APPENDIX E

Transportation Analysis Methodologies

This section summarizes the methodologies used to determine recommended ultimate build out roadway and intersection improvements and a schedule of when those improvements will be needed. Additional methodologies are presented that used the build out improvements to estimate planning level right-of-way and construction costs in current (2008) dollars. Finally, a benefit/cost analysis methodology is described as it pertains to the South Meridian Transportation Study.

Build Out Capacity Analysis Methodology

The build out capacity analysis methodology was used with 2030 forecast peak hour traffic volumes on the arterial roadways and intersections in the South Meridian Area. ACHD's *Intersection Planning Level Standards* and the planning level roundabout intersections and typical roadway sections presented in the report were used in the capacity analysis to determine the required roadway and intersection improvements.

Roadway Capacity

The roadway sections used for the build out capacity analysis for the South Meridian Transportation Plan were based on planning level roadways identified in the report. With some exceptions, the roadway functional classifications are based on the COMPASS 2030 Planning Functional Classification Map.

These typical roadways were evaluated using the forecasted South Meridian Area traffic volumes and the arterial street capacity thresholds developed for ACHD's arterial roadways to determine future capacity needs in the CIP. These thresholds are based on the Florida Department of Transportation (FDOT) multi-modal policy and application tools for arterial street planning (ARTPLAN). They are consistent with the Federal Highway Administration's (FHWA's) *Highway Capacity Manual*. These thresholds are based on the peak hour traffic volume in the peak direction on the arterial. **Figure E-1**, reproduced from Table C-4 in the CIP Overview dated July 26, 2006, displays these thresholds. LOS E was used as the threshold for median controlled principal arterials for needed improvements along principal arterial roadways. LOS D was used as the threshold for minor arterials for needed improvements along minor arterial roadways.

Figure E-1. Ada County Street Capacity Guidelines

Arterial Class	Lanes	Hourly Volume-Peak Level of Service C	D	E
ACHD Principal Arterials				
No Left-Turn lane	1	***	550	690
Continuous Center Left-Turn Lane				
	1	270	750	880
	2	590	1,600	1,770
	3	890	2,440	2,660
Median Control, Channelized Left-Turn Lanes @ Major Intersections				
	1	280	790	920
	2	620	1,680	1,860
	3	930	2,560	2,790
ACHD Minor Arterials				
No Left-Turn lane	1	***	550	690
Continuous Center Left-Turn Lane				
	1	270	750	880
	2	590	1,540	1,770
	3	890	2,370	2,660
Median Control, Channelized Left-Turn Lanes @ Major Intersections				
	1	280	760	920
	2	620	1,620	1,860
	3	930	2,490	2,790

Intersection Capacity

Arterial road intersections in the South Meridian Area were analyzed for needed improvements. COMPASS' peak hour model traffic volume forecasts were used to estimate turning movements at each intersection in the South Meridian Area. The Highway Capacity Software Plus was used to analyze signalized intersections, while the FHWA's capacity method in *Roundabouts: An Informational Guide* was used to analyze roundabouts. A spreadsheet was developed for input of forecasted traffic volumes and output of roundabout capacity to provide information in a manner similar to the HCS output for signalized intersections. LOS E was used as the threshold for needed improvements for principal arterial intersections to be consistent with the principal arterial roadway LOS threshold. LOS D was used as the threshold for needed improvements for all other intersections in the analysis.

Peak Hour Turning Movements

The PM peak hour turning movements were estimated for each intersection based on the peak hour link volumes entering and exiting the intersection. Each growth scenario was modeled separately and turning movements were estimated for each. The entering volumes were distributed to left-turning, through, and right-turning movements using the WinTurns software. This program computed forecast turning volumes using the techniques described in Chapter 8 of the *Highway Traffic Data for Urbanized Area Project Planning and Design* (NCHRP 255). It derives forecast turning movements using an iterative approach which alternately balances the inflows and outflows until the results converge. Observed turning movement volumes were entered into the program based on the existing traffic counts. Some adjustment were made to accommodate future traffic volumes at intersections that only have three legs now and are forecast to have four, such as the Overland Road intersections with Black Cat Road, Ten Mile Road, Linder Road, and Locust Grove Road. The 2030 capacity analysis was completed for the PM peak hour.

