ENTRA
CONSULTANTS

City of Sudbury - Sudbury Transit

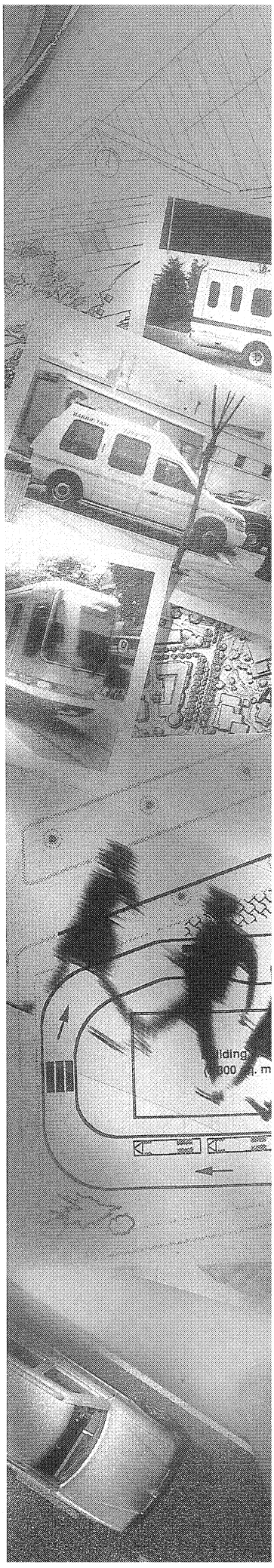
Ridership Growth Strategy and Asset Management Plan

Final Report

February 2006

in conjunction with

The Gooderham Group



Excellence in Transportation Planning

City of Sudbury

Sudbury Transit

Ridership Growth Strategy and Asset Management Plan

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Ridership Growth Strategy and Asset Management Plan

Executive Summary

The Ridership Growth Strategy and Asset Management Plan are required by the Ministry of Transportation as a condition of provincial gas tax funding. This plan must be approved in principle by City Council and submitted to the Ministry.

Beyond that formal requirement for funding, these plans are an opportunity for Sudbury Transit to plot a strategy for the future, to promote ridership growth in ways consistent with the objectives of the draft Official Plan and Transportation Master Plan, and help achieve the mobility objectives and needs of the Greater Sudbury Community.

The Fare Collection Feasibility Study, completed by The Gooderham Group as part of this overall review, examines the opportunities for new technology and business applications as Sudbury Transit moves towards the replacement of its fare collection equipment.

This study examines fare collection and revenue management from the perspective of Sudbury's needs, to ensure that potential vendors are meeting Sudbury's requirements, rather than Sudbury managing its needs and expectations to meet vendor requirements, The study outlines a comprehensive business case, comparing popular fare technologies, and recommends technology and business options for Sudbury Transit.

1. Ridership Growth Strategy

1.1 Service Standards

The study recommends a series of formal service standards to define transit's role in the community and give staff the necessary tools to design, measure and evaluate existing and new services in a consistent fashion that ensures the most effective and equitable use of resources.

1.1.1 Performance Standards

The study recommends one major performance standard, boardings per vehicle-hour, for urban and commuter routes, with a variation, cost per trip, for TransCab services. The standards also include a comprehensive analysis process to measure and evaluate routes and services with these standards, recommending thresholds for good, average and below-average performance to assist in identifying routes in need of improvement.

The study also recommends monitoring measures to assist staff and council in evaluating the progress of the system's on-going improvement. ENTRA recommends that Sudbury Transit adopt a minimum performance target of 30 passengers per capita, with medium-term target of 34 passengers per capita representing a 12 percent increase in performance.

Current revenue/cost ratio performance is approximately 40 percent, and service recommendations in this plan are designed to maintain or improve that level.

1.1.2 Service Design Standards

Service Design standards are recommended in the following areas, and described in detail in Chapter 2 of the report:

- service area;
- service hours;
- walking distance and stop spacing;
- fare structure;
- service frequency and passenger loading standards;
- schedule adherence;
- introduction of new services.

1.1.3 Service Review Process

The report also recommends a comprehensive review process, comprising regular reviews of individual routes, periodic reviews of requests and issues, an annual process for comprehensive review as input to the budgetting process, and the data collection requirements to support the plan.

1.2 Existing Service Review

The Existing Service Review examines the existing routes and applies the recommended service standards to identify necessary immediate improvements and opportunities for structural change in the short- and medium-term.

Recommended improvements include:

- elimination of 1 evening trip on Route 701 - Lively;
- elimination of 1 evening trip on Route 103 - Conistan;
- restructuring of Route 141/142 to a local route connecting at New Sudbury Centre ;

- close monitoring of Route 12 - McKim;
- service frequency increases in major corridors; and
- restructuring to provide more frequent direct service on routes in New Sudbury.

1.3 Ridership Growth Strategies

Based on a detailed review of travel patterns (described in Section 4) and the review of existing services, a series of general strategies were developed as a framework for short-term recommendations and development of longer term plans.

1.3.1 Urban Routes

Strategies for the Urban routes include the following:

- Introducing direct Non-Downtown Routes: connecting major origins and destination without directly serving the downtown transit center, to speed travel and reduce transfers. Major focus points include Cambrian College, New Sudbury Center, Millennium Center, Sudbury Regional Hospital and Laurentian University. Specifically, ENTRA recommends an overlay (additional) service combining Route 310 and 500. operating directly between Cambrian College and Laurentian University, and serving only New Sudbury Center, Millennium Center and the Sudbury Regional Health Center.
- Restructuring and additions to service in New Sudbury, including streamlining routes, and adding service in the major corridors. Specifically, ENTRA recommends elimination of minor diversion on some routes, and the introduction of a new service operating via Kingsway, Barrydowne, LaSalle and Paris (in both directions) to enhance service in these corridors.
- In the long-term, managing the evolution of the system to comprise 4 major corridor routes with high frequency, direct service, supported by local routes and complementary commuter services.

1.3.2 Commuter Routes

Strategies for Commuter Routes include the following.

- Supplement service to ensure a consistent block of no fewer than 9 trips per day on each route, comprising 3 inbound AM trip, on midday return trip, 3 outbound PM trips and one outbound evening trip. This basic block of routes should be considered the minimum service requirement for Commuter routes. The trip pattern of 9 trips is required to support service connections, and to ensure that passengers have the necessary travel choices and flexibility to confidently choose transit.
- Configure commuter routes and service levels to be able to provide capacity to support urban routes, where appropriate, within the urban area.

1.3.3 TransCab Services

TransCab services are a valuable tools for introducing and maintaining service in low demand and remote areas, but must be carefully considered before being used as a cost-saving measure to convert from an existing fixed route.

Performance measures specify thresholds for the conversion of TransCab service to fixed-route service (85 percent of the fixed route cost).

ENTRA also recommends the elimination of the $2.00 fare premium primarily as a ridership growth and mobility strategy, but also to maintain equable treatment of service areas.

1.3.4 Evening and Sunday Service

The existing service review identifies opportunities to improve evening and Sunday service, but not in the immediate timeframe. Ideally, the After-10 component of evening service should be eliminated, with reduced frequencies on the regular route system introduced.

Prior to this step, ENTRA recommends investigating partnership opportunities with local businesses that require evening service and are currently funding private options. Entering into service agreements with these companies can help to subsidize late evening service throughout the system, not only benefitting the specific businesses, but the community as a whole.

1.3.5 Post-Secondary U-Pass

A comprehensive analysis of student ridership and revenue was completed as part of this review and identified both the service and revenue requirements for the introduction of a universal pass at the three campuses. In this concept, under investigation by the students involved, post-secondary students at participating institutions would be required to purchase a reduced-price pass for the school year, in return for unlimited travel on the system.

The objective of this plan is to use the additional revenue from the student passes to fund additional service to support increased ridership, and remain revenue-neutral.

The study recommends a pass price of $25 per month, or $200 per school year for this pass (current price is $60 per month) and specific service increases to support and promote additional ridership.

Approval to proceed with the U-Pass concept must result from a student referendum, which may or may not be passed by the three institutions at the same time, if at all. Recommendations from this study assume an implementation date of September 2007 as the earliest opportunity.

1.3.6 Other Fare Strategies

Several fare strategies are recommended as ridership growth opportunities, with minor cost or revenue impact. Many of these and other fare strategies will be supported by the recommended fare collection technology.

TRANSFERABLE PASS

ENTRA recommends that Sudbury Transit convert its existing adult monthly pass to a transferable pass, permitting travel by family members or others when the principal rider does not require the pass. This will promote off-peak ridership, particularly in the evenings, with little loss of existing revenue. It is possible (though not assumed in the analysis) that increased pass sales could offset the small revenue loss. The transit industry generally is beginning to recognize the ridership benefits and low cost of this type of strategy.

OPEN TRANSFER

ENTRA recommends that Sudbury Transit adopt an open transfer policy, permitting travel anywhere on the system for a period of two hours from the time of the transfer issue. Similar to the transferable pass concept, this strategy can increase ridership, enhance mobility among at-risk populations, and improve the image of the system, at very low cost and loss of revenue. Costs for additional transfer printing will increase slightly, and some minor loss of initial revenue will occur. However, it is the experience of other systems (though not assumed in the financial plan) that increased ridership will offset the cost increase and revenue loss, providing a net gain to the system in addition to the ridership increase.

1.3.7 Technology Options

In the longer term, Sudbury Transit will be able to take advantage of a variety of maturing technology options to enhance transit operations and customer service, and increase ridership. This report recommends the first of those step in the recommendations for fare collection technology, as described in the feasibility study. That analysis demonstrates how technology options can contribute to the long-term health of the system, with reasonable cost-recovery periods, relying on only modest ridership gains to result from the introduction of the system

The same concept can be applied to other technologies, such as transit signal priority, automatic vehicle location and automatic passenger counting. Specific analysis of the feasibility of these options was beyond the scope of this study, but should be considered for detailed review in the future.

In the short-term, Sudbury should consider stand-alone implementations of transit signal priority at key bottleneck locations particularly exits from:

~ Downtown Transit Center;

~ New Sudbury Center; and

~ Millennium Center.

1.3.8 Other Features

ENTRA also recommends that Sudbury Transit:

~ invest in a new Rider's Guide, investigating opportunities for private partnerships available in the industry to produce a high quality guide; and

~ hire one additional staff member to assume responsibilities for planning/scheduling and marketing.

1.4 Short Term Service Components

In addition to the recommendations outlined in the previous section, ENTRA recommends a series of short-term service opportunities.

1.4.1 Frequency Improvements

In support of the Official Plan policy to enhance student mobility, and in conjunction with the proposed U-Pass introduction, ENTRA recommends service increases on:

- Route 500 to 10-minutes in peak periods
- Route 401 to 10-minutes in peak periods;
- Route 14 to 15-minutes in peak periods; and
- Route 501 to 15-minutes in peak periods.

1.4.2 New Service Opportunities

ENTRA recommends a pilot project to introduce service in the Hanmer area of Valley East, providing local access throughout the community with connections to the commuter service at Hanmer Mall. Hourly service should be introduced with a small bus, and monitored closely against the recommended service standards for new services. Depending on the results of this service, a similar service should be considered for Chelmsford.

Other service areas should be considered where commuter connections are available, and local service area populations are in the range of 8,000 to 10,000 people residents.

ENTRA also investigated the options for service to Greater Sudbury Airport, but cannot recommend this service in the short- or medium-term. However, the recommended service standards provide staff with the analysis framework to continue to monitor this and other service requests in the future.

1.5 Financial Plan

Table E-1 shows a summary of the proposed financial plan, based on the elements described in previous sections of this report. Explanation of the assumptions used are described in Section 7 of the report.

