both accidents and other incidents are distributed by level of severity based on their impact on traffic capacity based on the distributions in the table below.

Distribution of Incident Severity by Incident Type

Incident Type	Multilane Blocking	Single Lane Blocking	Shoulder Only
Accident	8%	32%	60%
Disablement	0.5%	19.5%	80.0%
Other	2%	28%	70%

Once the incidents are distributed by severity, a screening analysis is conducted to determine what portion of daily incidents will actually cause a reduction in roadway capacity that will produce non-recurring delays. The severity of non-recurring delay is highly dependent on the level of congestion throughout the day. A heavily-traveled roadway could be vulnerable to a large portion of relatively minor incidents throughout the day, while a lightly-traveled roadway is only affected by the most serious incidents. The distribution of vehicle miles of travel by v/c ratio is used to screen out a portion of each type and severity of incident. These screened incidents are not assumed to produce measurable delays. For shoulder incidents, only traffic operating at LOS E is vulnerable to delays. For single lane blocking incidents, traffic operating at an LOS worse than C is vulnerable. For multilane incidents, traffic operating at an LOS worse than B is vulnerable.

<u>Incidents and Non Recurring Congestion</u>
Non recurring congestion was estimated based on a one-year period worth of accidents and incidents (note that accidents are one type of incident). Incident activity was estimated corridor-wide as a function of total corridor accidents using incident-accident relationships from the "Incident Management Study" prepared for the Trucking Research Institute and the ATA Foundation, Inc. in June, 1990. Incidents were classified as *accidents*, *disablements* or *other*. The resulting distribution of accidents and other incidents were then segregated into different levels of severity including on-shoulder, single lane blocking and multi lane blocking.

As previously mentioned, these incidents were then screened to eliminate those that would not produce non recurring delays. This screening process produced a final group of incidents, stratified by type and severity that would produce non recurring delay. The delay per incident was then estimated based on ranges reported in the "Incident Management Study". The delay per incident was a function of the type of incident, the severity, and the degree of loading on each roadway segment modeled. The index used to determine the vehicle hours of delay per incident is the AADT/C ratio divided by a maximum practical value of 16. Therefore, $X = (AADT/C) / 16$. The equations used to predict average vehicle hours of delay per incident are listed below.

Multilane Blocking Accidents

$X < 0.5$	$D = 4800 * X$
$X >= 0.5$	$D = 15200 * X - 5200$

Single Lane Blocking Accidents

$X < 0.5$	$D = 2400 * X$
$X >= 0.5$	$D = 7600 * X - 2600$

Shoulder Accident

All X	$D = 1000 * X$

Multilane Blocking Disablement Incident

$X < 0.5$ $\quad D = 2000 * X$
$X \geq 0.5$ $\quad D = 6000 * X - 2000$

Single Lane Blocking Disablement Incidents

$X < 0.5$ $\quad D = 1000 * X$
$X \geq 0.5$ $\quad D = 3000 * X - 1000$

Shoulder Disablement Incidents

All X $\quad D = 200 * X$

Multilane Blocking Other Incidents

$X < 0.5$ $\quad D = 4000 * X$
$X \geq 0.5$ $\quad D = 2000 * X + 1000$

Single Lane Blocking Other Incidents

$X < 0.5$ $\quad D = 2000 * X$
$X \leq 0.5$ $\quad D = 1000 * X + 500$

Shoulder Other Incidents

All X $\quad D = 200 * X$

The total non-recurring delay produced by all incidents is obtained by multiplying the delay per incident by the annual number of weekday incidents for each of the nine incident type and severity categories, and adding together the resulting delays.

Segregation of Vehicle Miles Traveled by Speed

Accurate emissions and fuel consumption analysis requires that the vehicle miles of travel on each roadway segment be segregated by the speed encountered by the traffic during the time that it used the facility. This means that the speed of traffic for each level of service, and the speed of traffic under incident congestion must be estimated. For recurring congestion delays, freeway speed flow curves are used to segregate uncongested travel delays from congested travel delays. Congested travel delays apply to that portion of traffic operating at level of service F, and the average travel speed of this traffic is the vehicle miles of travel divided by the vehicle hours of travel and delay. Non-recurring travel speeds are dependent on the portion of lane capacity blocked. This required an assessment of the typical operating speed of a queue under congestion induced by partial blockage of the freeway lanes. These speeds range from 4 to 42 miles per hour, depending on the normal number of freeway lanes and the number blocked.