Intersection Capacity Analysis

Intersection type and layouts were determined based on roadway cross-sections, the ACHD *Intersection Planning Level Standards*, and the planning level roundabout intersections. The simplest intersection meeting the recommended roadway section was initially selected for the intersection capacity analysis. The following assumptions were used in the intersection capacity analysis:

- Future Peak Hour Factor (PHF) – 0.95
- Traffic Signal Cycle Lengths – 60 seconds to 120 seconds
- Used a 4-phase signal cycle
- Assumed 4 seconds of yellow time and 1 second of red time for each phase
- Allowed right turn on green when opposing left turn phase occurred
- Assumed Ideal Saturation Flow Rate of 1,900 passenger cars/hour of green time/lane
- Did not estimate pedestrian movements or model pedestrian phases in analysis
- Did not assume bus stops in analysis
- Percent Heavy Vehicles – 5%
- Signalized Intersection Capacity Analysis – Used HCS+ software following *Highway Capacity Manual 2000* procedures
- Roundabout Intersection Capacity Analysis - Based on Exhibits 4-6, 4-9, and 4-10 of Chapter 4: Operation of *Roundabouts: An Informational Guide*, Pub. No. FHWA-RD-00-067
- Roundabout Intersection Level of Service - Based on Control Delay and compared to Exhibit 17-22, LOS Criteria for AWSC Intersections of *Highway Capacity Manual 2000*

The intersections eligible for roundabouts were analyzed as such with the applicable turning movements converted to entering and circulating volumes. The FHWA capacity methodology in the *Roundabouts: An Informational Guide* was used to analyze roundabouts. This method determines the capacity of a roundabout based on the roundabout type (single lane or dual lane), the entry type (single lane, single with flared dual lane, or dual lane approach), and the circulating flow. The volume-to-capacity (v/c) ratio, the control delay per vehicle, and the 95th percentile queue length are calculated for each leg of the roundabout. LOS is estimated using the LOS Criteria for all way stop controlled intersections which is based on control delay per vehicle.

The signalized intersections were analyzed using the HCS software. Turning movements were input and a generic 4-phase signal phasing plan was assumed. Signal cycles were optimized in the software up to a maximum signal cycle length of 120 seconds. This cycle length is recommended in the Access Management Plan. A 120 second cycle will allow signals at ½ mile spacing to be coordinated and allow good progression speeds along arterials. If the intersection operated at LOS E or F, the next intersection from the ACHD *Intersection Planning Level Standards* was analyzed. This analysis methodology was continued until the intersections were estimated to operate at LOS E for principal arterial intersections or LOS D for minor arterial intersections. Some of the planning level intersections were modified to meet the needs of specific intersections and they are identified in the analysis.

Roundabout Analysis

All intersections in the project area were evaluated to see if a roundabout intersection control strategy would be feasible. They were evaluated based on the guidelines to determine advantageous locations found in the *Ada County Roundabout Study: Roundabout Application Guidelines for Ada County*. Roundabouts were considered the preferred intersection geometry along Amity Road consistent with the completed roundabout study recommendations. If the roundabout was determined to fail in the 2030 capacity analysis, signalized intersections were considered. A screening analysis was done to eliminate those intersections that would not work based on a geometric or functional reason. Criteria included:

- Triple lane roundabouts were not considered for the South Meridian Area. Therefore roundabouts were not permitted along roadways with three or more through lanes in one direction.
- Roundabouts were not permitted on State Highways, Mobility Arterials, or Residential Mobility Arterials as defined in the South Meridian Access Management Plan. These roadways are intended to be high speed, high volume roadways that emphasize long distance through movements over access. Roundabouts require vehicles to slow to 15-20 mph, which would reduce the efficiency of these roadways.

Interim Year Capacity Analysis Methodology

An interim year capacity analysis was used to determine when the improvements will be needed. When a roadway or intersection failed with interim design year traffic volumes, the recommended improvements for the 2030 build out were scheduled to be constructed by that interim design year.