Table E-1
Financial Plan Summary

	2006	2007	2008	2009	2010
Existing Budget Provision (1)	**16,500,000**	**17,700,000**	**18,500,000**	**19,750,000**	**21,000,000**
Incremental Budget Provision(2):					
Existing Service Review	(45,000)	(45,000)	(45,000)	(45,000)	(45,000)
Urban Routes	-	1,200,000	1,750,000	1,750,000	1,750,000
Commuter Routes	40,000	40,000	40,000	40,000	40,000
New Service	-	-	275,000	275,000	275,000
TransCab Contract Additions	-	25,000	30,000	35,000	40,000
Frequency Increases	-	180,000	360,000	360,000	360,000
Smartcard System (3)	-	(5,000)	127,750	172,000	132,500
Staff Increases	30,000	60,000	60,000	60,000	60,000
Incremental Operating Cost	**25,000**	**1,455,000**	**2,597,750**	**2,647,000**	**2,612,500**
Total Gross Operating Provision	**16,525,000**	**19,155,000**	**21,097,750**	**22,397,000**	**23,612,500**
Less:					
Operating revenue					
Budgetted Revenue (1)	6,790,000	6,828,000	7,000,000	7,100,000	7,250,000
Transferable Pass	(45,000)	(45,000)	(45,000)	(45,000)	(45,000)
TransCab Premium	(35,000)	(35,000)	(35,000)	(35,000)	(35,000)
New TransCab Ridership	14,000	14,000	14,000	14,000	14,000
Revenue from New Service (4)	14,000	499,000	1,078,000	1,400,000	1,455,000
Upass(5)	-	375,000	700,000	750,000	800,000
Net Operating Revenue	**6,738,000**	**7,636,000**	**8,712,000**	**9,184,000**	**9,439,000**
	0.408	0.399	0.413	0.410	0.400
Net Operating Costs	**9,787,000**	**11,519,000**	**12,385,750**	**13,213,000**	**14,173,500**
Performance Measures					
Projected Ridership	4,253,000	4,763,000	5,453,000	5,738,000	5,876,000
Projected R/C	0.41	0.40	0.41	0.41	0.40
Projected Boardings per Vehicle hour	34	37	41	43	44
Projected Ridership per capita	26.9	30.0	34.1	35.8	36.4
Capital Costs					
Expansion	-	2,400,000	2,400,000	1,200,000	1,200,000
Replacement (6)	3,675,000	2,600,000	2,600,000	2,500,000	2,500,000
Refurbishing(6)	270,000	187,500	187,500	-	150,000
Fareboxes(7)	1,327,000	1,000,000		-	
Service Vehicles (6)	50,000	-	50,000	-	50,000
Vehicle Hoists	80,000				160,000
Wash Rack/Cleaning System (6)	-	150,000	-	-	-
New garage -2012 (8)	-	-	-	-	100,000
Shelters(9)	10,000	10,000	10,000	10,000	10,000
Terminal Upgrade(9)			250,000		
ITS systems(9)				500,000	500,000
Total Capital Costs	**5,412,000**	**6,347,500**	**5,497,500**	**4,210,000**	**4,670,000**
Transit Funding Sources					
Provincial Gas Tax Allocation (10)	(2,200,367)	(2,708,144)	(2,708,144)	(2,708,144)	(2,708,144)
Federal C48 funds	(675,000)	(675,000)	-	-	-
OTVP Capital Subsidy (11)	(1,102,500)	(780,000)	(780,000)	(750,000)	(750,000)
	-	-	-	-	-
Net Capital Offsets excluding reserves)	**(3,977,867)**	**(4,163,144)**	**(3,488,144)**	**(3,458,144)**	**(3,458,144)**
Net Capital Cost to be funded from reserves	**1,434,133**	**2,184,356**	**2,009,356**	**751,856**	**1,211,856**

Notes:
1. Based on 2005 actual and 2006 budget. Future years based on similar increase
2. All amounts carried forward to future years from first year of implementation
3. Based on Financial Analysis (Total Cash Flow) from Gooderham study
4. New service revenue based on reduced initial ridership, inc reasing over 2 years
5. Based on September 2007 implementation, $25 per student monthly, September-April
6. Based on current capital plan
7. Based on total capital cost from Gooderham study
8. Initial design cost allowance for new garage
9. Future allowance for unspecified improvements
10. 2008 and beyond based on 2007 amount
11. Provincial subsidy up to 33 percent available. Estimates based on 30 percent of vehicle replacement costs

2. Asset Management Plan

The Asset Management Plan of this review should be read in conjunction with the overall study report, since the Ridership Growth Strategy provides much of the rationale and context for the plan. Also, the financial plan required as part of the Asset Management Plan in incorporated into the information in Table E-1.

In summary, the Asset Management plan supports the current practice and plans of Sudbury Transit, adjusted to reflect the change in fleet requirements as a result of the ridership growth strategy. Generally, thins includes:

- maintaining the current policy to replace vehicles after 18 years for all vehicles purchased before 1995 and after 15 years for all newer vehicles;
- maintain a spare ratio of 20 percent, as long as the average age of the fleet exceed 8 years;
- reduce spare ratio to approximately 15 percent to 18 percent, once the average age reaches the target range of 7.5 years;
- replace the existing fare collection system according to the recommendations of the fare collection feasibility study;
- replace major equipment, including hoists, wash rack and interior cleaning system according to existing plans, as outlined in the financial plan
- replace the entire storage and maintenance facility in 2012; and
- maintain the existing effective preventive maintenance and safety program.

3. Fare Collection Feasibility Study

3.1 Study Process

The study process comprised the following steps:

1. Assessment needs of current fare collection system and new system requirements
2. Establish technical and functional requirements for new fare collection system
3. Determine general farebox specifications and alternative electronic fare media to be assessed
4. Assess financial and non-financial costs and benefits of each alternative fare media
5. Recommend fare media technology selection

3.2 Conclusions

The study determined that the general farebox specifications must include the ability to:

- Accept fare payment by coins and banknotes, magnetic stripe and contactless smart cards
- Issue and accept magnetic stripe based transfers

and the study recommended that the following two fare media alternatives be considered further:

1. Magnetic stripe based tickets, passes and transfers, and
2. Contactless smart card based tickets and passes and magnetic stripe based transfers

3.3 Recommendations

Based on a detailed business case analysis of these two fare media alternatives, the study recommended that Sudbury Transit pursue the following strategy with respect to the procurement of a new fare collection system:

1. Purchase new validating fareboxes for its bus fleet and related garage equipment and systems with the following minimum functionality:
    a. Accept fare payment by coins, banknotes, and contactless smart cards,
    b. Issue and accept (read) magnetic transfers,
    c. Upload/download fare transaction data wirelessly c/w garage base station,
    d. Secure the collection of cash with through-the-wall vault receivers, and
    e. Manage the farebox system configuration, operation and report generation.
2. Implement smart cards for transit fare payment, initially replacing all prepaid tickets and passes and then offering payment from an electronic purse on the card. It is recommended that the City issue more expensive dual interface contactless/contact or 'combi' smart cards with a view to simplifying the required POS reload infrastructure and to accommodating future municipal and other uses of the card. The analysis and comparison between magnetic and smart card ticketing technologies clearly indicates that smart card technology is the preferred ticketing alternative for Sudbury Transit for the several compelling reasons.
    a. Overwhelmingly advantageous non-financial benefits
    b. A more favourable 10-Year NPV for the complete system,
    c. A positive 10-Year NPV for the smart card ticketing technology addition to the base farebox investment, whereas the corresponding 10-Year NPV for magnetics is negative,
    d. If the capital costs are amortized appropriately, Sudbury Transit needs only to increase its ridership by less than 3% to be able to break even on its investment.
3. Progressively use these smart cards for other municipal services as both a secure method of validating qualified residents' entitlement to access municipal services and as a method of paying for municipal services such as parking or recreation fees from the e-purse on the card as an integral part of the City's progressive 'mysudbury.ca' initiative.

4. Progressively use smart cards for selected non-municipal services through two strategies:

    a. Consider adding selected non-municipal applications that would enhance the perceived value of the card to passengers/citizens and support cross incentives to drive transit ridership. These could include a merchant loyalty points program that provides enhanced benefits for regular transit riders or shopping discounts based on displaying the card. It could include both frequent rider and frequent shopper loyalty schemes. It could include extensions to the U-Pass and employer E-Pass program that could be part of the card.

    b. Consider enabling other applications to 'rent' space on the Sudbury Card to install and operate their application, with appropriately secure firewalls. Examples would include campus applications for physical and logical access and e-purse payment.

City of Sudbury

Sudbury Transit

Ridership Growth Strategy and Asset Management Plan

1. Introduction

1.1 Sudbury Transit Context

Sudbury Transit services the communities of Greater Sudbury, with a total population of 150,000 and a service area population of approximately 130,000. The former City of Sudbury, where most of the transit services are focussed, makes up about 65 percent of the service area population, or about 85,000 people.

Following amalgamation in 2001, Sudbury population jumped from 106,000 to 130,000 in the transit service area, and Sudbury responded with increases in service, particularly the addition of commuter routes to service the small urban communities outside the former City. Since that time, population in the region has remained quite stable.

Despite this stability in population, Sudbury Transit ridership has continued to grow, increasing the ridership per capita from 27.1 to more than 28.5, and increasing ridership per hour by a similar percentage.

These statistics, along with the success of the commuter rotes serving the smaller urban communities, points to the strength of the Sudbury Transit environment, a base on which to establish a Ridership Growth Strategy for the future.

1.2 Official Plan Objectives

One of the objectives of this Ridership Growth Strategy is to support the principles and objectives of the draft Official Plan (OP), as well as to build on the transit objectives contained within the plan. As noted in the draft Official Plan, Greater Sudbury takes pride in being a green community and a world leader in environmental protection. It is also a healthy and sustainable community, recognizing that quality of life is directly related to environmental, economic and social factors.

Both of these characteristics speak directly to transit-supportive principles. Specific transportation objectives in the draft Official Plan include:

~ provide affordable, convenient and reliable public transit access;

- promote all travel modes; and
- support programs that aim to reduce the environmental impacts of certain modes of transportation.

The draft Official plan specifically outlines support for transit programs that:

- improve fare collection methods;
- promote transit ridership through transit passes and other tools;
- develop services and fares that attract students;
- expand surface transit routes to meet demand; and
- improve customer amenities.

Each of these objectives is addressed within the Ridership Growth Strategy.

1.3 Report Format

This report takes a comprehensive view of transit services in Sudbury to develop a Ridership growth Strategy.

Section 2: Service Standards, addresses standards and guidelines for the development and design of transit services.

Section 3: Existing Service Review, examines the existing service according to the recommended standards.

Section 4: Travel Patterns, - outlines the overall travel patterns in Sudbury, and suggests an idealized transit network to support them

Section 5: Ridership Growth Strategies, outlines options for Sudbury Transit to consider as part of its Ridership Growth Strategy and in support of the objectives of the draft Official Plan., including recommendations for new fare collection technology.

Section 6: Short-Term Service Components, outlines short-term recommendations for service changes to address immediate issues, and promote ridership growth.

Section 7: Preferred Strategy and Recommendations, includes the overall capital and operating cost summary.

Section 8: Asset Management Plan, provides details the capital plan to support the Ridership Growth Strategy.

A number of technical materials are included in the Appendices, including:

- Fare Collection Feasibility Study:
  - Functional analysis and needs assessment;
  - Technical specifications; and
  - fare collection business case.
- Travel Patterns Analysis
- Student U—Pass Analysis Details

2. Service Standards Review

One of the first objectives of this review was to develop and introduce comprehensive standards for Sudbury Transit. Like many communities, Sudbury Transit has no formally approved standards, but a number of informal guidelines that inform the service design process.

Service standards define the level of service that will be provided as determined by the community. In essence, they define transit's role within the community, and often define the transit system itself. They can be quite varied, and can be global or very detailed. Many systems define their service standards in terms of two types of service.

The ***base service***: the minimum amount of service that is provided by policy throughout the community, regardless of the level of ridership. This base service is the "universal" service, which provides access and mobility to the residents of the community. Base service is usually expressed in terms of coverage, hours of service, frequency of service, and travel times.

The ***customer-based service***: the amount of service that is provided above the base service where ridership is sufficiently high to warrant and support additional service. This service is usually provided through higher frequencies, where the return on investment is significantly higher than the return experienced in the base service. These services will be required to meet economic performance targets, as established by City Council on a regular basis.

Within both levels of service (either separately or combined) are several factors such as coverage, frequency of service, reliability, performance indicators, ridership thresholds, and such. There may be standards regarding how or when services are introduced into new subdivisions, as well as how services evolve from peak service only to full service. There are also customer expectations regarding vehicle loading, customer amenities in the vehicle, at the stops and at the terminals.

Service standards are very useful tools in defining transit's role in the community as well as the level of service transit customers can expect. It is important that service standards be sufficiently detailed so that they can be measured and applied consistently. Service standards must also be flexible enough so transit officials are not so constrained that they cannot consider various service options that may be more effective or cost efficient, or which may better satisfy customer needs or City objectives. To allow flexibility, yet ensure that standards are consistently applied, ENTRA recommends a standards format that requires action when standards are not met, yet allows flexibility in what action is taken.

2.1 Performance Standards

Performance standards usually establish benchmarks for the overall assessment of the system in a few key areas that are important to the community. Typically, these include measures of:

- overall financial performance, such as revenue/cost ratio;
- cost-effectiveness, such as cost per passenger;
- service effectiveness, such as passengers per hour; and
- cost-efficiency, such as operating cost per hour.

In this evaluation, the performance of Sudbury Transit is compared to that of its population group among Canadian Urban Transit Association members, based on 2004 reported data.. However, since Sudbury's total population (157,000 in 2004) and service area population (127,000 in 2004) are near the threshold of the larger population group, (150,000 to 400,000), comparisons are also made to the average performance of that group.

In some specific areas, separate standards are recommended for Urban routes and Commuter routes. These routes refer to those serving the main urban area of the City and the suburban Commuter areas respectively.

2.1.1 System-wide Performance Targets

FINANCIAL PERFORMANCE - REVENUE/COST RATIO

Recently, the financial performance of Sudbury Transit service has been in the 50 percent range, higher than the average for Sudbury's population group and at the average of the larger group.

