HILLSBOROUGH COUNTY

INTERSECTIONS PROGRAM MASTER PLAN

WHITE PAPER

November 15, 2004

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INTRODUCTION

Hillsborough County is one of the fastest growing counties in Florida. With a population growth rate of approximately 18,000 persons annually, the increased vehicle demand is pushing many roadway facilities beyond acceptable capacity levels. In most cases, intersections that operate near or above capacity experience higher accident rates as a result of increased vehicle and pedestrian conflicts.

The Hillsborough County Public Works Department maintains complete or partial jurisdiction over approximately 14,000 at-grade roadway intersections throughout the County. Of those, over 400 are controlled by traffic signals. The maximum vehicle capacity along any roadway segment is dependent upon the maximum vehicle capacity at the signalized intersections along that roadway segment.

The County's Public Works Department recognized the need to develop a program for implementing intersection capital improvement projects to improve traffic operations. The purpose of this document is to summarize the County's efforts to develop and maintain an Intersections Program Master Plan to satisfy these needs.

HISTORICAL PROCEDURES

Until recently, there had been no formal policy or procedure regarding capital improvements of intersections. There have been and continue to be many more intersections perceived as needing improvements than financial resources to make all of the improvements. As a result, prudence dictates that the intersection improvements be prioritized to determine which projects should fall within the County's work program.

The previous methods of prioritizing intersection capital improvement projects have been ad-hoc and fairly subjective with County staff making judgments about the desirability and relative importance of competing projects, and occasional input from elected officials. Without a defined prioritization methodology, intersection improvement prioritization was based on essentially two factors. The first factor was the County staff's opinion of the degree of inadequacy of an intersection, which was largely a function of the perceived frequency with which they had to deal with problems at that intersection and the perceived severity of the problems. The second factor was public complaints concerning traffic operational and safety issues through such methods as

administrative referrals. These methods of addressing intersection operational concerns are highly reactive.

INTERSECTIONS PROGRAM MASTER PLAN GOAL

The goal of the intersections program master plan is to analyze, organize, prioritize, and implement intersection capital improvements. This program serves to optimize traffic flow and improve safety, using the County's limited financial resources. The purpose is to abandon the existing reactive approach of subjective decision-making and establish a comprehensive pro-active plan for implementing intersection improvements. The master plan is coordinated with other proposed roadway improvement projects as identified in the MPO's 2025 Long Range Transportation Improvement Program, the Florida Department of Transportation's Adopted Work Program, the County's Capital Improvement Program and developer roadway projects.

PROJECT APPROACH

The approach to the initial development of the intersections program master plan is summarized by the following major tasks:

- Establish the prioritization methodology and develop a program to automate the procedure to the greatest extent possible.
- Develop a screening process and a reasonably economical sized list of intersections (100-150) to study, from the entire 14,000 intersections.
- Develop a Geographic Information System (GIS) to organize and maintain any data relative to the intersections program.
- Collect data necessary to prioritize the intersection improvements and support the intersections program.
- Determine the intersections program annual "maintenance" requirements for updating the master plan and the priority list.

METHODOLOGY FOR PRIORITIZATION

The primary task in the development of the intersections program master plan was to establish formal procedures and criteria by which proposed intersection improvement alternatives could be prioritized using a well-defined, consistent methodology.

Presently, there is no nationally adopted methodology for prioritizing intersection improvements. Research was conducted among members of the American Public Works Association, Institute of Transportation Engineers, all 50 state Departments of Transportation, and many other professional organizations. The consensus is that most agencies prioritized intersection improvements based

upon one of two criteria, either critical accident mitigation (accident reduction) improvements or congestion mitigation and air quality (reduction in vehicle delay) improvements. Both of these methods use a benefit to cost ratio to compare and prioritize intersection improvement projects. Several local agencies had considered other factors in their screening process including transit, citizen input, social impacts, system continuity, and support from other programs. These factors, however, are highly subjective and may not directly correlate to intersection operational improvements.

The research for the County included an evaluation of a study that was conducted by the Department of Civil and Environmental Engineering, University of South Florida (USF), in 1999. The USF study concluded that the two critical factors that should be considered in the prioritization of intersection operational efficiency improvements are: 1) accident reduction and, 2) vehicle delay reduction.