The interim year recommended schedules for improvement are based on several assumptions, particularly the location and pace of development. Adjustments to these schedules should be made as development occurs so that the intersections and roadways affected will be improved. Thus, these schedules do not dictate when specific projects and improvements will take place. They reflect the best information on the development pace available at this time. The ACHD Five Year Work Plan (FYWP) and Capital Improvements Plan (CIP) are updated often to prioritize projects based on the constantly changing development scenarios. The schedules presented here are simply additional tools to guide ACHD in prioritizing projects in the FYWP and the CIP when they review updating those plans.

Interim Year Traffic Volume Procedure

An interim year capacity analysis was conducted to roughly determine when improvements may be needed between 2009 and the 2030 horizon year. First, a linear extrapolation from the current year volumes to the design year forecast was prepared to estimate the growth in travel demand as development occurs. Travel demand forecasts were prepared from this extrapolation for each interim design year, namely 2010, 2015, 2020, and 2025 and then the capacity analyses were conducted for the arterial roadways and intersections in the South Meridian Area. If an existing or planned intersection failed in an interim design period, the intersection improvements recommended for the 2030 design year are recommended for implementation in that interim design period. Stages of construction for intersections are not recommended, e.g. constructing a single lane roundabout first initially and then reconstructing it as a dual lane roundabout ultimately. These detailed project stages will be developed during detailed design and through the FYWP/CIP process.

The recommended roadway improvements schedule is depicted in **Figure 5**. This figure color codes the 2030 build out intersections and roadway segments to identify the interim period the existing (or current FYWP) intersection or roadway fails. This figure presents each interim design year period broken out in five-year increments. Intersections that are recommended to be improved before a particular interim design year are displayed with the color representing that period. Spreadsheets detailing the interim year capacity analysis and listing all of the proposed improvements are found in **Appendix F**.

Generally, intersection improvements are required before roadway segment improvements. Intersections are usually the bottlenecks along arterial corridors. This is because capacity is limited by the traffic flows on each leg of the intersection demanding the same space to maneuver. Intersection improvements are needed to accommodate the additional demand on each leg of the intersection.

Planned Transportation Improvements

Several intersections and roadway segments are scheduled for improvements before 2010 in the 2008-2012 FYWP. These improvement projects were included in the 2010 capacity analysis and subsequent design year analyses of each growth scenario as long as they operated at an acceptable LOS. These intersection and roadway segment improvements are described below:

- The Eagle Road/Victory Road intersection is scheduled to be reconstructed with 5 lanes on each approach and a traffic signal added in 2008. \
- Eagle Road from the Ridenbaugh Canal to Victory Road will be widened to 5 lanes as part of the Eagle Road/Victory Road intersection reconstruction project.
- The Meridian Road (State Highway 69)/Columbia Road intersection is scheduled to be reconstructed and a traffic signal added in 2010.

Interim Year Roadway Capacity

The interim year capacity analysis process is identical to that used for the build out roadway capacity analysis described above. The roadway sections used for the South Meridian Transportation Study were based on planning level roadways identified in the report. With a few exceptions, the roadway classifications are based on the COMPASS 2030 Planning Functional Classification Map.

If a roadway segment in the 2010 network operated at an acceptable LOS, the configuration for that segment was carried forward to the 2015 model for analysis with those interim year forecast traffic volumes, and so on to the 2025 interim design year. If the roadway segment failed in a particular interim design year, then the 2030 recommended cross section was recommended to be built before that interim design year.

Interim Year Intersection Capacity

The process for interim year capacity analysis for intersections is identical to that used for the build out intersection capacity analysis described above. Arterial road intersections in the South Meridian Area were analyzed for the interim design years to determine when they failed. The COMPASS peak hour model traffic volume forecasts for the interim design years were used to estimate turning movements at each intersection in the South Meridian Area. The Highway Capacity Software Plus (HCS+) was used to analyze the intersections in each of the interim design years.

Peak Hour Turning Movements

The PM peak hour turning movements were estimated for each intersection in each interim design year based on the forecasted peak hour link volumes entering and exiting the intersection. The turning movement volumes were estimated based on the linear interpolation between existing and 2030 forecast volumes. Some adjustment was made to accommodate future traffic volumes at intersections that only have three legs now and are forecast to have four, such as the Overland Road intersections with Black Cat Road, Ten Mile Road, Linder Road, and Locust Grove Road.