Currently, Sudbury Transit does not have a formal revenue/cost (R/C) target, and ENTRA does not recommend that Sudbury adopt a specific target as part of this plan. Rather, ENTRA recommends that Sudbury Transit use R/C performance as one monitoring measure to gauge performance, and assist staff and Council in making decisions regarding investment levels.

COST-EFFECTIVENESS: - COST PER PASSENGER

Cost per passenger is not recommended as a performance measure, since it is affected by inflation. While the overall objective is to reduce cost per passenger, inflationary effects on costs can reduce or eliminate evidence of progress in this measure.

SERVICE UTILIZATION - BOARDINGS PER VEHICLE-HOUR

Sudbury Transit's historic performance in this measure has shown a trend of consistent increase as ridership has increased. An increase in service in 2004 of almost 10 percent stalled this trend, with performance remaining level between 2003 and 2004. This is very common, since ridership increases tend to follow service increases, with a delay of up to one year. In 2005 calculations, performance passengers per hour and boardings per hour are up more than 10 percent.

Boardings per vehicle-hour is a measure of effectiveness that can be directly affected by service and routing decisions, and be improved without necessarily adding service.

Assessment based on 2005 data shows this performance level to be approximately 38 boardings per vehicle-hour (excluding express and TransCab routes). On this basis, ENTRA recommends that Sudbury Transit adopt a minimum average performance level of 35 boarding per vehicle per hour, with a target of 40 boardings per hour over the medium term.

This means that when performance consistently meets or exceeds the target, the minimum and target values should be adjusted upwards to ensure continuous quality improvement.

SERVICE UTILIZATION - PASSENGERS PER CAPITA

Sudbury Transit's historic performance in this measure is approximately 25 to 30 passengers per capita, with 2004 performance just less than 31 passengers per capita. Again, this puts Sudbury Transit higher than its population group average and higher than almost every system in that group. The average performance of the larger population group is still about 30 percent higher

than Sudbury Transit's level, though this is to be expected since the passenger per capita statistic tends to increase with population size.

Passengers per capita is another measure of effectiveness that can be directly affected by service and routing decisions, and be improved without necessarily adding service.

ENTRA recommends that Sudbury Transit adopt a minimum performance target of 30 passengers per capita, with medium-term target of 34 passengers per capita representing a 12 percent increase in performance.

2.1.2 Route Level Performance Targets

For route-level assessment, the recommended performance measure is boardings per vehicle-hour. It is important to assess boardings, or unlinked trips, so that routes that perform a high ratio transfer role are properly credited for that performance.

The boardings per vehicle-hour measure gives a standard measurement against which to assess new services and provides the basis for the assessment approach used in the short-term analysis to identify routes for remedial action. Existing routes that perform higher than the system average contribute to raising that average and should be maintained. New proposals with estimated performance in this range can be recommended, subject to budget approval.

Routes that have performance lower than the system average - the 'below average' routes are easily flagged and subjected to detailed assessment to determine if there are remedial measures which can improve the performance of the route.

The third level of routes is the small group of routes with boardings per hour significantly less than the system average. These routes have a negative influence on the average system performance and should be examined to identify a major change that will improve performance. For routine route assessments, such as those completed for this review and described in the Existing Service review section, this threshold is set at one-third the minimum system average. Each time period should be examined separately, with its own set of performance thresholds. These thresholds are based on existing performance, with the goal of continuous improvement set to improve the level of each performance indicator over that of the previous year.

Table 1 shows the recommended average and minimum thresholds for route performance, based on industry comparisons and the 2005 route performance. This analysis was based on May and September ridership, with adjustments for lower summer ridership to establish the appropriate targets.

When assessing route performance, the average of all routes in each time period and overall must be equal to or greater than the minimum average performance threshold, and no single route's performance should be less than the required minimum threshold. Average annual ridership for each route and time period should be the basis for the assessment. If non-summer monthly ridership is used, these targets should be adjusted about 12 percent higher.

Conducting this assessment on a route-level basis requires reliable data collection methods and staff resources. Section 5 of this report outlines the fare technology recommendations and staffing requirements appropriate to achieve this important measurement and monitoring function.,

Table 1

Route-Level Performance Targets

Time Periods	Minimum Average Performance Target	Minimum Performance Threshold
Urban routes		
Weekday Peaks	45	15
Weekday Midday	40	13
Weekday evening	18	6
Saturday	22	7
Sunday/After 10	22	7
Total	30	10
Commuter Routes		
Weekday Peaks	26	10
Weekday Midday	18	6
Weekday Evening	9	5
Saturday	13	5
Sunday/After 10	10	5
Total	18	6

Note that minimum performance is limited to 5 bph. Below this level, alternative service delivery methods such as TransCab should be considered.

2.1.3 TransCab Services

Regular route services should be considered for conversion to TransCab service if the route's performance consistently falls below 5 boardings per hour. Conversely, a TransCab area should be considered for regular route service when the cost of the TransCab contract reaches approximately 85 percent of providing the minimum service levels with regular fixed routes. Minimum service levels are defined as the basic 9-trip block prescribed for commuter routes.

TransCab services are an excellent way of introducing service into low-demand areas in advance of increasing ridership to support fixed route service, or as a way of serving consistently low-demand areas, where no other service has been provided.

Compared to fixed route service however, this type of service is often not preferred by customers, and careful consideration should be given to converting a fixed route service to TransCab in response to low or declining ridership, since further ridership decline may result.

Generally, TransCab service should be introduced instead of or as a precursor to transit in low demand areas, or in areas where conventional or small transit vehicles are unable to navigate. Minimum threshold is measured in terms of cost per trip, and set at 3 times the average for all TransCab services.

The decision to convert to fixed route is even simpler. Calculation of the cost of extending the connecting routes to serve the TransCab areas is a straightforward issue for staff. Once TransCab change to the contractor reach approximately 85 percent of this amount, the service should be

converted. The added attraction of fixed route service, without the need to call for transportation, will result in a small ridership increase that will compensate for the difference.

2.1.4 Applying Route Performance Standards – An Example

The Review of Existing Services assessment applies these standards in an evaluation framework that compares the performance of each route against each other and the required targets. For example, the average performance of all Urban routes in the Sudbury Transit system in the midday (based on September 2005 data) is 51.2 boarding per vehicle-hour (bph), which is greater than the required minimum average of 45 bph. The lowest performing City route in the midday is Route 12-McKim, with a performance of 15.6 bph. This level is greater than the minimum performance level (13 bph), so the standards indicate that no specific action is required.

However, under the continuous quality improvement guidelines outlined in the existing services review, this route should be reviewed, based on its relative performance to the existing City route average. At 15.6 bph, the performance of Route 12 is less than one-third the existing City route average for the midday, and therefore are identified as the routes where improvement efforts should focus.

As another example, Route 301-LaSalle-Maidson has a bph measure over more than 100, greater than 2 times the required average and 75 percent greater than the City route average for the AM Peak. At this level, additional service should be considered to build on the strength of this service and provide an improved quality of ride during crowded periods.

As a further example, Route 12 McKim in the evening shows a performance level of only 2.7 bph. At this level, serious consideration should be given to modifying this route to improve this performance level.

2.2 Service Design Standards

2.2.1 General

These standards apply to general system design. In some cases, standards are discussed that are not recommended. This information is provided to enhance comparisons to standards in other systems.

2.2.2 Service Area

A Service Area standard assists staff and public requesting service to understand the practical limits of service. This standard should be integrated with the service coverage standards. This allows Sudbury Transit to apply service warrants to all areas, without a blanket expectation of service. References to specific types and focus of service are not appropriate in this standard.

PROPOSED STANDARD

The Transit system shall serve the urbanized areas of Greater Sudbury, including the urban Commuter areas, subject to the provisions of the approved service design standards.

PERFORMANCE

Sudbury Transit's services generally conform to this standard.

2.2.3 Service Hours

Many systems have service hour standards that include specific operating hours for weekdays, and weekends. This type of standard is only recommended for base service, since the extent of service hours is better determined by economic performance. To ensure continuity of service, and a base level of hours, a minimum standard is recommended, with economic performance governing service outside these times.

PROPOSED STANDARD

Service shall be provided on all Urban routes generally between the hours of 7 am and 10 pm on all service days. Service hours will be adjusted to ensure the economic performance of first and last trips within the overall performance standards, according to the approved first/last trip performance standard and with consideration for transfer requirements and other customer service policies.

Service on Commuter routes shall include no fewer than 9 daily trips, with a minimum of 3 inbound trips in the AM peak, 3 outbound trips in the PM peak, 1 midday inbound and outbound trip and 1 evening outbound trip. (Normally, these trips will need to be return trips, but for the purposes of the standards, only the peak direction trips are required.)

The first AM trip on these routes should be designed to arrive at its City terminal point no later than 8:00am, the last PM trip should be designed to leave the City terminal point no earlier than7:00pm.

PERFORMANCE

Because of the flexibility of this standard, all urban routes currently conform. Enhancements to Commuter routes to bring them closer to or in conformance with this standard are recommended.

2.2.4 Transfers

Many systems specify a design standard with respect to minimizing transfers in the system. While not inappropriate as a design target, detailing specific transfer rates and waiting times unnecessarily limits flexibility.

PROPOSED STANDARD

None

2.2.5 Walking Distance

PROPOSED STANDARD

Areas within urban communities will be considered for transit service if they are beyond a 400-metre walk from existing service.

Minimum stop spacing shall be 250 metres, unless otherwise by reason of safety or in areas of high demand. A bus stop will only be implemented where it can provide a safe point of entry and exit, and where it can be well delineated and maintained. Where appropriate and possible, shelters may be provided.

PERFORMANCE

Sudbury Transit's current stop inventory generally adheres to this standard.

2.2.6 Fare Structure

Fares are an important part of a transit systems marketing strategy and both ridership and revenue are directly tied to fares. Fare increases need to be carefully considered, not just for the revenue implications, but also for the impact on ridership within individual markets. Across-the board fare increase should be avoided, unless there is a specific related strategic objective to doing so.

With electronic fare payment a likelihood in the near future, a diverse range of fare strategies will become available, and Sudbury Transit should use this flexibility to its full advantage to specifically tailor fares and incentive to specific market, to maximize ridership and revenue, not just one at the expense of the other.

PROPOSED STANDARD

Fare structure should offer an economic incentive for use through discounts fares with tickets, passes, or smartcard applications. The review of the fare structure shall be considered annually. Adequate lead-time will be provided in advance of introducing a fare increase to allow public notification.

Exact cash fare system is maintained for reasons of security and simplicity of operation.

Fare structures are designed to encourage efficient and cost-effective use of the system through volume discounts.

2.2.7 Payment of Fare

PROPOSED STANDARD

Passengers are required to pay the appropriate fare or present valid fare media when boarding the bus. Proper identification must be presented upon request when paying a concession fare. Drivers do not carry change; passengers must present exact fare and proper identification for concession fares.

2.2.8 System Equipment

PROPOSED STANDARD

Sudbury Transit is committed to expanding accessibility of its fleet for persons with disabilities. Until the objective of 100 percent low-floor accessibility is achieved, all purchases of new bus equipment shall replace high-floor buses with low-floor buses. Where necessary to meet short-term demands, purchase of used, non-accessible buses shall be permitted.

Daily operation shall be designed to maximize the proportion of the service provided by low-floor buses. Low-floor buses shall be deployed within the route structure to maximize the number of major origin/destinations served by consistent low-floor services.

All passenger buses will be maintained to comply with all current and legislative safety standards.

All passenger buses will be purchased and utilized on the basis of economic advantage with respect to original capital cost, operating expenditures, ease of maintenance, useful life and estimated salvage value upon disposal.

All passenger buses will be purchased and maintained such that their aesthetic appeal will

encourage public use and will conform to reasonable standards expected in the community.

All buses will be operated and maintained to ensure noise, emissions, oil leaks and road damage are minimized.

2.2.9 Route Performance

For route analysis, a consistent effectiveness performance standard is proposed, boardings per vehicle-hour, which more accurately reflects the role routes may play in carrying transfer passengers. This measure counts all boarding passengers, including both fare-paying and transferring passengers. The measure can be calculated for the system as a whole, for individual routes, or even for portions of routes.

PROPOSED STANDARD

Individual routes whose performance is below the minimum boardings per vehicle-hour shall be reviewed to identify changes that may further improve the route's economic performance.

2.2.10 Schedule Adherence

PROPOSED STANDARD

No bus shall leave earlier than its designated time of departure. At least 90 percent of the buses should be "on time" within three minutes late of schedule.

PERFORMANCE

Detailed data to assess this standard are not available, but anecdotal information and observations indicate that overall travel times are appropriate. Specific trips on busy routes, particularly in peak periods, can operate outside the schedule adherence limits, but likely comprise less than 10 percent of trips. Section 6 of this report identifies specific opportunities to improve these problem areas.

2.2.11 New Services

SERVICE IN NEW AREAS

Services introduced in new areas not previously served should be guaranteed for a minimum 12 months of operation to ensure adequate time for travel patterns to adjust and for 4-season ridership patterns to be accounted. At the end of the 12 months, the service must meet the minimum performance thresholds required for its class of service.