The methodology that was recommended and agreed to by the County was to establish the prioritization based upon the following formula:

Benefit/Cost = (Economic benefit of vehicle delay savings + accident reduction savings)/Cost of improvements, over time.

BENEFIT TO COST RATIO

A benefit to cost ratio is an economic analysis of the benefits of the proposed improvement relative to the cost associated with the improvement. A transportation improvement will generate economic savings benefits in terms of safety improvements/accident mitigation and/or reduced vehicle delay (improved overall Level of Service). The costs associated with a proposed improvement will include, when applicable, Project Development and Environmental (PD&E) studies, design, right-of-way acquisition and miscellaneous related fees, construction and maintenance.

An economic analysis of a transportation improvement will require the comparison of existing conditions versus improved conditions. An analysis of this type requires monetizing annual benefits due to a reduction in accidents and average vehicle delay, amortizing those benefits over a specific time frame, converting the future benefits into present worth, and dividing by the total present worth costs.

ACCIDENT REDUCTION

The initial screening of candidate intersections is based upon the accident history, and more specifically, the accident rate (measured in accidents per

million entering vehicles). This practice will also help to identify intersections that may be failing as a result of traffic congestion, since congested intersections experience a higher rate of traffic accidents. The evaluation of potential traffic accident reductions at a particular intersection is be based upon a review of the accident history for the most recent 24-month period. This is best done by preparing a collision diagram for each intersection under consideration. Accident data is collected for all accidents reported within 100 feet of an intersection from both the Hillsborough County Sheriff's Office (HCSO) and the Florida Highway Patrol (FHP). A Traffic Engineer determines through field observation and assessment of a collision diagram whether there is a preventable accident pattern. An accident pattern is considered preventable if it is determined that at least five (5) accidents occurred within any consecutive 12 month period that are correctable through the implementation of certain countermeasures. Engineering judgment and practical experience should be used with great care in determining whether or not a particular pattern of traffic accidents may be mitigated through the implementation of certain countermeasures/ improvements. The proposed improvements may range from adjustments to the existing signal timings to the installation of a traffic signal or the construction of an exclusive turn lane. As an example, traffic signals reduce the occurrence of right angle collisions and, therefore, offer significant accident mitigation value. If it is determined that certain improvements may reduce or eliminate a number of traffic accidents then it can be assumed that the implementation of certain improvements will reduce a number of accidents annually during the life expectancy of the proposed improvement.

The economic benefit associated with accident mitigation is based upon the "Manual on Identification, Analysis and Correction of High-Crash Locations"(commonly referred to as the HAL Manual). The procedures provided in this manual are similar to those adopted by the Florida Department of Transportation (FDOT) for calculating benefit/cost. FDOT, however, relies on older and less defined procedures from the "ACCIDENT REDUCTION FACTORS FOR USE IN CALCULATIONG BENEFIT/COST" manual.

According to the HAL Manual the first step in the procedure is to determine the probable causes of crashes and the appropriate countermeasures (or improvements). Each countermeasure has an associated Estimated Crash Reduction (CR) Factor based on historical before and after traffic studies performed by a variety of Traffic Engineers and government agencies throughout the United States. Such countermeasures include: channelization, construction/reconstruction, traffic signals, signing, street lighting, pavement treatment, pavement markings, delineation, and roadside improvements. A great deal of engineering judgment and common sense should prevail when applying CR factors. It is critical to the entire Benefit/Cost analysis procedure that each CR

factor be applied to only those crashes that have a reasonable chance of being corrected by the associated countermeasure.

Once established, the CR factor is multiplied by the accident cost for each correctable accident to determine the accident reduction value. The average cost per traffic accident is based on the following crash severity categories.

2004 TRAFFIC CRASH COSTS

Crash Severity	Crash Cost ($)
Fatal Crash	3,400,000*
Injury Crash	57,330*
Property-Damage-Only	4,200
* A weighted average cost for combined fatal and injury crashes is recommended for application in economic analysis procedures.	