Impact of ITS User Services

The I-75 corridor currently benefits from an incident management program supported by a surveillance and detection system to assist in verifying incidents and calling appropriate response vehicles for incidents requiring special treatment. Though the analytical framework is capable of accounting for accident and delay reduction benefits of ITS user services, these were excluded from consideration since the results would be systematic to both alternatives (that is, similar benefits would apply with and without the HOV facilities).

Secondary Performance Measures

Secondary performance measures included excess fuel consumption, emissions and vehicle operating costs due to freeway congestion, and accident and person delay impacts. These measures were considered secondary because they are all a function of the primary measures.

Fuel consumption rates are based on the rates used in FHWA's TRANSYT-7F traffic simulation model. The relationship between freeway speeds and fuel consumption rates was derived based on a parametric analysis of traffic flow profiles at different speeds. These profiles consist of patterns of stopped delay, speed change cycles and maximum speeds that result in composite fuel consumption rates that mimick freeway travel behavior at different speeds.

Emissions rates are based on a modified version of the MOBILE 5b model used by the Atlanta Regional Commission to develop emissions rates for air quality conformity analysis. The speed correction factors are modified to represent freeway travel conditions for purposes of assessing emissions. The process for developing speed correction factors was similar to that used to develop fuel consumption rates.

Excess vehicle operating costs were based on the 1992 FTA publication "Characteristics of Urban Transportation Systems". Accident costs were stratified by severity. Accident costs by severity type were based on an October, 1991 FHWA study entitled "The Cost of Highway Crashes". Person delays were estimated by multiplying vehicle hours of delay by an average corridor vehicle occupancy based on the ARC Region. The delay unit costs were obtained from the 1992 FTA publication "Characteristics of Urban Transportation Systems".

The table below summarizes the cost components and unit costs used to develop differential monetary benefits to roadway users between alternative roadway network scenarios. By comparing analysis results between a build scenario and the no build scenario, the differential benefits of each project are determined.

Cost Components and Unit Costs

Cost Component	Unit Cost
Cost per Passenger Hour Traveled	$13.85
Average Daily Vehicle Occupancy	1.20
Cost per Gallon of Fuel	$1.25
Excess Vehicle Operating Cost per Mile	$0.027
Impact Cost per Ton of CO Emissions	$31.81
Impact Cost per Ton of HC Emissions	$359.09
Impact Cost per Ton of NOX Emissions	$1187.27
Average Accident Impact Cost (per event)	$87,900

Present Value of Benefits

The analytical framework was used to assess a variety of improvement scenarios for I-75. The assessment was performed for the years 2005, 2010 and 2025. The annual benefits (or burdens) were interpolated or extrapolated to represent all years between 2003 and 2030. The net present value of benefits was computed by amortizing the benefits (or burdens) of each year to the present day using a discount rate of 7 percent.

Computational Steps in the Traffic Operations Modeling Framework

The following list identifies the computational steps used to estimate performance measures for the study:

1. Apply a percentage reduction in average daily travel demand due to ITS demand reduction strategies to forecast traffic volumes to produce post-ITS daily demand forecasts. (examples include measures that improve effectiveness of TDM (travel demand management) or transit ridership) (Note, the ARC travel demand model accounts for transit and carpool strategies internally when developing traffic forecasts)
2. Given freeway lane configurations, lane widths, lateral clearance, percentage of trucks, type of terrain and number of lanes in each direction; estimate freeway mainline free flow speed based on HCM methods.
3. Estimate vehicle hours of normal travel time as vehicle miles of travel divided by free flow speed. Compute total vehicle hours normal travel time for full corridor. Annualize normal travel time assuming 250 weekdays and 115 holiday-weekend days per year.
4. Estimate initial average lane capacity from adjusted free flow speed based on HCM speed-capacity relationships. Compute total section capacity of general use lanes. Add HOV lane demand levels to section capacities to account for HOV lane capacity benefits.
5. Increase section capacities due to impact of ITS strategies, or operational improvements such as auxiliary lanes or collector-distributor roads. (ITS strategies to increase freeway capacity are not in use on I-75)
6. Use hourly volume to capacity ratio stratification model to estimate percent of volume below v/c ratio cut-off of each level of service based on LOS cut-offs tabulated in the HCM. Subtract cumulative percentages to obtain volume of traffic at each level of service.
7. Multiply percentage of traffic at each level of service by freeway section volume and length to obtain VMT at each level of service. Compute VMT-weighted average level of service distribution for full corridor.
8. Use post-ITS daily demand forecast and post-ITS freeway section capacity to estimate vehicle hours of weekday and weekend recurring delay using HPMS equations.
9. Apply recurring delay reduction percentages due to ITS strategies to reduce total daily recurring delay. (these reductions are not used for the I-75 assessment since there are no recurring congestion control strategies in use in the corridor)
10. Compute total vehicle hours recurring delay for full corridor. Annualize total recurring delay assuming 250 weekdays and 115 holiday-weekend days per year.

11. Use post-ITS daily demand forecast and post-ITS freeway section capacity to estimate average weekday recurring delay during peak period and peak hour using HPMS equations.
12. Apply recurring delay reduction percentages due to ITS strategies to reduce peak period and peak hour recurring delay. (these reductions are not used for the I-75 assessment since there are no recurring congestion control strategies in use in the corridor)
13. Combine normal travel time and delay to estimate travel time per trip for peak period and peak hour, converted to minutes per trip.
14. Separately sum peak period and peak hour travel times for full corridor. Divide corridor length by travel time to estimate peak period and peak hour average travel speed.
15. Estimate number of accidents using average daily traffic to peak hour capacity ratio using equation developed for I-64 (or optionally, the HPMS models) to predict accident rates.
16. Multiply accident rates by vehicle miles traveled, and add together accidents on all segments.
17. Estimate annual corridor-wide non-accident incidents. Disablement incidents are approximately 8 times the number of accidents. Other incidents are approximately equal to the number of accidents.
18. Apply ITS accident reduction strategies to reduce the quantity of accidents expected to occur (these reductions were not used for the I-75 assessment).
19. Assign disablement and other incidents to individual freeway sections in proportion to the VMT carried.
20. Segregate accidents and incidents according to severity: shoulder-blocking, single-lane-blocking, or multi-lane blocking, using severity probability trees.
21. Use daily level of service stratification to determine what portion of incidents will occur when demand levels are high enough to produce non recurring congestion delays. Eliminate incidents that do not produce delay.
22. Estimate average non-recurring delay per incident based on freeway section loading level, incident type and severity using delay ranges from “Incident Management Study”.
23. Multiply number of incidents of each type and severity by the estimated non-recurring delay per incident.
24. Apply non recurring delay reduction percentages due to ITS strategies to reduce non recurring delay. (these corrections are not used for the I-75 assessment)
25. Add non recurring delays from each incident type and severity class to obtain total annual non recurring delay. Total annual non recurring delay for full corridor.
26. Apply rates and equations to predict secondary performance measures based on the sum of annual recurring and non recurring delay. These include excess fuel consumption; excess emissions of CO, HC and NOx; excess vehicle operating costs; annual costs due to accidents, excess fuel and emissions; and person delay costs.