Intersection Capacity Analysis

The intersections were analyzed using the HCS software. The turning movements were input into the appropriate module (all-way stop control, two-way stop control, and traffic signal control) with the 2010 intersection geometry. If an intersection roadway segment in the 2010 network operated at or better than the LOS threshold, it was carried forward to the 2015 model for analysis with those forecasted traffic volumes. This process was repeated to the 2025 interim design year. If the intersection failed in a particular interim design year, the 2030 build out intersection was recommended to be built before that interim design year.

Build Out Right-of-Way Estimate Methodology

The ACHD Geographic Information Systems (GIS) Division provided information depicting the existing parcel, roadway, and intersection limits in the South Meridian Area. The centerlines for the arterial roadways and intersections were established from the GIS data. The recommended build out improvements were superimposed over the existing parcel and roadway mapping to determine the additional right-of-way needed to accommodate the improvements. All improvements were assumed to be centered on the existing roadways and intersections. The intersection right-of-way needs were determined separate from the roadway segment needs. Separate cost estimates for results of each arterial/arterial intersection and roadway segment are presented in later sections.

Individual parcel impacts were not calculated or estimated. The purpose of this exercise was to develop a conceptual idea of costs associated with the proposed improvements. Some areas appeared to contain easements and other unique features. For simplicity, these areas were not separated in this conceptual right-of-way estimation.

The right-of-way estimates and cost approximations are for planning purposes and comparisons only. Those improvements included in the CIP will include the necessary right-of-way purchases by ACHD. Those recommended improvements not included in the CIP will require adjacent developments to dedicate the necessary right-of-way. Specific right-of-way needs and costs will be determined during design activities. Detailed tables presenting cost calculations are presented in **Appendix J**.

Roadway Right-of-Way

The roadway segments were defined as those areas between the arterial/arterial intersections that were uniform in number of lanes and width. The roadway segment right-of-way widths determined in the report were used to estimate the proposed right-of-way needs along the arterials. The existing right-of-way centerline was offset to the new, proposed right-of-way width and shapes were created between the right-of-way shown on the GIS mapping and the proposed right-of-way line. Estimated right-of-way needs along the arterial roadway segments between arterial intersections were calculated and combined for a total segment right-of-way estimate.

Intersection Right-of-Way

The recommended intersection improvements for each growth scenario were used to estimate the intersection right-of-way needs. These recommended intersections were centered on the existing intersections and adjusted as needed in a CAD program. Shapes were created between the right-of-way shown on the GIS mapping and the proposed right-of-way. Estimated right-of-way needs at the intersections were calculated and combined for a total intersection right-of-way estimate. The intersection right-of-way needs were estimated to include all of the roadway length from the intersection, including tapers and widening for turn lanes, back to the basic roadway segment width. This length was assumed to be identical to that presented in the *Intersection Planning Level Standards* drawings and roundabout drawings.

Right-of-Way Cost Estimate

Unit costs for right-of-way were provided by Integrity Appraisal, which performed a market analysis of land and home sales conducted in the South Meridian Area since 2001 in a report titled *South Meridian Transportation Plan Estimate of Right of Way Acquisition Costs*. They compiled over 300 single family residential sales and 225 vacant land sales in the area since 2001 to develop a current average cost per acre at each arterial/arterial intersection in the area. These costs were applied to the estimated intersection and roadway segment right-of-way needs to determine the associated costs. These costs are presented in tabular form for each intersection and roadway segment improvement recommendation in the South Meridian Area. A copy of Integrity Appraisal's report is found in **Appendix K**. Included in Integrity Appraisal's report is an estimate of how the current right-of-way costs may increase over time and how that dramatic increase may affect the South Meridian Transportation Plan.

Build Out Construction Cost Estimate Methodology

A procedure similar to the right-of-way estimation was used to identify the proposed intersection and roadway segment costs. The estimated construction costs were calculated for each intersection and roadway segment so that they could be combined with the right-of-way costs to provide an estimated cost for the respective intersection and roadways segment improvements.

Roadway Construction

The roadway segments were defined as those areas between the arterial/arterial intersections that were uniform in number of lanes and width.