For several reasons, it is recommended that a weighted average cost for combined fatal and injury crashes be used in the economic analysis procedures. Based on the HAL Manual, a value of $226,200 was chosen for the accident cost of both fatal and injury accidents.

The annual accident savings is simply the sum of each accident reduction value divided by the 2-year study period.

DELAY REDUCTION

The amount of congestion or delay experienced at an intersection is measured in terms of average vehicle delay (seconds) for all vehicles passing through the intersection. It is often expressed as the Level of Service ('LOS'). A candidate intersection may be found not to have a preventable accident pattern but may experience unacceptable Levels of Service. The evaluation of vehicle delay should be based upon a capacity analysis performed using the most recent AM and PM peak hour intersection turning movement counts. The analysis for signalized intersection should be performed using the latest TEAPAC SIGNAL2000 software, which follows the Highway Capacity Manual procedures. Non-signalized intersections should be analyzed using the latest Highway Capacity Software. An intersection should be considered a candidate for capacity improvements only if the existing AM or PM LOS is less than 'D'. To determine the proposed improvements, the peak hour turning movement counts should be projected out twenty years, to the assumed design year, using an average annual growth rate of 2% per year. Using 20-year traffic projections will ensure that the proposed improvements will not only address the existing Level of Service (LOS) capacity concerns but also LOS capacity concerns in the future. The goal of this analysis is to determine the minimum auxiliary lane geometry and storage length requirements necessary to maintain a level of service of 'D' at an intersection.

Because adding through travel lanes creates projects of considerable length and cost, the analysis should not include the addition of through lanes at an intersection. Through lane capacity improvements should be addressed by road widening projects. In many cases the failure in the Level of Service at an intersection is due to the lack of through lane capacity. Also the engineer should use proper judgment to assure that the auxiliary turn lane improvements are not being proposed only as a result of the need for additional green time assignment for the through traffic.

Upon determining the geometric requirements, the engineer shall calculate the vehicle delay savings for the peak hour periods of analysis.

In an effort to fairly assess and prioritize intersections that are added to the candidate list specifically because the intersection met signal warrants, a special case analysis must be allowed. When a traffic signal is introduced on a major highway, the average vehicle delay on the major highway will increase (representing a negative benefit). Under this special case, the 'Before' analysis should be performed using HCS Non-Signalized Analysis to determine the side street delay. The 'After' analysis should be performed using the optimization procedures of SIGNAL2000 to determine the average vehicle delay. The results should be compared using only the side street volumes to develop the overall vehicle delay savings.

The economic benefit value assigned to vehicle delay savings is determined by converting these values into annual vehicle delay savings. The annual reduction of vehicle delay is then multiplied by $10 per hour based on Minnesota Department of Transportation's data to represent the vehicle user's operating costs.

The sum of the benefits is then amortized over a 20-year time frame, which is a typical range for transportation improvements. This time frame should be long enough to capture most of the useful life of the project.

In a transportation economic analysis, most costs associated with a transportation improvement are usually encountered in the early years and the benefits will accumulate over many future years. When performing an analysis of this type, it is necessary to convert the future benefits that occur in different years into comparable numbers. The benefits will increase from year to year based upon an increase in traffic growth, which is considered to be 2 percent per year. Using a discount rate of 7 percent, the annual benefits and salvage value are discounted back into the base year. The 7 percent discount rate approximates the marginal pretax rate on an average investment. Future costs and benefits are worth less in today's time value of money. A future cost and

benefit can be converted into present worth using the following formula.

$$PW = \frac{AB}{(1+r)^y}$$

(Where PW = present worth, AB = annual benefit, r = discount rate, and y = the year in which the benefit occurred.)

Subsequently, the construction costs for the proposed project are estimated for the appropriate year of construction. The annual maintenance costs are also included and discounted back to the base year. Finally, the total benefit is divided by the total costs. The result is the benefit to cost ratio (B/C) for the proposed project. The greater the B/C ratio of an intersection project, the higher the relative priority and ranking.