Within this trial period, interim targets are set to ensure that a service that is clearly not capable of meeting the ultimate targets is identified as early as possible. Monitoring at 3, 6 and 9 months is completed to ensure that the new service is trending towards the appropriate standard. Targets for these interim periods are set at 25 percent, 50 percent and 75 percent of the ultimate target, respectively. If the performance at the end of each period has not reached at least 75 percent of the target value, the route should be re-examined to identify potential changes to improve its performance. If the same standard is not met in the next period, the changes should be recommended.

SERVICE IN NEW OPERATING PERIODS

Routes that introduce service in new operating periods where routes already exist, or modify the

existing route are subject to similar evaluation, but over a shorter 6-month period. If the service change is substantial, staff may recommend a longer trial period at the service introduction stage. Interim targets are established at 2 months and 4 months, with target levels of 33 percent and 66 percent of the ultimate target.

2.2.12 Vehicle Loading

PROPOSED STANDARD - URBAN

The number of buses required for a route shall be determined as follows:

- maximum route loading will not exceed 150 percent of seated capacity per bus on average; and
- during weekends and evenings, minimum route loading will not be less than an average of 10 passengers per bus per revenue hour.

PROPOSED STANDARD – COMMUTER

For Commuter routes, service levels shall be adjusted to ensure that, on average, the number of passengers does not exceed 130 percent of the seats available, within the commuter portion of the route (outside the major urban area) This slightly higher standard recognizes the comfort needs of passengers with buses operating at higher speed along some portions of these routes.

2.2.13 Frequency Of Service

Frequency of service standards indicate to the public the level of service that can be expected in each period of service, and set the standard for economic analysis by staff.

PROPOSED STANDARD - URBAN

Service shall be provided on all regular route services at a minimum frequency of 60 minutes during all periods on weekdays, subject to meeting the required economic performance targets.

PROPOSED STANDARD – COMMUTER

Service shall be provided on all commuter routes to provide at least 9 trips per weekday, comprising 3 am peak inbound trips and 3 PM outbound trips, plus one trip in each direction in the midday and one outbound trip later in the PM.

PERFORMANCE

Currently, all Sudbury Transit urban routes meet the urban standard services. For commuter routes, all routes meet the minimum number of trips requirement, but the distribution of trips on some routes should be adjusted to provide more AM inbound trips to support the employment and student market.

2.3 Service Review Process

2.3.1 Regular Service Reviews

Regular service reviews are conducted on an on-going basis to ensure the most effective allocation of resources to individual routes. Each route is assessed to ensure the adequacy of its operation

against several standards including adequate frequency in all periods, appropriateness of start and finish times, adequate safety and other factors. Service change proposals can be submitted to the periodic review process or the annual review process, depending on the magnitude of the proposed changes. Ideally, routes would be analyzed at regular intervals. Given Sudbury Transit's size and level of operation, a review of each should occur at least once every two years. New routes or routes serving rapidly changing areas may require more frequent monitoring.

2.3.2 Periodic Service Reviews

Periodic service reviews are conducted on an ad hoc basis. Routes are assessed in response to customers' service requests or by staff as part of the on-going monitoring process. Service requests can fall into one or more of several categories, as described in the following sections. Each proposal is first assessed a set of screening standards to ensure adherence to minimum operating standards then assessed for its economic performance. If an acceptable proposal does not require capital budget and there is sufficient operating budget available, it can be implemented in the next service period. If the proposal requires additional vehicles, or there is insufficient operating budget for implementation, it is reviewed further in the Annual Service Review and compared against other proposals to ensure it is the most effective use of resources.

NEW ROUTES OR ROUTE CHANGES

Routing proposals are developed on the basis of the individual request and must meet four principal routing criteria:

- routes must be safe and operationally feasible;
- there should be no major deviation of a corridor service, except at the ends of routes;
- the route should serve an area not already served; and
- there should be no avoidable duplication of service.

If any of these criteria cannot be met, the proposal should be reconsidered. If it passes this initial screen, the proposal should be further assessed to ensure that it has a positive net benefit, that is, that more riders benefit from the change than those that are inconvenienced. Finally, the additional cost of the new route, route portion or routing change and the economic performance are calculated. If the economic performance is above average, the change can be implemented, subject to budget availability.

ADDITIONAL PERIODS OF SERVICE

If a service is not operated in all periods, additional periods of service such as Saturday evenings or Sunday, are assessed for their economic performance only, assuming that the routing has already met the minimum operational standards during the current periods of service.

If the economic assessment shows the economic performance for the period in question to be 'above average', service can be implemented subject to budget availability. If the assessment is 'below average', the service proposal should be referred to the Annual Service Review.

Modified routing proposals can be considered for additional periods of service to improve economic performance or ridership, provided they conform to the operation standards described in the assessment of new or revised routes.

EARLIER OR LATER TRIPS

Routes are considered for earlier or later trips based on the economic performance of the existing first or last trip. This assessment compares the existing trip against three warrants:

- no existing service alternative;
- boardings per vehicle-hour equal to or better than 50 percent of the all day route average; and
- 25 percent of seated load at the peak point of the trip.

Additional trips can be considered outside of these warrants if specific information is available to indicate that a different trip time would accommodate new demand, such as a shift start or finish time for a major employer. In these cases, consideration should first be given to adjusting first or last trip times, before adding a new trip.

IMPROVED FREQUENCY OF SERVICE

The need for improved frequency is assessed on the basis of passenger loads, and confirmation from field observation. Part of this assessment includes consideration of assigning larger 40-foot vehicles to routes where smaller vehicles are in use, to provide necessary capacity.

SPECIAL SERVICES

Special services, by definition, are not easily assessed within the Service Review framework. These could include requests for seasonal services, special events, or premium fare services. Each of these requests is assessed on an individual basis.

OTHERS

Other requests, which do not fall into any of the previous categories, are also assessed on an individual basis. These are often non-service related, and may include requests for such things as fare concessions or special programs.

2.3.3 Annual Service Review

The Annual Service Review comprises an overall assessment of service proposals that have been deferred from the other review processes throughout the year or major proposals developed by staff or requested by others.

Each route is assessed in terms of its:

- ridership potential;
- contribution to economic performance or other targets; and
- cost.

Measurements in each area are made and scored according to a weighted ranking system. All proposals are considered together so that an effective priority list of projects can be considered. Annual budget availability is used to determine the number of proposals from the priorities that are recommended for implementation.

2.3.4 Data Collection Requirements

The cornerstone of the service review process is a comprehensive data collection program

including data from both Sudbury Transit's operation and other elements of the transportation system. Much of the necessary day-to-day data can be provided by the recommended fare collection system, and these data will be invaluable in solving immediate issues, and addressing on-going planning issues to promote ridership growth. In addition to those regular daily data, Sudbury Transit should consider a supplemental data collection program to provide more specific and detailed data with respect to travel patterns to assist in longer-term planning,

On/Off Counts

Sudbury Transit's fareboxes currently record the number of passengers by time of day. This is an effective source of data that can be used for overall route and system performance assessment. Additional detailed data collection is necessary to examine specific portions of routes.

An on-off count records the number of passengers boarding and alighting at each stop, along with supporting data such as time of day, arrival time at control points, and exceptional circumstances. Full on-off counts should be conducted on each route, including weekdays, Saturdays and Sundays (if applicable), on an on-going basis every two years to conform to the Regular Service Review. Regular counts should be conducted between September and May. Special summer counts should be conducted on routes subject to seasonal variation and as conditions warrant. On-board riders should conduct these regular counts. After initial set-up costs, the approximate cost of a full riding count is approximately $15,000.

Standing Counts

Standing counts are supplementary counts taken by an individual 'standing' at a single point along the route. The count records route and run numbers, scheduled and actual arrival times, and arrival and departure loads. Standing counts are typically conducted at the stop identified as the peak point along the route but can also be completed at other points to meet specific needs.

Contracted staff or light-duty operators can complete standing counts. The cost of a standing count at any location is approximately $500.

Transfer Trace

Transfer trace information is can be collected by drivers retaining transfers for a specific period of time and analyzing the patterns from those transfers. If conducted by drivers, the costs of a transfer trace are limited to the assessment costs, which could be approximately $2,500.

Data Collection Cost Summary

Total costs for the recommended data collection program are approximately $10,000 annually.

3. Existing Services Review

3.1 Background

This review of assessment of existing routes and short-term changes and adjustments is based on September 2005 monthly ridership data provided by Sudbury Transit and revenue vehicle hours estimated from Transit Travel Guide dated August 2005 and current website data. The purpose of this review is to identify strengths and weaknesses in the existing system, and identify potential for short-term changes and adjustments that can improve the effectiveness and efficiency of the existing system.

Consistent with the recommended service standards, boardings per vehicle-hour is used as the main performance indicator to conduct this review. The performances of the routes for different time periods of the day were also reviewed to further assist identifying potential short-term improvements.

3.1.1 Methodology

For the purpose of this service review, ENTRA developed performance benchmarks for the entire system and then identified each route as good (above the average boardings per vehicle-hour), average (average to one-third of the average) and below-average (below one-third of the average).

The average boardings per vehicle-hour of all routes was calculated and used as the benchmark for the review. Routes were assessed individually against the benchmark and classified to each category of performers. Performance for different service periods and route type were considered as well during the review process since data by the time periods is available.

Details of this assessment are shown in table 1. The table represents the September 2005 monthly ridership and estimated revenue vehicle hours. The latest available boarding/revenue passengers by the time of the day (September 2005) were used for all routes. Revenue vehicle hours for each operating period of each route were estimated based on the existing schedule in the latest Transit Travel Guide obtained from Sudbury Transit.

Boardings per vehicle-hour were then calculated for each route for each operating period of weekdays, Saturdays and Sundays as well as the average of the entire system. Poor performers were identified and possible remedial actions were recommended based on the review of each specific below-average performer against the benchmarks. The colored column in the table represents the performance indicator of boardings per vehicle-hour. For this performance indicator, each route was classified into one of three categories:

- Good performers (green), with performance at or better than the average performance of all routes;
- Average performers (yellow), with performance between the average and one-third of the average; and
- Below Average performers (red), with performance levels below that of the average performers.

EXIBIT 1
ROUTE PERFORMANCE ASSESSMENT

3.2 Assessment

3.2.1 Performance Thresholds

Thresholds were developed for all routes operated within the City of Greater Sudbury, based on the calculation of average performance in the boardings per vehicle-hour indicator. The performance indicator thresholds shown in Table 2 were the basis for this analysis and are derived from September 2005 data. Note that these values will change with each assessment, since they are relative values based on existing performance.

Table 2

Performance Indicator Thresholds

Time Period	Good	Average	Below Average
		Urban Routes	
Total	>69	69 to 23	<23
AM Peak	>70	70 to 23.5	<23.5
Midday	>51	51 to 17	<17
PM Peak	>49	49 to 16.3	<16.3
Evenings	>26	26 to 8.7	<8.7
Saturday	>32	32. to 10.7	<10.7
Sunday/After 10	>13.7	13.7 to 4.5	<4.5
		Commuter Routes	
AM Peak	>50	30 to 10	<10
Midday	>27	27 to 9	<9
PM Peak	>30	30 to 10	<10
Evenings	>12	12 to 4	<4
Saturday	>18	13. to 4.3	<4.3

3.2.2 General Observations

Exhibit 1 shows the routes ranked by boardings per vehicle-hour. From this table, we make the following observations.

- The average boardings per vehicle-hour is 40.5 for all routes in all periods (excluding two Express routes and the TransCab routes). This indicates that Sudbury Transit is out-performing most of other systems in other municipalities with a similar size population and services, and is on par with the performance of systems in the larger population group (up to 400,000).
- A few routes are performing very well in the AM peak period with the boardings per vehicle-hour close or greater than 100, which suggests more service hours may be necessary to improve service frequencies to continue to attract passengers to these services;
- The performance of all routes in AM peak period is better than their performance in PM peak period. The main reason discovered from the analysis is that fewer vehicle hours (1,450) are provided for the AM peak period compared to the PM peak period (2,023 vehicle hours) with similar boarding passengers in both periods (96,114 vs. 91,558);

- Most routes are performing very well during the midday (approximately 48 bph), but not in the evening (approximately 21 bph), with lower values on the Commuter routes and Sunday/After 10 routes; and
- Some Sunday routes perform at a better level compared to the weekday average. The rest of Sunday routes fall into the category of the average performers even when applying the weekday criteria.

3.2.3 Route Assessment

The assessment format identifies the Below Average performing routes as the focus of the first short-term analysis. These routes are identified as Below Average performers relative to the other routes in the system. This indicates that these routes have the largest negative influence on the indicators, and they need to be reviewed for short-term remedial action. These actions may include discontinuing service on the route to reallocate the resources to other uses or cost reduction, or restructuring of the route to improve its performance. However, from an operational and economic perspective, the performance level of these routes indicates that status quo is not an acceptable alternative, unless the route is serving some other policy function. Mitigating factors might include elements such as:

- sole service in a service area;
- hours of service policies; or
- key network connection.