Intersection Construction

Many of the intersections within the study area taper from 6-, 8-, and 9-lane cross sections at the stop bars to 3-, 5-, and 7-lane cross sections on the roadway segments. Intersection lanes for the construction cost estimate were estimated as the number of lanes at the stop bar. The intersections that are forecasted to be controlled by roundabouts have an additional cost to account for the additional paving, curbing, and landscaping the roundabouts require. This additional cost was estimated at $180,000 for single lane roundabouts and $443,000 for dual lane roundabouts. The intersections that are forecasted to be controlled by a signal have an additional $250,000 estimated cost to account for the signal addition or upgrade.

Construction Cost Estimate

ACHD provided roadway cost estimates for various roadway cross sections, specifically the number of lanes, based on recent bid openings and other planning activities. The estimated costs from the 2007-2011 Five Year Work Plan were compared with actual costs and the results formed the basis for the unit costs used in the South Meridian Transportation Study. Costs were inflated to estimate 2008 values. The unit costs provide a planning level estimate of the current construction costs without breaking out individual bid items, material quantities, utility costs, and other unique construction impacts.

These estimates are unit costs in current dollars per foot of the particular roadway segment. The unit costs provided by ACHD are presented in **Figure E-2**.

Figure E-2. Construction Cost Estimate Unit Costs

Construction Cost Estimate	
Number of Roadway Lanes	**Unit Cost per Foot (2008 $)**
3	$ 600
4	$ 700
5	$ 900
6	$ 1,000
7	$ 1,200

Benefit/Cost Analysis Methodology

A benefit/cost analysis was prepared for recommended intersection improvements for each of the growth scenarios included in the South Meridian Transportation Study. Intersection improvement projects were prioritized for each growth scenario based on the benefit/cost analysis, which utilized the build out and interim year capacity analyses and recommended schedule of projects.

Discussion of Present Worth Method

The benefit/cost ratio present worth method is often used to evaluate municipal projects, specifically to compare alternatives. This method determines the present worth of all benefits and the present worth of all costs associated with a given alternative of the project. Benefits (in present year dollars) are divided by the present worth costs to determine the benefit/cost ratio. A given alternative is acceptable if the ratio equals or exceeds 1.0. Alternatives for a project can be compared using their benefit/cost ratio. The alternative which provides the highest ratio, and thus the most benefit for the associated costs, is usually selected as the preferred alternative.

The benefits and costs associated with each alternative are quantified for the period of time during which they may be realized. For example, construction costs may occur during a small window of the entire project planning period (2-4 years) while maintenance costs may occur annually or semi-annually over the life of the facility. Benefits can be identified as daily, monthly, annually, or as a one time occurrence.

All of the costs and benefits are converted from future estimates to their present value. This conversion requires making several assumptions regarding the interest rate, the inflation rate, the timing and frequency of expenditures, and the accuracy of the future costs. Tax implications and depreciation may also be included. The future benefits and costs for each alternative are discounted based on the assumed interest and inflation rates to determine the amount in present year dollars that are needed to provide the future improvements.

Modified Analysis for South Meridian Transportation Study

The benefit/cost analysis used for the South Meridian Transportation Study is not a traditional benefit/cost present worth analysis because there are not project level alternatives to compare. Only one recommended improvement for each intersection based on the forecasted traffic volumes associated with each growth scenario was developed. Thus the analysis provides a comparison of the benefit/cost ratios between each growth scenario.

The following planning level analysis calculates the present worth benefits and costs at each intersection to determine which intersection projects will have the highest benefit/cost ratio given an interim design period and a growth scenario. Each intersection project is then prioritized based on its calculated benefit/cost ratio.

Estimated Cost

The planning level costs fell into two categories: right-of-way and construction. Costs were estimated in 2008 dollars. Thus, no discounting as described above is required. The benefit/cost ratios developed for the purposes of this analysis only consider the one-time costs of right-of-way acquisition and construction.

Maintenance costs and other annual costs that may be associated with the intersections were not included due to the difficulty in estimating them and the cursory nature of this analysis. As individual projects are developed in the South Meridian Area, more detailed benefit/cost analyses can be performed that include estimates of the costs associated with maintenance and other various improvement activities. These more detailed analyses should be used to compare specific intersection improvement alternatives.