DETERMINING THE COST OF IMPROVEMENTS

There are two purposes for estimating the monetary cost of constructing certain intersection improvements. The first is for determining the priority of each project based upon the benefit to cost ratio. The second is to establish the budget requirements for the CIP Plan once a project ranks high enough on the B/C ranking. It is important to provide a conservative estimate using the best available historical data and right-of-way costs.

Once it has been established which geometric improvements are to be made at an intersection, the engineer will develop preliminary engineering drawings depicting the scope of the improvements. Through the use of aerial photographs and the GIS data available through the Real Estate Department, base maps can be produced representing the existing field conditions. This information can be imported into CADD for the purposes of drawing the proposed improvements. The geometric improvements will be based upon the latest FDOT and AASHTO design standards as adopted by the County. Most importantly, the proposed right-of-way needs can be approximated from these scaled drawings.

A significant component of these costs is the potential costs of stormwater management requirements associated with the improvements. These costs are best expressed in the form of land area needed to meet stormwater-permitting requirements of Hillsborough County, Hillsborough County EPC, SWFWMD and FDEP. The most accurate way to determine stormwater management requirements is to do a detailed drainage analysis at each intersection. This is not practical for a B/C program of this magnitude. However, a method of approximating stormwater management requirements is needed in order to calculate B/C ratios as accurately as possible.

In some cases, it is necessary to estimate the potential impacts that pond construction has on environmentally sensitive areas. Actual environmental jurisdictional coverage's are not available; therefore aerial photographs are used to estimate the extent of potential wetland areas. Mitigation of wetland impacts are estimated at a ratio of 1:1 and are shown as additional area which may have to be purchased in order to accomplish the improvements identified for an intersection.

The stormwater methodology outlined below requires manual digitizing to determine areas for pre-developed and proposed conditions. Once these areas are determined, an estimate of required land areas for stormwater management is made. Once the digitizing of the pre-developed and proposed areas have been done, the remaining calculations are automated as part of the Intersection GIS with appropriate fields added to the Access Database as necessary.

It is emphasized that this methodology should be used for comparative purposes only and is no substitute for the detailed analysis that will be performed for actual design and permitting. Actual stormwater management area requirements may be more or less than those calculated using the following methodology.

Methodology

1. Determine proposed condition (post-developed) pavement area within project limits.
2. Determine existing condition (pre-developed) pavement area within project limits.
3. Determine hydrologic soil type. In dual classification soils, developed areas will be assumed to be in the drained condition.
4. Calculate area weighted Curve Numbers (CN).
5. Assume difference in post-developed and pre-developed area is grassed area in pre-developed condition.
6. Calculate pre and post Curve Numbers (CN).
7. Calculate volume of runoff for pre and post conditions using a 25-year/24-hour storm event and SCS TR-55 Methodology for areas that do not have known flooding problems.
8. Calculate volume of runoff for pre and post conditions using a 100-year/24-hour storm event and SCS TR-55 Methodology for areas that have documented flooding problems. In addition, this storm event will also be utilized for areas where it is known that there is not an outfall for the stormwater discharge.
9. Calculate direct runoff:

$$\mathbf{Q = (P - 0.2S)^2 / (P + 0.8S) \quad where \; S = 1000/CN - 10}$$

(Equation for Direct Runoff)

10. Subtract pre-developed runoff volume from post-developed runoff volume.
11. Assuming 1.0 ft. depth in stormwater management facility divide difference in runoff volume by 1.0 ft. to give estimate of area at top of bank.
12. Increase result of Number 7 above by 20% to account for maintenance berm requirements.

Assumptions

1. Stormwater treatment volume is included in volumes calculated in Number 6 above. Stormwater treatment may or may not be required by SWFWMD depending on nature of the improvement. In general, however, SWFWMD will require attenuation for any additional pavement added as a result of the intersection improvements.
2. Proposed methodology assumes "Open Basin" criteria. It does not account for "Closed Basin," "Volume Sensitive," "Peak Sensitive," "FDOT 14-86 Drainage Connection," or any basin specific criteria, nor does it include any area for potential floodplain compensation. These criteria are considered site specific and should be utilized for detailed design. However, the volume difference between the 100 year analysis and the 25 year analysis does not affect pond sizes to a large degree. Given the conservatism of pond depths, and percentages allowed for berms, the estimated pond areas are applicable for planning level purposes.
3. Estimates of land area for stormwater management computed using the above methodology should be used for comparison purposes only and not as a basis for final design. Other factors that could influence the actual design and sizes of proposed stormwater management facilities include adequacy of existing drainage systems and outfalls, amount of offsite runoff draining to/through the project area, potentially more stringent regulatory requirements at the time of design, etc.