Appendix D.3

Tables and Graphs of Annual Weekday Costs

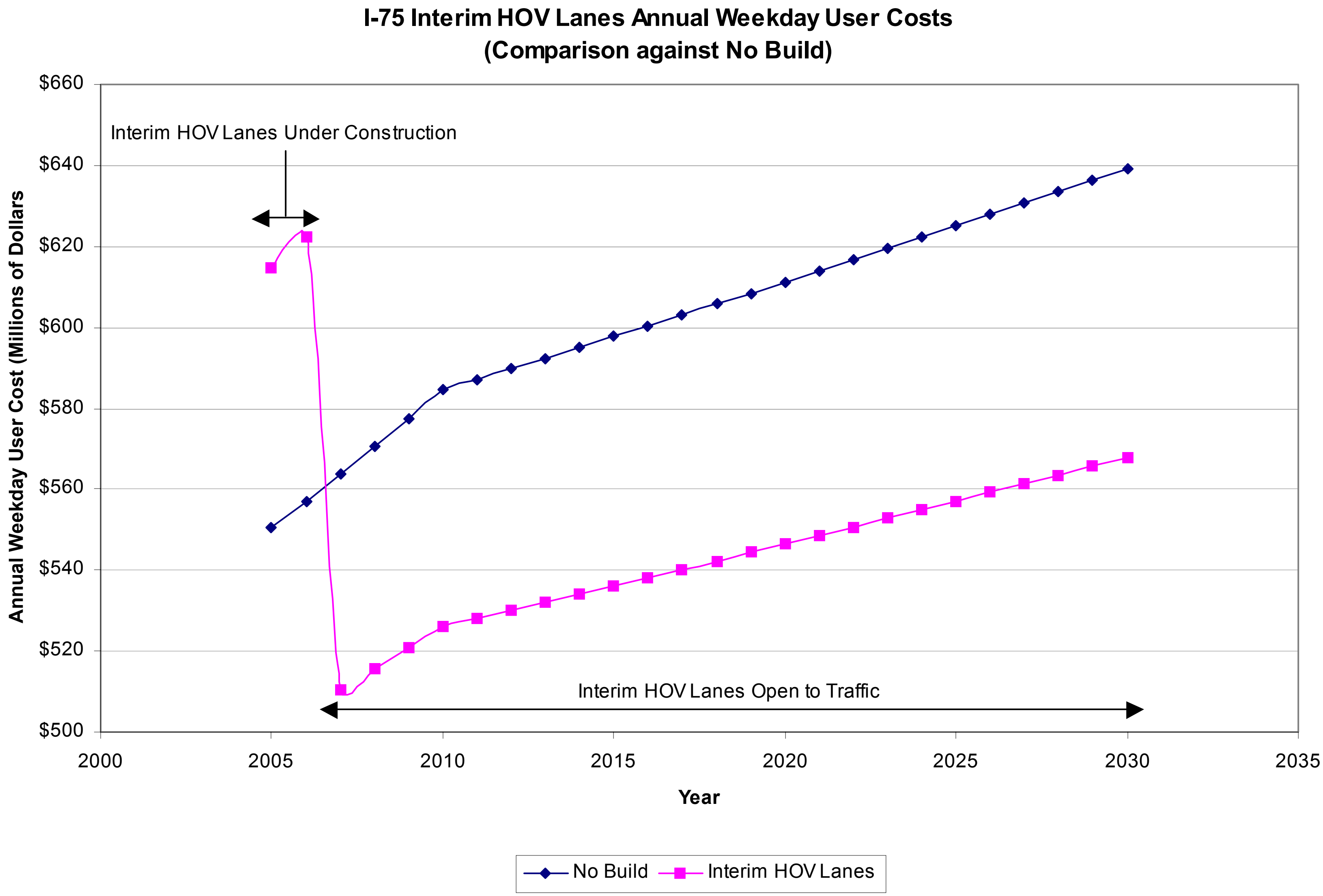
Annual Weekday User Costs
(Millions of Dollars)
I-75 North HOV Lanes - Cumberland Blvd to Wade Green Rd
Interim Facility Only
Interim Facility Construction in 2005-2006

Annual Discount Rate = 7%

Year	No Build	Interim HOV Facility Only
2005	$551	$615
2006	$557	$622
2007	$564	$511
2008	$571	$516
2009	$578	$521
2010	$584	$526
2011	$587	$528
2012	$590	$530
2013	$592	$532
2014	$595	$534
2015	$598	$536
2016	$600	$538
2017	$603	$540
2018	$606	$542
2019	$608	$544
2020	$611	$546
2021	$614	$549
2022	$617	$551
2023	$619	$553
2024	$622	$555
2025	$625	$557
2026	$628	$559
2027	$631	$561
2028	$633	$563
2029	$636	$566
2030	$639	$568