Estimated Benefit

A major benefit of intersection improvements is the driver's reduced travel time through the intersection. This benefit is measured as the reduction in delay to vehicles traveling through the intersection. For this study, delay reduction is based on the average delay calculated for each intersection using the Highway Capacity Software Plus. Delay reduction is the only benefit quantified for this analysis. Additional benefits, including fuel consumption savings, can be calculated for the improvements identified. These additional benefits would increase the estimated benefit. More detailed benefit/cost analyses can be performed in the future to compare specific alternatives and include these additional benefits.

The benefit/cost analysis was performed for each intersection based the build out recommended intersection improvements and the proposed schedule of the improvement for each growth scenario. For example, if an intersection failed with the traffic volumes forecast for 2015, the average delay per vehicle under the existing intersection configuration was recorded and compared to the delay associated with the improved configuration recommended. The difference between the delay per vehicle before and after the intersection improvements was recorded as the benefit per vehicle. This delay reduction per vehicle is multiplied by the number of vehicles traveling through the intersection in the peak hour of the interim design year (2015 in this example) to determine the number of hours saved by travelers through the intersection during the peak hour.

A weekday daily delay reduction is determined by multiplying the peak hour reduction by two, assuming two peak hours daily. The annual delay reduction is calculated by multiplying the daily delay reduction by 260 weekdays per year. It is assumed that the weekend traffic will not experience excessive delays at these intersections and so are not included in the analysis.

The annual delay reduction benefit was converted to dollars to directly compare with the estimated costs. An average 2007 wage rate is multiplied by the annual delay reduction to determine the annual travel delay cost savings. This dollar amount represents the money all weekday travelers save traveling through the intersection after improvements are made.

The wage rate is an approximation of the value of each traveler’s time and is used to quantify how the intersection improvements benefit the traveling public. This wage rate is based on the Ada County Profile prepared by Idaho Commerce & Labor in December 2008 and presented in **Appendix L**. The per capita median annual income in Ada County is estimated at $39,302. This median annual income was converted to an estimated hourly rate of $18.90. This analysis used this value as the average travelers wage rate.

For the purposes of this analysis, the peak hour average vehicle delay without improvements is capped at 100 seconds. The calculated delay may be much higher for a given intersection, but the capacity software (HCS+) only analyzes isolated intersections and does not account for traffic patterns shifts. Realistically travelers will find alternative routes when delay becomes unacceptable and 100 seconds is assumed to be the point at which diversion occurs. Therefore, any calculated delay at a given intersection greater than this cap is adjusted to 100 seconds.

Roundabouts have unique characteristics that make calculation of delay a bit more difficult. The roundabout capacity analysis performed to determine the delay per vehicle was based on the FHWA’s *Roundabout: An Informational Guide* methodology. Delay at roundabout intersections is calculated with a logarithmic function that greatly increases as saturation flows are reached.

Before those flows are reached, very low average delays per vehicle are estimated. All intersections improved with roundabouts were assigned a delay per vehicle of 15 seconds unless the calculated delay was higher. This minimum delay represents the intersection operating at an LOS of mid-B. This provides a more realistic estimate of the benefits travelers will find as the roundabouts are constructed.

The total present worth benefit at each intersection is estimated over a span of years between the interim design year when improvements are needed (2010, 2015, 2020, and 2025) and the build out design year of the South Meridian Transportation Study (2030). This span represents a reasonable design life for each intersection and gives a finite time period for this planning level analysis. Traffic volumes and patterns beyond the 2030 design year have not been included in this analysis. The number of vehicles traveling through the intersection will change each year and delay will increase or decrease as the volumes fluctuate. However, this analysis assumes that the delay reduction calculated for the specific interim design year traffic volumes will remain similar throughout the years included in the analysis period.

As more individual projects are developed in the South Meridian Area and better traffic forecasts are developed for those projects, more detailed benefit/cost analyses should be performed that include detailed estimates of the monetary value of benefits. These more detailed analyses should be used to compare specific intersection improvement alternatives. Future analyses will also allow for a more detailed estimate of the intersection improvement life span than can be estimated by this planning level analysis.