Once the right-of-way needs have been established and agreed upon by the appropriate County staff, the land areas required from each parcel is easily determined. This information is handed over to a property appraiser to price out the cost of land acquisition and all associated business damage fees.

DATA COLLECTION REQUIREMENTS

The Hillsborough County Sheriff's Office maintains a database of all accident information or reports filed by either the Florida Highway Patrol or themselves. This database of information is downloaded to the Public Works Department monthly and is used to populate Magic, the County's accident reporting software. This information is given free of charge to the County. The Magic software is an appropriate tool for performing gross analysis of accident history for a particular

intersection or group of intersections, however this program is not suited for the detailed analysis necessary for the intersections program master plan. Each intersection on the intersections program requires copies of all of the traffic accident reports for the previous twenty-four months which are obtained from the Hillsborough County Sheriff's Office and Florida Highway Patrol as appropriate. A collision diagram displaying the accident history is prepared for each intersection. These activities are the first step in the data collection process.

The collection of 8-hour traffic turning and movement counts are necessary for the determination of the vehicle delay savings component of the B/C ratio. The collection of this data can cost anywhere from $650 to $1300 per intersection. Any existing traffic counts that are dated over five years from the time of analysis should not be accepted for the purposes of vehicle delay calculation.

The field review of each intersection is conducted only after a collision diagram is prepared and the 8-hour turning movement counts have been conducted. A qualified traffic engineer conducts the field review. During the field visit, a digital photo is taken from each approach of the intersection to document field conditions and to assist in estimating construction costs.

After completing the field review, a capacity analysis is performed for the a.m., p.m., and off-peak periods using 20-year projected volumes to compare the average vehicle delay for the existing conditions versus improved conditions. The capacity analysis is conducted using the latest version of the Highway Capacity Software or any other capacity analysis software approved by the County's Traffic Services Division.

The results of the field review and the capacity analysis is used to determine the scope of the proposed intersection improvements. Based upon the proposed improvements, a construction cost estimate is prepared considering the costs of preliminary engineering, design, right of way, construction, and annual maintenance. The cost estimate includes historical similar project costs and right-of-way input from the County's Real Estate Department.

INITIAL SCREENING PROCESS USED TO PRODUCE THE FIRST MASTER PLAN

With approximately 14,000 intersections throughout unincorporated Hillsborough County to be considered, it is not feasible to perform a benefit/cost economic analysis at every intersection. Under the constraints of the allowable budget for development of this program and with consideration given to the idea of having a large enough list of projects available to satisfy a 6-year work program, it was agreed to that a priority list of approximately 100-150 intersection projects would be developed.

Since accident history (through Magic) is the only existing information readily available for all 14,000 intersections, the total number of accidents per intersection was used for the initial screening. The first measure was to determine the intersections that experienced the greatest number of accidents per year for the previous two-year period. Because the total number of accidents occurring at an intersection correlated strongly with the level of traffic congestion, looking at accident counts give a strong indication to deficiencies in intersection capacity (i.e. high vehicle delay).

Using a threshold of 14 accidents or more over a two-year period, a list of 350 intersections was compiled. Eliminating intersections that were under the complete jurisdiction of FDOT or located in an incorporated city first reduced this list of 350 intersections. The list was further reduced by eliminating intersections that were included under other proposed roadway improvement projects.

Several intersections were added to this initial list for the following reasons:

1) The intersection had met traffic signal warrants.
2) The intersection was remaining from the previous list of intersections used to develop the FY01 and FY02 programs and not yet funded.
3) The public recommended intersections through the four public meetings held, or from an administrative referral recommending the intersection.
4) The Public Works Department Roadway Maintenance Division recommended the intersection for improvement.