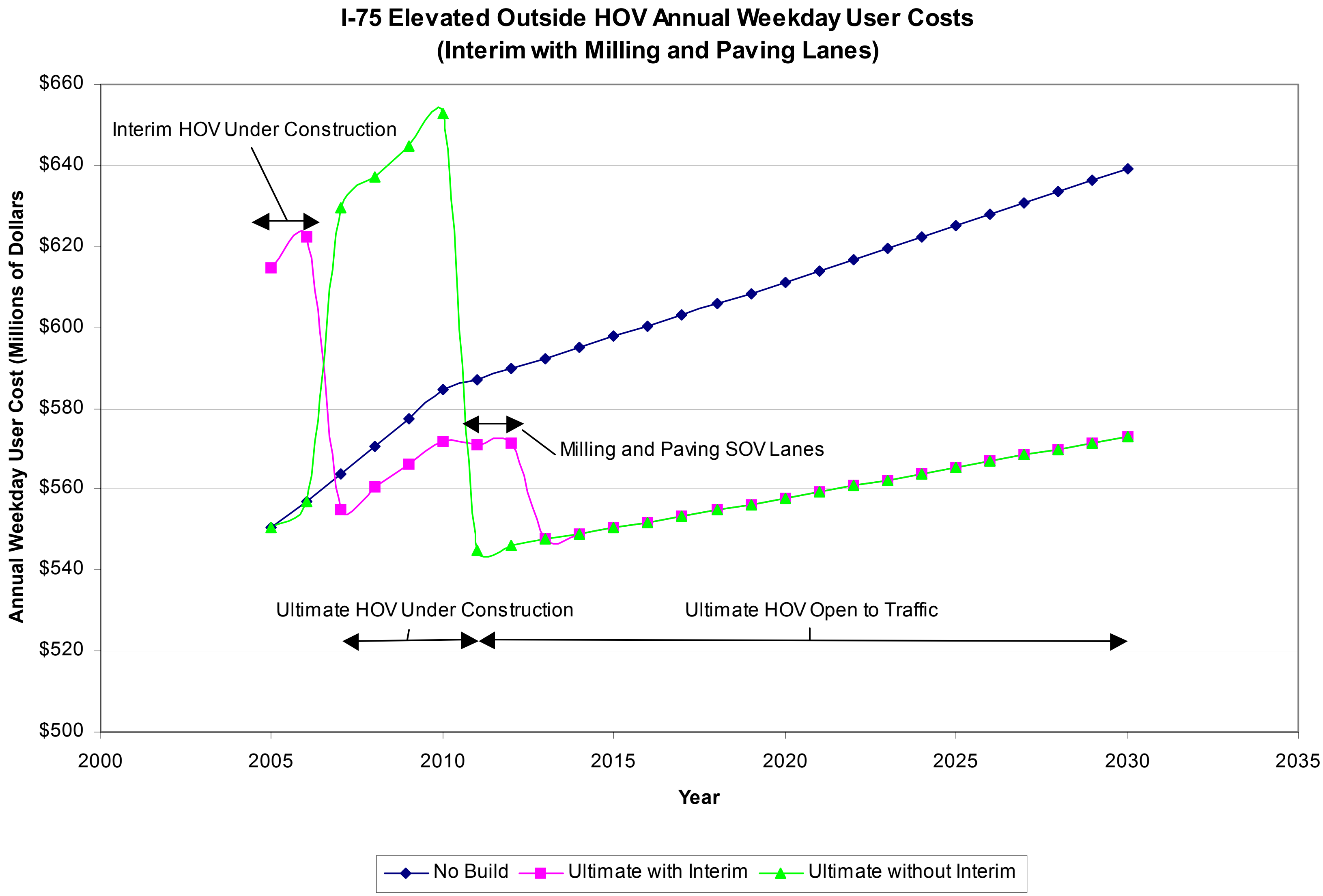
Net Present Value of Annual Weekday User Costs