The following sections outline the performance of each of the poorest performers in the system with suggested remedial action.

ROUTE 701 – LIVELY

Performance Indicator

Boardings per Hour: 9.5 average, ranging from 5.7 bph evenings to 17.6 bph AM peak

Comments

Route 701 is the only transit route serving Lively Community and Mikkola Subdivision via Copper Cliff with a TransCab connection to Whitefish. This route provides two inbound trips in the AM peak during the weekday, one trip at each direction in the midday Monday to Saturday and then one trip at each direction every two hours in the afternoon and evening Monday through Saturday. In addition, six inbound and five outbound trips are provided in the area on Sundays.

This route is the poorest performer in the entire system with 9.5 boardings per vehicle-hour, and is the only route carrying less than 10 passengers per vehicle-hour. With performance at 5 bph in the evenings, the service is very near the threshold for consideration of alternative service delivery, such as TransCab, during this period, if performance cannot otherwise be improved. In other periods, the route is a below-average performer, and consideration should be given to ways of improving overall route performance.

Recommendation

Since the service already meets the minimum level of service requirements, additional service to improve ridership is not recommended. Based on the performance indicator for the different time periods of the day, the lowest boardings per vehicle-hour of 5.7 occurs during the evening period. As described above, the existing service schedule indicates a same service frequency for midday, PM peak and evening off-peak. The review of the performance indicator suggests that a reduced service frequency should be considered for the evening period to improve the route performance.

ROUTE 103 – CONISTON

Performance Indicator

Boardings per Hour: 12.6 average, 3.5 bph Saturdays

Comments

Route 103 serves Coniston from 7:00 in the morning to midnight Monday through Saturday with reduced services on Sundays. The route schedule is coordinated with Route 401 at New Sudbury Centre to provide a connection to the Downtown terminal. A basic two-hour service is provided on this route Monday to Friday, with reduced trips on Saturday.

The performance of this route is below the system average falling into the category of below-average performers with boardings per vehicle-hour of 12.6, and 3.5 bph on Saturday.

Recommendation

This route does not conform to the recommended minimum service levels, with very few early trips and the first trip arriving at the transfer connection point at 8:50 am. This may be affecting its overall attractiveness for the student and commuter market, though weekday peak and midday performance on this rote is not particularly low.

Similar to Route 701, consideration should be given to reducing service in the evening off-peak period, which would allow some vehicle hours to be relocated to other service periods or busier routes and improve the overall performance of this route.

ROUTE 141/142 – WESTMOUNT/GRANDVIEW/SHOPPING CENTRE

Performance Indicator

Boardings per Hour: 11.8 (combined for Routes 141 and 142)

Comments

Routes 141 and 142 serve the local communities in New Sudbury at a service interval of 60-minutes operating in the peak periods only. These two routes operate together forming a large one-way loop from the Downtown terminal to the New Sudbury Centre via Kingsway and local communities along Barrydowne Road, and then return to the Downtown terminal via neighborhoods along LaSalle Blvd. and Notre Dame Avenue. The route reverses this pattern in the PM peak.

The combined performance of these two routes is approximately 12 boardings per vehicle-hour, which is the lowest of the Urban routes.

Recommendation

The performance of this route is not only less than the relative assessment threshold for below-average routes, it is also less than the minimum standard requirement for peak routes (based on recommended standards).

Consideration should be given to discontinuing the connections to the Downtown terminal to eliminate the large one-way loop formed by Routes 141 and 142. Route 141 would still serve the Barrydowne community with connections to the New Sudbury Centre and Millennium Centre. Route 142 would serve the existing service areas along LaSalle Blvd. connecting to the New Sudbury Centre and other major attractors such as the College Boreal and the Tax Data Centre. Both routes would have a schedule coordinated with other routes operating to the Downtown terminal at the major transit stops, particularly at the New Sudbury Centre.

Additional service would be required on other routes connecting the Downtown terminal and the New Sudbury Centre to accommodate passengers transferred from these two revised routes.

ROUTE 12 – MCKIM

Performance Indicator

Boardings per Hour: 14.6 average; m15.6 midday, 2.7 evenings; 9.8 Saturday

Comments

Route 12 McKim provides hourly service to the local communities northwest of the downtown core, with service from 7:00am to approximately 9:30pm and no Sunday service. The midday performance of this route is 15.6 bph, which is greater than the minimum standard threshold but the lowest midday performance of Urban routes.

Recommendation

With service levels of 60-minutes, service reductions on this route are not recommended. Since the performance level is not less than the minimum required level, no action is recommended at this time, but the service review will examine ways to improve ridership in the context of overall system improvements.

3.2.4 Assessment Summary

This analysis has addressed the problems and recommendations of each below-average performer in the system based on the data available. This review suggests:

- more service hours are required on some busy routes, especially during the AM peak period;
- evening services on some routes may be adjusted to a lower service frequency to improve the overall performance on these routes;
- more services are required on Sundays to meet the travel need in the City of Greater Sudbury; and
- large one-way loops discourage transit users and should be avoided in the service design.

4. Travel Patterns

This section begins with an examination of the overall travel patterns within the region for employment and post secondary trips, and transit's role in accommodating them, to identify potential changes in the route structure to promote ridership growth.

4.1 Global Work Trip Patterns

Exhibit 2 shows the aggregated zones and their characteristics used in this analysis. This analysis built on the previous work of the Transportation Master Plan, including 2001 census and place of work data, existing routes and services and current schedules, as well as input from Sudbury Transit staff. Based on this information, an estimated origin-destination matrix was developed. Further details of this process and matrix are included in the separate Technical Appendix.

Exhibit 3 shows the overall work trip patterns developed from the origin-destination matrix. As shown in Exhibit 3, about 90 percent of all work trips have one trip end in the former city area, and of these:

~ about 43percent are contained within the former City area;

~ about 33percent are inbound to the former city area; and

~ about 13percent outbound from the former city areas.

Further, about 10 percent of work trips remain outside of the former city area.

This means that the former City area is the origin or the destination of 90 percent of the work trips and more than 75 percent of work trip destinations are within the former city area. Further examination of the work trip matrix reveals the major travel patterns into the city, with the most significant connection from:

~ Valley East (11 percent);

~ Rayside-Balfour {7 percent);

~ Nickel Centre (6 percent); and

~ Walden (5 percent).

However, it is also important to note the outbound trips in the commuter patterns as well, with more than 13 percent of trips outbound in the morning, including to:

~ Valley East (3 percent);

~ to Walden (3 percent);

~ to Rayside-Balfour (2 percent); and

~ to Nickel Centre (2 percent).

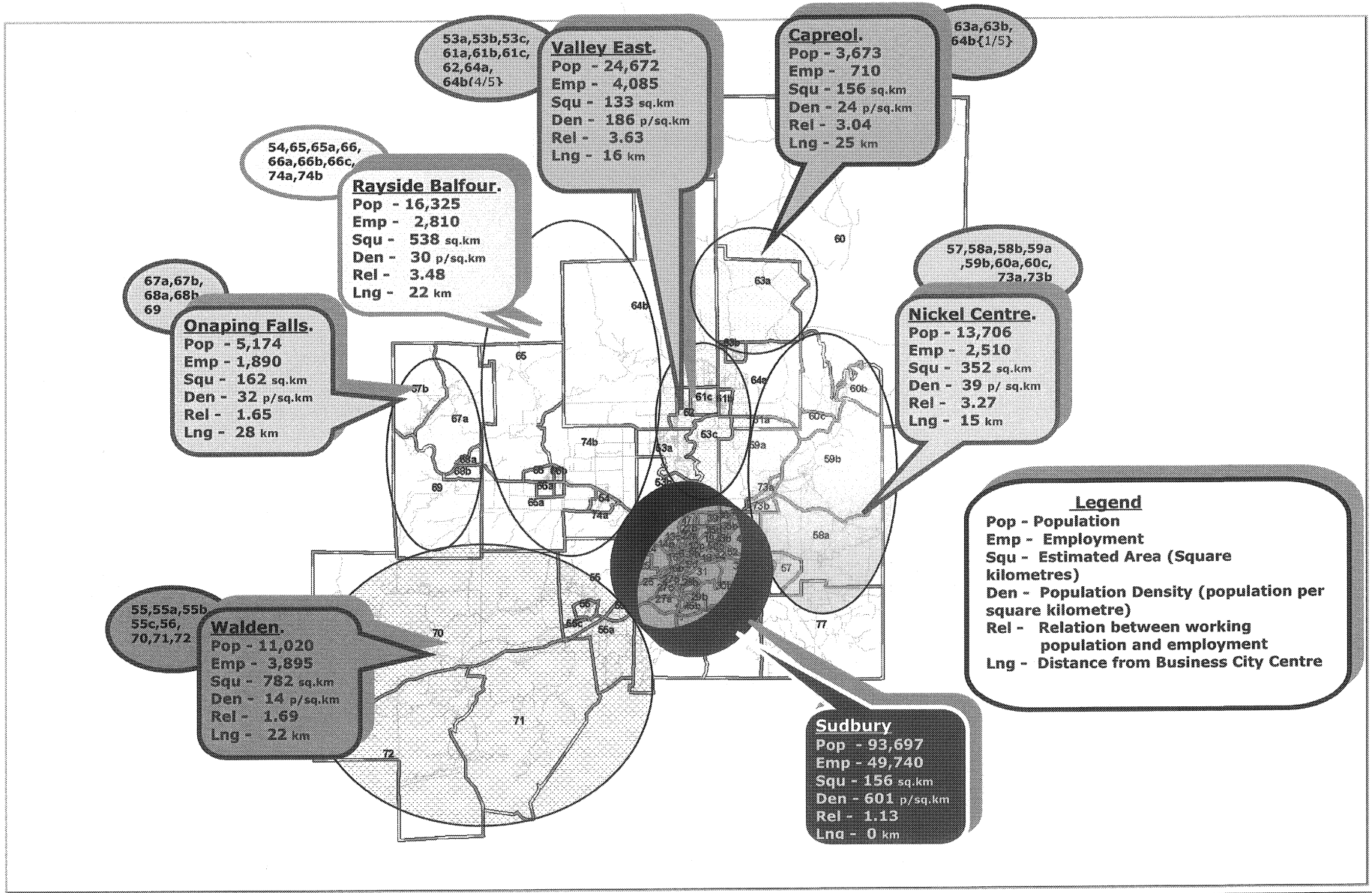
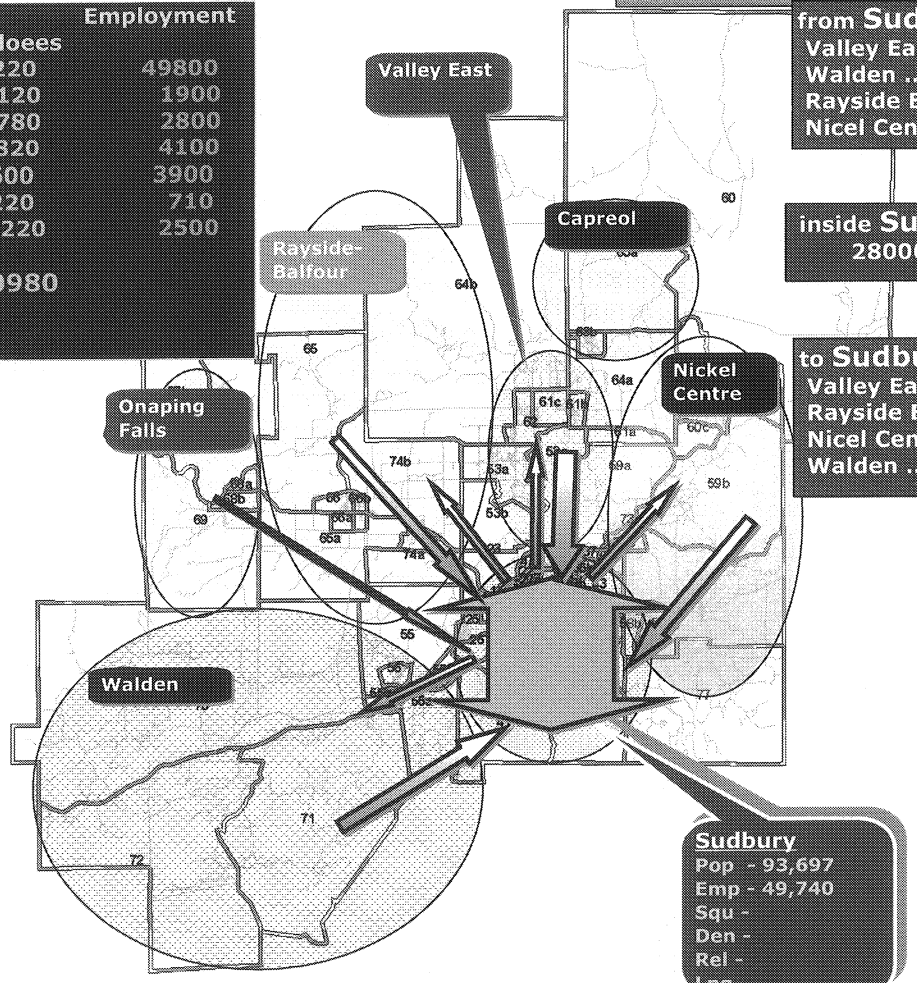


Exhibit 2
Sudbury Transit Riderhip Growth Strategy
Aggregated Analysis Areas

ENTRA CONSULTANTS

Area	Poulation Total	Employment Emploees	
Sudbury	93700	56220	49800
Onaping Falls	5200	3120	1900
Rayside-Balfour	16300	9780	2800
Valley East	24700	14820	4100
Walden	11000	6600	3900
Capreol	3700	2220	710
Nickel Centre	13700	8220	2500
Total	168300	100980	65710



Results of O-D Estimation model.
Only links with more than 2% are presented :

from Sudbury to:
- Valley East..... 2169 { 3.3%}
- Walden ..... 2066 { 3.1%}
- Rayside Balfoor .. 1539 { 2.3%}
- Nicel Centre ..... 1374 { 2.1%}

inside Sudbury :
28000 {42.6%}

to Sudbury from:
- Valley East..... 7260 {11.1%}
- Rayside Balfoor .. 4824 { 7.3%}
- Nicel Centre ..... 3855 { 5.9%}
- Walden ..... 3256 { 5.0%}

Exhibit 3
Sudbury Transit Riderhsip Growth Strategy
Aggregated Travel Patterns

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4.2 Urban Travel Analysis

For detail analysis the Sudbury City area was re-divided into 9 sub-zones built on combination TAZ and Employment tracts.:

- small enough to reflect individual travel characteristics and patterns;
- large enough to permit easy analysis; and
- based on available data.