The outcome of intersections being eliminated from and added to the initial list was a new list of approximately 250 intersections.

Since accident rate is a good indicator for comparing safety or relative risk at different intersections, the accident rates were developed for each intersection. The accident rates were calculated in terms of accidents per million entering vehicles (AMEV).

The 250 intersections were then ranked according to their AMEV values. From the ranking, 150 intersections were selected based on the highest AMEV values. Accident data was gathered and traffic counts were performed for these top 150 intersections.

After the analysis and evaluation, a scope of proposed improvements was developed for each intersection. During this process several projects were found to not need improvements because the major concern was only a lack of through lane capacity along the major street. Some intersections were found to only need minor improvements that could be handled internally, such as signal timing

adjustments. The results of the scope development process produced a final list of 102 intersection improvement projects. These intersection improvement projects became the initial Hillsborough County Intersections Program Master Plan.

INTERSECTIONS PROGRAM MANAGEMENT INFORMATION SYSTEMS (IPMIS)

The development of an electronic database is necessary to house and organize intersection traffic data as a result of the data collection required for the support of the intersections program master plan. With the County's adoption and commitment to a GIS platform, it is most practical for the intersections program to incorporate the master plan data into the County's active GIS environment (ArcView). Separate customized themes have been created within GIS to allow for visual mapping displays of intersection data.

The advantages to utilizing a GIS database include the ability to overlay data from one County department with data from another. Separate themes for roadway projects proposed in the MPO's Long Range Transportation Plan and the Florida Department of Transportation's and the Cities' Adopted Work Programs have been developed to act as a visual aid in the coordination efforts of the intersections program master plan.

The GIS database includes the unique identification number for each intersection that was assigned by the Hillsborough Asset Management System (HAMS). This common identification and unique number will allow the GIS database to be linked with the HAMS database in the future. The actual linkage has not yet been performed, but the common attributes needed for the sharing of information between the data sources are in place. This virtual, permanent linkage between the databases will allow for the free association of information in HAMS to be accessed by the GIS database.

Microsoft Access and Excel software is used to develop and upgrade the program. Excel is used to calculate the benefit and cost of each intersection. Access is used to calculate the B/C ratios and to prioritize the proposed intersection improvements. The Access database is directly linked to GIS for graphical display.

INTERSECTIONS PROGRAM MASTER PLAN MAINTENANCE REQUIREMENTS

The County is responsible for maintaining and updating this program on a regular basis. The master plan and its process is a vital tool in assisting County

staff in everyday decision making such as responding to citizen calls and administrative referrals as well as assisting in roadway improvement planning efforts. The reliability of the intersections program master plan requires a commitment by the County to maintain this program through continuing data collection, hardware and software support, and the assignment of properly qualified staff.

Each year the intersections program priority list is used to select the intersection capital improvement projects that are funded for the upcoming fiscal year. As certain intersection improvement projects are funded each year, new intersection projects can be added to the master list to maintain an active list of approximately 70-100 intersections. A list of intersection candidates eligible for evaluation and possible selection for the priority list is maintained throughout the year. An intersection may be added to the candidate list based upon a number of factors. These factors may be as follows: high number of accidents; met signal warrants; a perception of operational problems by County personnel; citizen concerns; or as directed by a higher authority. The criteria for selecting new intersections from the candidates to compete on the priority list are based upon number of accidents or accident rate if possible. Once selected from the candidate list for prioritizing, the County must commit to providing the data collection as specified above in the Data Collection Requirements to incorporate the new intersections and prioritize them with the active list of remaining intersections.

Due to the changing rate of inflation, the unpredictability of land development and the dynamic nature of traffic patterns, the data used in calculating B/C changes constantly. For these reasons we cannot accurately predict future traffic conditions. We can attempt to compensate for such changes by applying linear growth factors The IPMIS program includes formulas to account for inflationary costs and traffic growth. As the data used for prioritizing intersections becomes dated, the legitimacy of its use decreases. Since it is not financially practical to perform data collection and re-evaluate each intersection annually, only the intersections that have experienced the greatest change in traffic conditions are re-evaluated.