	No Build	Interim HOV Facility Only
	$6,981	**$6,483**
Design Life Benefits >		**$498**


I-75 Interim HOV Lanes Annual Weekday User Costs
(Comparison against No Build)
$660
$640
$620
$600
$580
$560
$540
$520
$500
Annual Weekday User Cost (Millions of Dollars
Interim HOV Lanes Under Construction
Interim HOV Lanes Open to Traffic
2000
2005
2010
2015
2020
2025
2030
2035
Year
No Build
Interim HOV Lanes

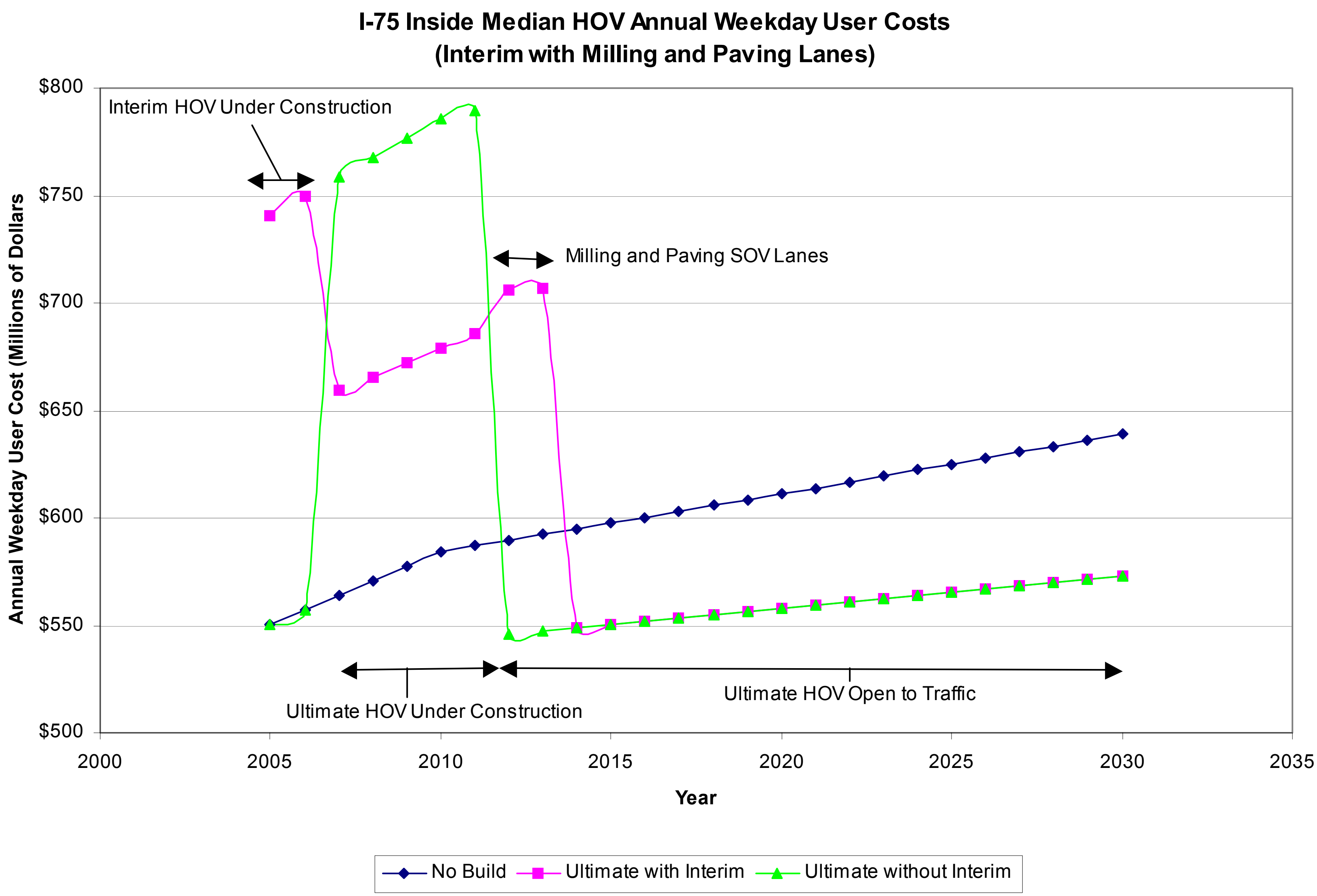
Annual Weekday User Costs
(Millions of Dollars)
I-75 North HOV Lanes - Cumberland Blvd to Wade Green Rd
Inside Median Alternative
Interim Facility with Milling and Paving in 2012-2013
Annual Discount Rate = 7%