Exhibit 4 shows the zone system used for this analysis.

A similar origin-destination matrix analysis was developed, using a gravity-type model to pair trips between zones. Details of the matrix that was developed are included in the separate Technical Appendix. The results of this analysis points to the following conclusions:

- travel patterns in this analysis were similar to the global analysis completed for the same areas;
- despite overall city balance between population and employment there are some important variations at the zonal level
- Areas such as New Sudbury -North(1),Lockerby (5), and Minnow Lake (7) have the highest ratio of employed labour force to employment (> 1.5);
- areas such as New Sudbury-South (2,Lo-Ellen (6), and Copper Cliff (9) have the lowest ratio of employed labour force to employment (<0.6)
- most other zones have a balance of employed labour force and employment.
- unlike commuter patterns, city travel patterns do not reflect a focus on one particular
- centre; and
- most zones have significant intra-zonal travel.

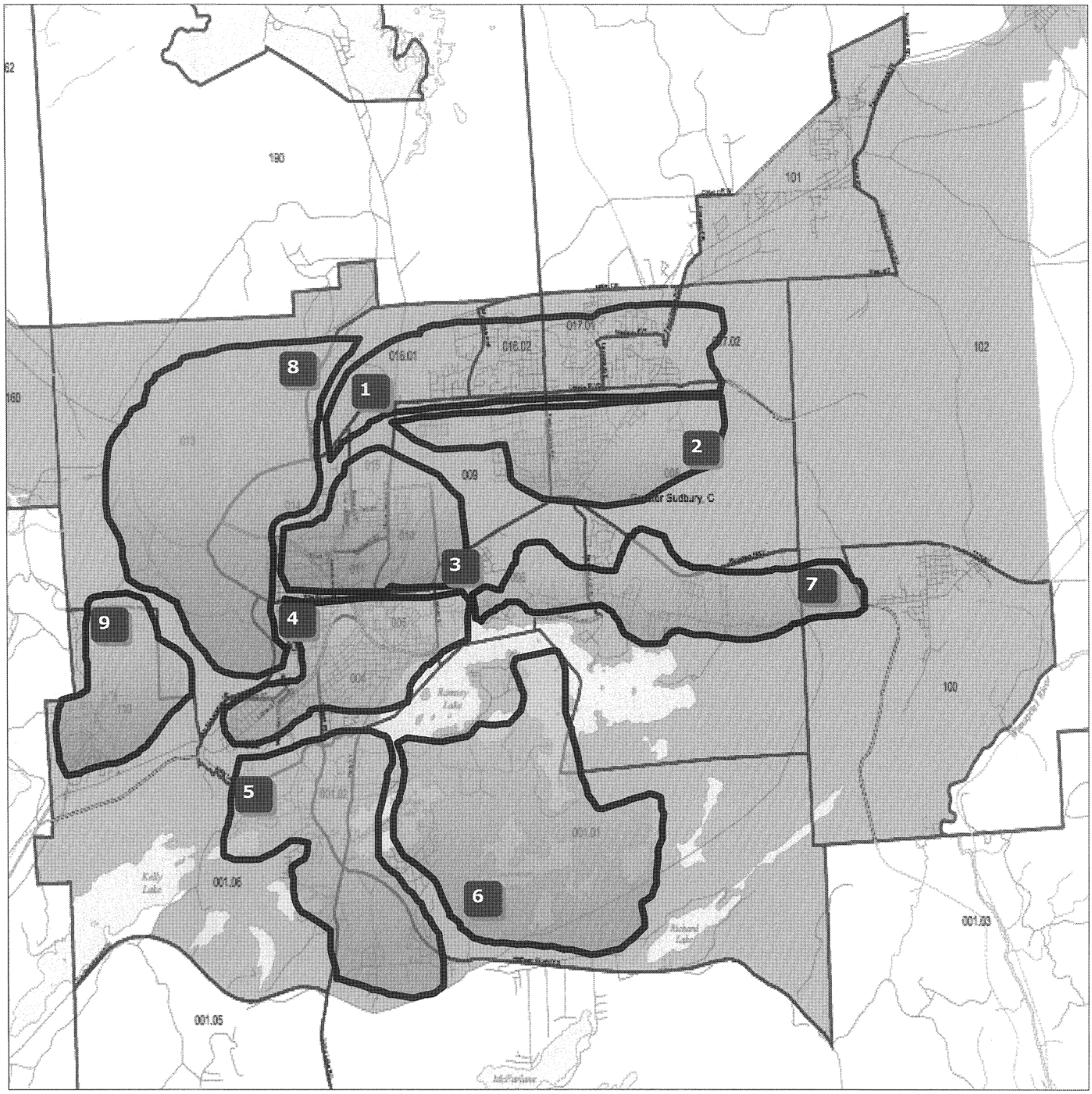

Exhibit 4
Sudbury Transit Riderhsip Growth Strategy
Internal Analysis Zone System

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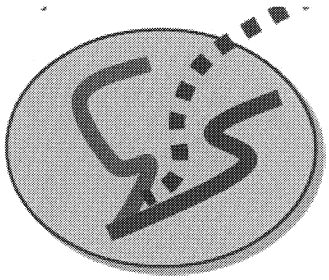
4.3 Transit Concept Development

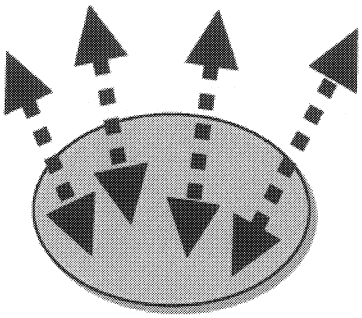
The analysis of AM peak period travel suggests the following general principles for the transit system.



1. The focus of the route structure should be the urban area of the former city of Sudbury
2. The Commuter route system is a crucial complementary component, with two important functions:

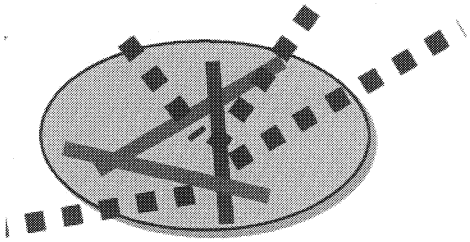
~ to bring passengers from commuter areas to Sudbury (and back); and

~ to supplement Urban routes with additional levels of service and trip connections.



3. Commuter route system should provide peak-direction focussed service to and from central city area, as well as provide connections for potential travel between the smaller urban communities.
4. Trip interlining is a crucial element of this structure, to be able to provide more trips in the peak direction than the off-peak, without unnecessary deadheading. In this fashion, inbound trips can interline into Urban routes to supplement levels of service.

4.3.1 Urban Route Principles



Distinct from the concepts of the Commuter routes, routes within the urban city core should attempt to create more direct travel between various zone pairs, with the objective to reduce passenger transfer, increase trip convenience of trips and make transit a more attractive choice for travel.

The ideal route structure will be simple and easily understood, with as few routes as possible and direct intuitive routings in major corridors. Routes should connect zones with highest travel demands with most direct routings in terms of time and distance. Schedules and fare policies should also support these travel connections.

4.4 Idealized Route Concept

This section presents the basis for the service strategies proposed in the next section - an idealized routing concept based on the travel matrix and routing principles described here. In the first step of this analysis, a simple corridor structure was developed, based on the O-D matrix data, and connecting the major zone pairs.