The number of intersections on the priority list that can be updated is limited by the funds and manpower available to commit to the update process and analyze new candidate intersections. The cost of performing 8-hour turning movement counts at a minor intersection is $650 and $1300 for a major intersection. The time required to re-analyze and re-calculate the B/C is approximately 60 hours per intersection.

The determination of which intersections on the priority list should be re-evaluated is based upon traffic accident counts. The intersections experiencing

the highest percentage increase in reported accidents from the previous year are candidates for re-evaluation and the ones with the highest percentage increase should be re-evaluated. This can be done with little effort using the Magic program. The number of intersections to be re-evaluated is based upon the available budget and manpower after the new candidate intersections have been considered.

Each year as the governing agencies adopt their list of funded roadway and intersection improvement projects, the intersections program GIS must be updated accordingly to coordinate these efforts and avoid duplication or overlaps of projects.

INTERSECTION PROGRAM YEARLY ACTIVITIES

The following annual procedures are necessary to maintain and update the intersections program:

Develop fiscal year priority list:

Each year the CIP program requires a list of intersection improvement projects to be funded for the following fiscal year. This involves taking the intersections that have the highest B/C ratio and moving them from the master list to the CIP. This allows additional intersections to be added to the intersections program.

Keep current list of candidate intersections:

With the annual adoption of certain intersection projects to the CIP, other candidate intersection projects are considered for the intersections program. The program engineer maintains a list of candidates including any backup data.

Choose new candidate intersections:

On April 1 of each year the Intersections Program Master Plan Update is started. The engineer with a committee determines from the list of candidate intersections which intersections are to be chosen to compete against the current remaining master list of intersection projects. At this time any existing intersections in the program needing re-evaluation is done based upon an increase in annual accident reports. Traffic signal projects that meet warrant safety study requirements are also added to the list for review at this time.

Obtain Accident Reports:

Traffic accident reports for the new candidate intersections and any intersections needing to be re-analyzed and signal warrant intersections are acquired.

Create/Update collision diagrams:

Based upon a review of the accident reports from the HCSO & FHP, collision diagrams are created.

Traffic count data collection:
The required 8-hour turning movement counts for the selected intersections are performed.

Field Review/accident evaluation:
Once the collision diagrams and the traffic counts have been completed for a particular intersection, a traffic engineer conducts a field review to evaluate the need for safety or delay improvements.

Capacity Analyses/Scope Development:
The capacity analysis is performed based upon traffic projections to determine the geometry requirements. This establishes the scope of the new intersection projects. These proposed scopes are reviewed with the Traffic Services Division.

R/W Estimates from Real Estate:
The engineer submits scaled drawings of the proposed intersection improvements to the real estate department for their use in estimating land acquisition and business damage costs. This includes estimated stormwater pond needs.

Reprioritize Intersection List (B/C):
After the benefits and costs are determined for the new intersections, the data is entered and the master list reprioritized.

Develop next fiscal year Priority List:
Based upon the available funding for intersections and the Traffic Signal Program, the intersections with the highest B/C ratio are entered into the CIP. The proposed intersection improvement projects are submitted to the BOCC in September of each year.

IPMIS REQUIREMENTS

Business Problem or Need

Hillsborough County's Intersections Improvement Program requires systems for managing and reporting comprehensive countywide program applications for the County's 14,000 intersections, including creating and updating the Intersection Master Plan. The managing systems have been coined the "Intersection Program Management Information Systems" (IPMIS).

The Public Works Department requires County computer resources to operate, maintain and update this system. The system is a tool that is used to develop and update the priority list ranking for proposing improvements to particular

intersections. The priority list, complete with benefit/cost ratio, estimated improvement costs and benefit dollar values, are used to propose intersection candidates for the annual Capital Improvement Program and potential projects as new funding may become available.

Manpower Needs and Capability

One stand alone computer system is used for running the IPMIS software and its associated components It is installed and being used by the Public Works Department, Design and Engineering Support Section. The Intersections Program Engineer uses this system. The IPMIS databases and systems are accessible to the personnel of the Public Works Department via the network server for read only and to produce reports.