Year	No Build	Ultimate HOV with Interim	Ultimate HOV without Interim
2005	$551	$740	$551
2006	$557	$749	$557
2007	$564	$659	$758
2008	$571	$666	$767
2009	$578	$672	$777
2010	$584	$679	$786
2011	$587	$686	$790
2012	$590	$706	$546
2013	$592	$707	$548
2014	$595	$549	$549
2015	$598	$550	$550
2016	$600	$552	$552
2017	$603	$553	$553
2018	$606	$555	$555
2019	$608	$556	$556
2020	$611	$558	$558
2021	$614	$559	$559
2022	$617	$561	$561
2023	$619	$562	$562
2024	$622	$564	$564
2025	$625	$565	$565
2026	$628	$567	$567
2027	$631	$568	$568
2028	$633	$570	$570
2029	$636	$571	$571
2030	$639	$573	$573
Net Present Value of Annual Weekday User Costs			
	$6,981	**$7,512**	**$7,356**
Design Life Benefits >		**-$531**	**-$375**


I-75 Elevated Outside HOV Annual Weekday User Costs
(Interim with Milling and Paving Lanes)
$660
$640
$620
$600
$580
$560
$540
$520
$500
Annual Weekday User Cost (Millions of Dollars
Interim HOV Under Construction
Milling and Paving SOV Lanes
Ultimate HOV Under Construction
Ultimate HOV Open to Traffic
2000
2005
2010
2015
2020
2025
2030
2035
Year
No Build
Ultimate with Interim
Ultimate without Interim

Annual Weekday User Costs
(Millions of Dollars)
I-75 North HOV Lanes - Cumberland Blvd to Wade Green Rd
Elevated Outside Alternative
Interim Facility with Milling and Paving in 2011-2012
Annual Discount Rate = 7%

Year	No Build	Ultimate HOV with Interim	Ultimate HOV without Interim
2005	$551	$615	$551
2006	$557	$622	$557
2007	$564	$555	$630
2008	$571	$561	$637
2009	$578	$566	$645
2010	$584	$572	$653
2011	$587	$571	$545
2012	$590	$571	$546
2013	$592	$548	$548
2014	$595	$549	$549
2015	$598	$550	$550
2016	$600	$552	$552
2017	$603	$553	$553
2018	$606	$555	$555
2019	$608	$556	$556
2020	$611	$558	$558
2021	$614	$559	$559
2022	$617	$561	$561
2023	$619	$562	$562
2024	$622	$564	$564
2025	$625	$565	$565
2026	$628	$567	$567
2027	$631	$568	$568
2028	$633	$570	$570
2029	$636	$571	$571
2030	$639	$573	$573
Net Present Value of Annual Weekday User Costs			
	$6,981	**$6,735**	**$6,817**
Design Life Benefits >		**$246**	**$164**


I-75 Inside Median HOV Annual Weekday User Costs
(Interim with Milling and Paving Lanes)
Annual Weekday User Cost (Millions of Dollars
$800
$750
$700
$650
$600
$550
$500
Interim HOV Under Construction
Milling and Paving SOV Lanes
Ultimate HOV Under Construction
Ultimate HOV Open to Traffic
2000
2005
2010
2015
2020
2025
2030
2035
Year
No Build
Ultimate with Interim
Ultimate without Interim