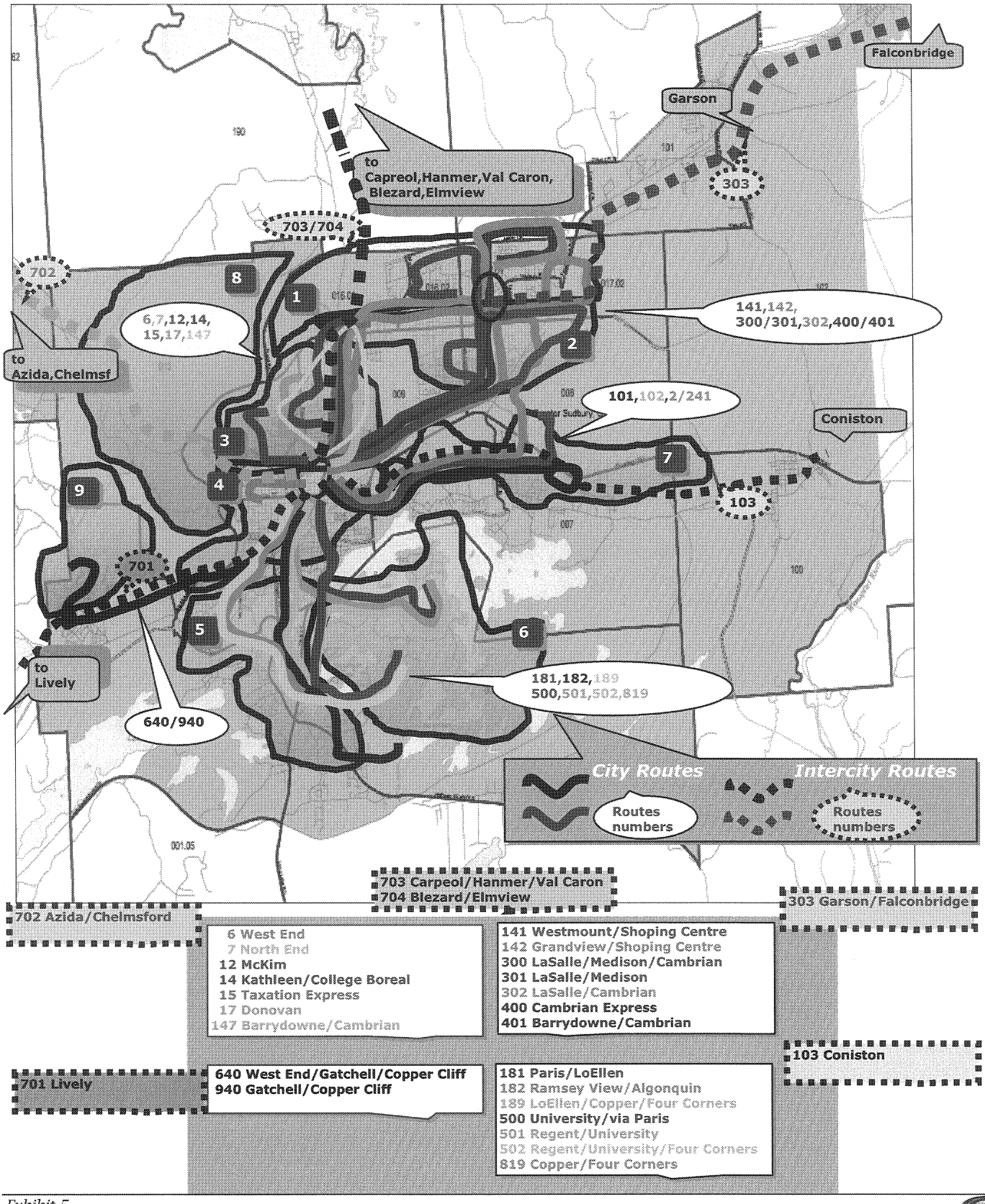


Exhibit 5
Sudbury Transit Riderhsip Growth Strategy
Existing Routes - Schematic

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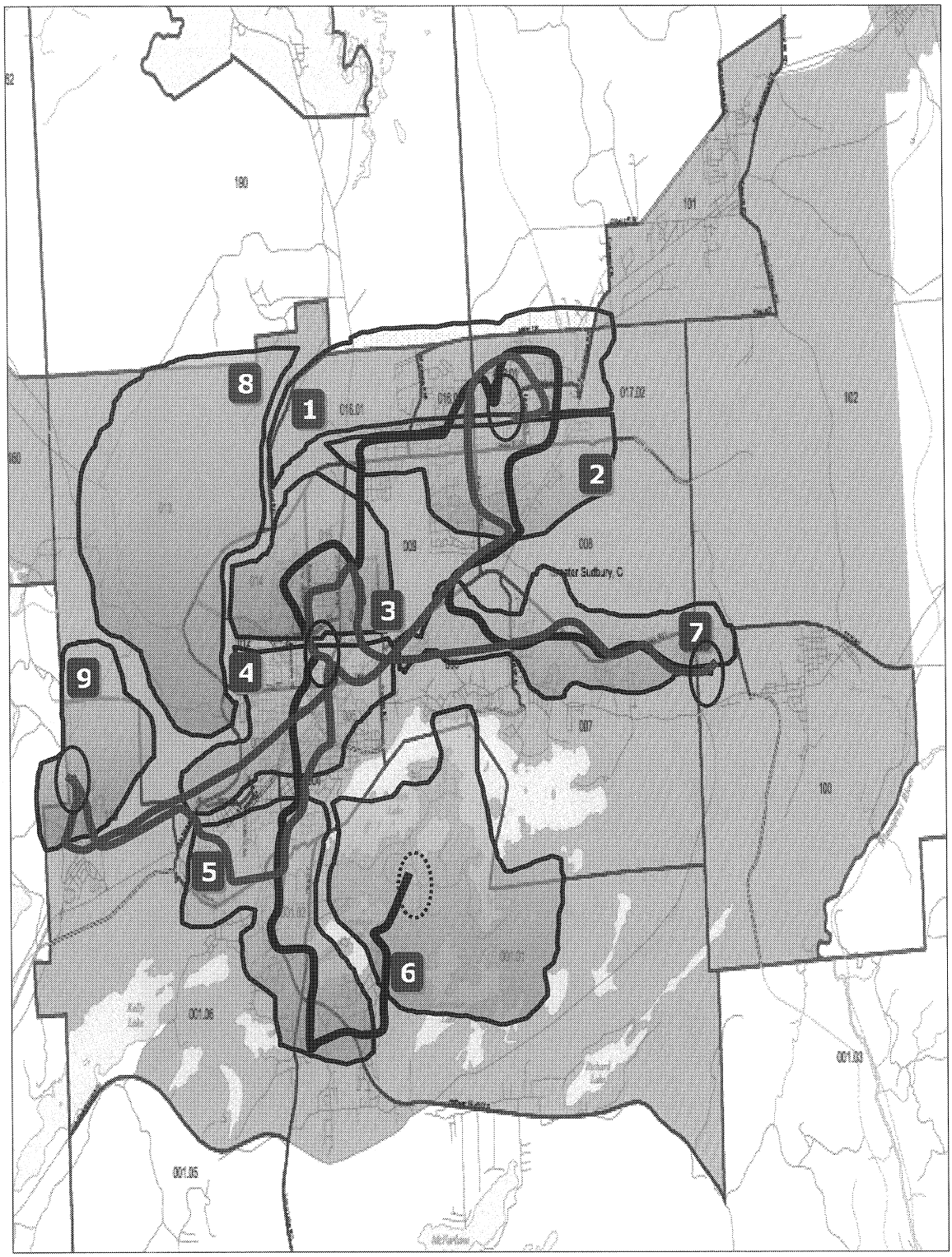

Exhibit 6
Sudbury Transit Riderhsip Growth Strategy
Basic Corridor Route Structure

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In the next stage of the analysis, each zone pair was analyzed on the basis of the attraction between them in terms of travel demand, the direct corridor routing and travel characteristics, and the actual travel corridor and characteristics. The ratio of travel times between these ideal and actual characteristics is used as an evaluation of the idealized network.

The separate Technical Appendix includes additional detail on the iterative process involved in comparing these travel patterns and links.

The results of this idealized network are shown in Exhibit 7, which then forms the basis for the development of specific Ridership Growth Strategies, presented in Section 5.

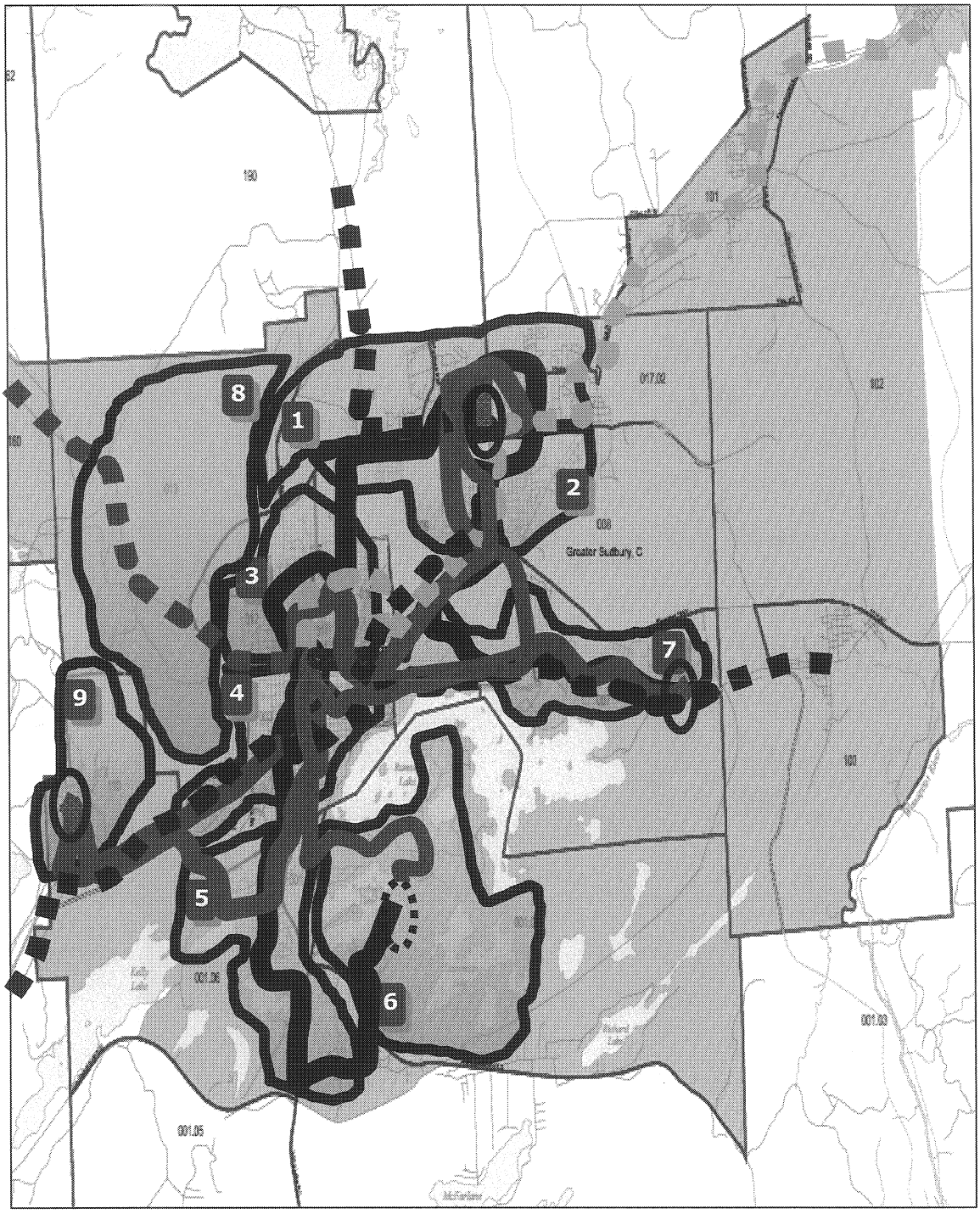

Exhibit 7
Sudbury Transit Riderhsip Growth Strategy
Idealized Route Network Concept

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5. Ridership Growth Strategies

The intent of this section is to provide an overview of various strategies that Sudbury Transit could consider in various areas, selection of which might be combined into a general preferred strategy for ridership growth. The following sections examine the various components of the Sudbury Transit service, including in-town and commuter routes, TransCab service, fare policies and structures, information services, and other non-transit components.

5.1 Urban Routes

In the medium term, the idealized route network represents an opportunity for Sudbury Transit to fine-tune and adjust its service to reflect the principles of the fastest, most direct service for the largest, most significant markets.

Generally, a number of Sudbury Transit routes already reflect this concept, either by design or in simply conforming to the available road pattern. However, there are several strategies that could be introduced, or strengthened to further promote ridership growth.

5.1.1 Introduce Direct Non-Downtown Routes

A small but key departure from the complete downtown focus in the present system is an opportunity to accommodate faster more direct travel. This involves establishing New Sudbury Shopping Center as a secondary hub to serve local and commuter routes in the northeast, a function that the location has already begun to take on.

It also includes establishing a similar factor in the south, in the vicinity of Four Corners. With these satellite facilities in place, direct trips can be used to connect the terminal areas to each other, as well as from them to key destinations such as the university or college campuses.

A direct route from north to south would logically operate via Paris Street, and would apparently operate through downtown. However, it is important to recognize that there are a variety of travel patterns that are not destined downtown, and can be significantly shortened in terms of travel time by not diverting to the downtown transit center and spending the required stop-over time there. This direct travel option offers an attractive advantage to riders, and can be a significant factor in ridership growth.

5.1.2 Service in New Sudbury – Northeast

One area where the idealized route network can clearly form the basis of route modifications is in the northeast, New Sudbury area. In this area, there is some overlap and duplication of services, along with some circuitous routing, and a mix of both low ridership and busy routes. There is an opportunity here to reduce the duplication and circuitousness, and improve major corridor services.

Sudbury Transit should consider adjusting routes to a stricter application of the proposed service standards. These are more fully described in Section 6.

5.2 Commuter Routes

Commuter routes were introduced following amalgamation, and several new services and service increases have been introduced since. As indicated in the existing service assessment, service on these routes cover the spectrum of performance, from low to high.

Most services provide approximately 10 trips in each direction throughout the day, with the exception of Route 701-Lively, which provides about 8 trips each, and Route 704 - Blezzard/Elorview, which provides 6 trips each direction.

In examining the trip patterns for each of these services, most provide only 1 or two inbound trips that arrive downtown in the AM peak period and 2 to 4 trips that depart from downtown in the PM peak period. A larger percentage of trips is offered in the off-peak periods - midday and evening indicating that these routes are not serving traditional commuter patterns.

As a general service strategy for the commuter routes, Sudbury Transit should consider increasing the number of peak direction trips in the peak periods on these routes, particularly in the AM period.

Generally, a base block of trips should include 3 AM inbound trips (arrive downtown before 9AM), 3 PM outbound trips (departing downtown between 4:00pm and 7:00pm), one trip in each directing during the midday and later evening outbound trips.

Other trips beyond this basic block can and should be provided on the basis of individual trip performance, but the basic block of service should be considered and evaluated as a block

The reason for this is the customers' need for reliability and flexibility in making the decision to use transit. Apart from needing specific trips that match their travel needs, riders are often reluctant to choose transit for their travel if they are not confident of their ability to return in the event of unforeseen circumstances such as needing to return home in an emergency, or working late past the peak hour service. There is clear evidence in commuter transit services that suggests that these additional trips, while they may not attract substantial ridership themselves, help support the peak period services.

In Sudbury Transit's case, one potential weakness in an effective commuter system may be the limited number of AM inbound trips. When making the decision to use transit, potential riders evaluate their options for both the inbound and outbound trip, looking for travel options that meet their desired travel pattern in both directions. For example, a person working in downtown Sudbury from 8:30am to 5:00pm will look for a combination of trips that will allow them to arrive downtown shortly before 8:30am and depart shortly after 5:30pm. If only one of these choices is available, the trip may not be taken by transit at all.

The importance of this factor in providing AM and PM trips is that the opportunities to match a person's travel patters is the product of the number of trips provided in each period. For example, if only 1 trip in each direction is provided, those trips will only meet 1 travel pattern, but is 2 trips are provided in each direction, those will met up to 4 combination of travel patterns.

Sudbury Transit already provides sufficient PM trips to meet this plan and sufficient midday and off-peak trips to support them. The fact that most of these services perform at acceptable or better performance levels also indicates that the trips are meting current travel needs.

However, to further enhance these services, and take advantage of the commuter concepts, Sudbury Transit should consider strategically timed AM trips and provide a range of trips arriving downtown prior to8:00am, prior to 8:30am and prior to 9:00am.

Enhancing this service will require additional vehicles, or redeployment of vehicles from other services through interlined routes. In the short- to medium-term, and additional 5 vehicles should be considered to supplement this service.

5.3 TransCab Services

Sudbury Transit currently operates six TransCab services throughout the region:

- Skead, connecting from Route 303;
- Dowling/Onaping, connecting from Route 702;
- Wahnapitae, connecting from Route 103;
- Richard Lake, connecting from Route 701; and
- Long Lake, connecting from Route 819.