Assumptions

The assumptions used in the South Meridian Transportation Study benefit/cost analysis include the following:

- All costs have been estimated in 2007 dollars (no discounting of costs).
- The average 2008 wage rate of $18.90 was used as the value of the average traveler's time.
- The benefit period is estimated over the span of years between the interim design year improvements are needed (2010, 2015, 2020, and 2025) and the build out design year of the South Meridian Transportation Study of 2030.
- Off-peak traffic volumes are lower than peak volumes and thus no reduction was calculated for off-peak travel delay.
- The peak hour delay per vehicle without improvements is capped at 100 seconds
- The minimum peak period delay per vehicle for roundabout intersections is 15 seconds.
- The peak period delay reduction is multiplied by 2 to account for two peak hours each day (AM and PM) and estimate the total daily delay reduction.
- The annual delay savings are calculated assuming 260 weekdays per year.

- The annual delay reductions calculated at each intersection for the interim design year are representative of the annual reductions for each year of the benefit period.

Interpretation of Benefit/Cost Ratio Results

The benefit/cost ratios calculated for the arterial intersections in the South Meridian Transportation Study require some interpretation to glean meaningful conclusions. The first issue is that some intersections exhibit a benefit/cost ratio of less than 1.0. One reason for this is because the benefits are only calculated for the 5, 10, or 15 years between the interim design year the improvement is recommended to be constructed in and the 2030 design year rather than the full 20 year life an intersection would typically experience. These intersections do not realize enough benefit in those periods to offset the costs of providing the improvements. A conclusion that could be made from this situation is that the intersections do not require the full 2030 recommended build out in the interim design year. By providing a partial improvement, the costs will be reduced and the benefits will be maintained.

However, by 2030 the full improvements must be provided and so this argument does not provide a solution to this issue. A more logical conclusion is that the intersections will continue to function at acceptable LOS after 2030 and so the benefits will continue to accrue beyond this planning horizon. The intersections that have a benefit/cost ratio less than 1.0 that may realize benefits beyond 2030 are shown in **red** in the results presented for each growth scenario.

The second issue raised by the benefit/cost ratios deals with certain intersection improvements that are not included in the current long range plan. Specifically, the Overland Road/Ten Mile Road, Victory Road/McDermott Road, and Victory Road/Meridian Road intersections exhibit very high right-of-way and construction costs that translate into benefit/cost ratios less than 1.0. The Overland Road connection from Black Cat Road to Ten Mile Road is not included in any long range plan and is not currently funded. These intersections and the roadway between them require a significant right-of-way investment and the benefits will not balance that investment until well beyond the 2030 planning horizon.

The McDermott Road and Linder Road intersections with Overland Road do not need to be improved until overpasses are provided over I-84 at each arterial. The Linder Road overpass is not included as a funded project in any long range plans. Thus, a significant investment is required before the benefits are realized. This could be well beyond the 2030 planning horizon. The concern from a planning standpoint is that if these overpasses are not constructed by 2030 the Black Cat Road overpass and the Ten Mile Road and Meridian Road interchanges will have to carry those vehicles that would have used a McDermott Road or Linder Road overpass. The larger traffic volumes on Black Cat Road, Ten Mile Road, and Meridian Road will require improvements to these arterial intersections with Overland Road sooner than the current schedule states. Ultimate build out of these facilities may require larger intersections and roadway segments.

The third issue raised by the benefit/cost ratios is the relatively high benefit/cost ratios of intersections improved with roundabouts compared with signalized intersections. Roundabouts tend to show higher B/C ratios because, while they serve lower traffic volumes overall, they reduce delay per vehicle more dramatically than signalized improvements in most cases. The intersections that are improved with roundabouts are converted from stop control and the delays are drastically reduced. This translates to a large annual delay savings and thus a large present worth benefit with a lower construction cost than the signalized intersections. All of the roundabout intersections show benefit/cost ratios greater than or equal to 1.0 and are generally at the top of each interim period priority list of projects. The roundabout intersections realize their benefits in shorter periods of time than the signalized intersections because of the high estimated benefits and lower costs. Roundabout intersections are shown in blue in the results presented for each growth scenario.