Sudbury Transit is one of several transit systems that use TransCab type services, including larger systems such as Hamilton, and small systems, such as Peterborough or Welland. In most cases, transfers to the regular system are free, with the exception of Welland, where a transfer is charged an additional $0.70.

The element that sets Sudbury's services apart from the others is the relatively high premium charged for the service. The $2.00 premium likely discourages some ridership, and introduces an issue of equity.

A recent staff report shows that 2005 ridership on TransCab was approximately 17,500, resulting in an annual revenue from fare premiums of approximately $35,000. However, this same report shows that when the fare premium was introduced in 2003, TransCab ridership declined by about 4,700 passengers in 2003 and a further 5800 passengers in 2004. In total the annual loss of ridership following the introduction of the fare premium was about 10,500. IN 2004, fare premium revenue was approximately $30,000, based on 15,000 rides.

If all of these reduced trips were diverted away from transit (meaning either the trip did not take place or was made by completely by another mode, the resulting loss of transit revenue is approximately $18,000, reducing the net fare premium revenue to $12,000, or about $1.20 per ride lost. If 50 percent of these trips were diverted away from transit, the resulting loss of transit revenue is approximately $9,000, reducing the net fare premium revenue to $21,000, or about $2.10 per ride lost.

Since the areas served by TransCab are part of the service area ad support transit through fares at the same rate as other small communities, and given that some of the TransCab areas are closer to the central city area than some commuter services, the premium fare for what is usually perceived as a lower quality service (requiring a phone call booking) is quite contradictory.

TransCab services are an effective way of providing transit service into remote, difficult to serve, or low demand areas. While the calculated cost per passenger trip for these services often appears high compared to transit's average, costs are actually reduced in these areas in two ways. First, particularly in low demand areas, services only operate in response to demand so costs are avoided when no one wants to travel, compared to the conventional transit model, where vehicles travel the route on a fixed schedule regardless of demand. Second, because these services are provided with sedans or vans, the cost per vehicle-trip is substantially lower than that of a transit bus. Further, since most trips in these areas only involve one or two passengers, both factors combine to reduce the cost compared to regular transit service.

For example, the 2005 expenditure of approximately $220,000 could have provided approximately 3,000 vehicle hours of service in conventional transit, or just less than 10 hours of service per day. Allocated among the six areas, this equates to approximately 1.5 hours of service per day. Therefore, to provide this service with conventional transit would likely mean the elimination of service to the smallest and more remote communities, with reduction in service in communities such as Long Lake, Richard Lake and Onaping to approximately 2 trips per day.

Residents on TransCab service areas trade-off lower quality service (at a lower cost) to secure transit service in these areas, and should not be further assessed a premium fare for that service. An exception to this would be cases where the travel distances involved required higher payments to the contractor than warranted by the economic standard for TransCab service. In these cases, the premium should be individually set for the specific service, and designed to bring the city subsidy level down to the threshold level.

Accordingly, ENTRA recommends that the TransCab premium fare be eliminated.

5.4 Evening and Sunday Service

Sudbury Transit provides substantially reduced service on weekday evening after 10:00 pm and on Sundays, using a completely different route structure that provides wider coverage (with greater walking distances) and reduced headways. Sunday service levels are based on historical demand patterns and the After-10 service was introduced in response to cost cutting requirements several years ago.

In a low demand environment, or in response to financial pressures, the alternate route concept with reduced service can be a sound strategy. However, particularly for the evening service, the switch to another route system can be confusing for passengers and discourage ridership. For evening service, Sudbury should consider maintaining the regular daytime routing, with m minimum service levels on selected routes. This would likely represent an increase in service but ridership is also likely to increase as a result of the consistency of the service, and there is anecdotal evidence to suggest that additional service in the late evening may be warranted.

For Sunday service, the alternate route concept is more acceptable, but again, evidence suggests that the lower level of service on Sundays may be suppressing ridership. Sunday service should also be considered for service increases, with consideration given to implementing the regular route network.

During the evaluation process, ENTRA identified an additional evening service opportunity that

may support additional evening service. Two major call centers, TeleTech and the National Call Center (NCC) have significant contracts requiring late night shifts ending after midnight.

Between the two operations, at least 300 employees finish between the hours of 12:00 midnight and 2:00 am. Currently, the two firms spend several thousand dollars monthly on after-hours transportation for their employees, and in addition to these direct costs, Teletech also experiences considerable attrition on these shifts and incurs substantial recruitment costs as a result. While specific consultation with NCC was not possible, there is no reason to think that the situation there is any different.

This situation presents an excellent opportunity to enter into a cooperative agreement with the call centers to provide additional service in return for a guaranteed revenue stream. One example of this type of arrangement would include the call centers purchasing a minimum number of passes, sufficient to justify the extension of the service. These passes could then be distributed to employees, either as a free benefit (currently taxable), at cost, or at a discount.

It is important to note that the pass purchase agreement is not based on the number of employees intending to travel by transit, but on the basis of recovering the cost of operation - in this example the pass is simply an easy accounting tool to manage the transaction.

Within the scope of this study, it was not possible to determine what extent of the service would need to be maintained late. For example, it may be possible to meet a large portion of the employees' needs with specific commuter routes, or with a flexible route system that takes central area employees home. Further discussion with call center management will be necessary to clarify and define this opportunity.

5.5 Post-Secondary U-Pass

5.5.1 Background

The Sudbury draft Official Plan specifically indicates the objective of developing fare strategies and structures that will attract students to the service. In recent years, a number of universities have adopted the concept of a universal pass or U-Pass that gives all students at a particular institution unlimited access to the transit system.

In return, all students at the institution pay an agreed sum as part of their mandatory student activity fee. In designing these systems, the objective is to generate sufficient revenue from the mandatory fee to cover the costs of additional service that may be required, and otherwise to remain revenue-neutral.

As a mandatory program, the U-Pass concept is subject to a student referendum, and requires considerable effort on the part of student administration and the institution. In Sudbury, the schools have different procedures and protocols for student referendums, and it is quite possible that the process may proceed at different times at the different schools. It is also possible that only one or two of the schools approve the concept, leaving some students out of the program.

This is not uncommon, for example, St. Mary's University in Halifax has had a U-Pass system with Metro Transit since the Fall of 2004, but the much larger Dalhousie University has just joined the program in January 2006.

It is also possible that the plan fails the referendum in initial attempts at some or all of the institutions. This too is not uncommon, and the success of the campaign depends on the effort of the students as well as the perception of the quality of the transit service relative to the cost. For example, a referendum at University of Northern British Columbia (6,000 students) failed in its first attempt in 2001, because of the widely held view that transit service to the campus was inadequate. Following service improvements in 2004, another campaign is underway, and is widely expected to pass for Fall 2007.

Ridership gains from these fare systems can be substantial. In recent examples across the country, ridership increases ranged from 10 or 15 percent (in large systems) to over 100 percent in smaller settings. Other benefits include reduced parking demand (which can be a negative factor in terms of revenue for the institutions), increased access to the schools from residential areas throughout the region, which in some communities has led to increased student rental opportunities in new areas, and reduced traffic congestion in campus areas.

With approximately 11,000 post-secondary students in 3 schools in Sudbury, this represents an excellent opportunity to increase ridership, and enhance student mobility.

5.5.2 Fare Analysis

As part of this analysis, ENTRA examined the capacity o the existing system, both system-wide and on campus-oriented routes. Sudbury is at a distinct advantage in this area, since the students are divided among 3 different campus areas, and can be served by 3 different routes. This means that a large percentage increase does not necessarily translate into a significant absolute ridership on one route, the way it can if all students a re at one campus location served by a single route.

For the purposes of this analysis, ENTRA assumed that the U-Pass concept would be implemented in all three institutions simultaneously, affecting approximately 11,000 students at the 3 campuses.

The objective of this analysis was to:

- identify the current level and pattern of student ridership among students using both monthly passes and cash and tickets;
- identify the range of ridership increase that could be accommodated within the existing system, including making use of some reallocation of resources;
- identify the strategic service increases that may be necessary to accommodate larger increases; and
- determine the cost per student that would be necessary to accommodate the system requirements under different ridership scenarios, including retaining the flexibility to increase some services beyond the necessary capacity requirements, but as part of enhancing student services to make the system more attractive.

Details of this analysis are included in the separate Technical Appendix, and are summarized here.

Pass Sales And Ridership Patterns

Historically, pass sales for student monthly passes have peaked in the Fall of each year. In

December, with limited classes, sales typically fall off significantly, then resume in January. In the last five years, winter sales in January, February and March have been lower than sales in the fall, which could be the result of changing travel patterns, students new to the area now riding with friends, or students making other arrangements if the system does not meet their needs.

However, also since 2001, the pass sales in the winter have been trending higher, and the gap between Fall and Winter sales has been reduced dramatically, with overall higher pass sales. In 2005, student pass users have been consistently greater than 2,000 in each of the core school months. Summer sales have remained consistent, at approximately 500 per month.

Using an average fare calculation, the overall student revenue was calculated for the typical patterns. In core months, revenue averages approximately $170,000, with off-peak months ranging from $45,000 to $70,000. In 2005, total student revenue is projects at just less than $1.5 million from passes, tickets and cash.

This analysis indicates that a large number of students are already using Sudbury Transit, either on a regular basis or less frequently. During peak months, 2000 pass users are joined by an estimated 500 individuals using the system an equivalent of twice per day, or 10 trips per week (for example, this could be 1000 students making 5 trips per week). This means that an equivalent of about 25 percent of the students are already using the system on a regular basis.

Potential Ridership Increases

Based on the experience of other systems, and the number of students already using Sudbury Transit, increases were calculated from 12 percent to 20 percent of total ridership, representing an increase in student ridership ranging from 50 to 85 percent. At the upper end of this range, this would represent the equivalent of 45 percent of students using the system on a regular basis, which in practical terms, means virtually every student making some use of the system.

Potential Service Increases

Potential service increases were calculated on the basis of capacity in the system and reallocation of resources that may be necessary. This analysis did not take into account general increases that may be necessary to make the system more attractive to students, but a factor to accommodate this is built into the pricing schemes in the next step.

Depending on the level of capacity increase required, and the desire to implement general service increases, additional AM peak service would be required on Route 301 Route 401, and Route 501, followed by further increases on these routes as well as Route 302.

Additional service will likely be required if ridership increases exceed 6 percent overall. Prior to that point, reallocation of resources may be required to accommodate specific student trips, such as diverting inbound commuter trips to school routes once they have reached the terminal.

If ridership increases exceed 10 percent overall, additional service and AM peak vehicle resources will be required, in addition to the reallocation of resources. This scenario has been incorporated into the Financial Plan in Section 7.

Potential Pass Prices

Initial discussions with student representatives indicate an expectation that the pass price would be approximately $20 per month in a U-Pass environment. This is based on a notion that

approximately 30 percent of students are using transit now, and three-fold increase in the number of students paying should permit a fare reduction to one-third current levels.

Strictly considering revenue, this calculation is approximately correct, in fact, at low levels of student ridership increases, the breakeven point is slightly less than $20. However, the most likely increase in ridership is in the area of 40 to50 percent or between 10 and 15 percent overall, and this will require additional service to be added into the system. Also as part of U-Pass negotiations, students may identify specific service increase that they feel are crucial to the success of a referendum campaign, and the costs of these increases should be built into the pass price.

On this basis, a pass price between $20 and $25 per term, for 8 months, for a total of $200 annually will be appropriate. Students would continue to purchase regular student passes during the summer moths, or, with the smartcard application recommended in this report, this function could be built in to the card purchase.

5.6 Other Fare Strategies

5.6.1 Transferable Pass

SERVICE CONCEPT

Sudbury Transit's current monthly pass is limited to a single user, controlled through a photo identification portion of the pass. This system, allowing only on customer to use a pass is still common in the industry, but a number of systems are switching to a transferable pass, allowing more than one customer to us e a pass, provided it is only used by one customer at a time.

RIDERSHIP AND COST IMPACT

The ridership impact of a transferable pass can be quite important, including generating ridership from new users. Once a pass has been purchased, it becomes readily available for anyone in the household to use at any time. This tends to generate additional off-peak ridership such as students using a parent's the pass in the evening or on weekends. Costs, in terms of revenue forgone, can be variable, depending on the existing pattern of pass use, and a number of options are available to compensate.

Generally, if a pass is purchased by a regular commuter travelling to and from work daily (or school) the pass is only available for off-peak trips, and usually evening and weekends. While there is some potential here for existing revenue trips to now take advantage of the pass, there is also the opportunity for new rides to be generated by the availability of the "free" pass. The cost associated with the lost revenue is usually an excellent investment in new ridership.

Since these trips are primarily off-peak rips where no additional capacity is required, so actual system costs do not increase.

In some cases, households previously using tickets for multiple trips may be able to combine their travel on the more deeply discounted pass, also creating a loss of revenue.

If this is a concern, there are several options that can be used to minimize the impact, while still increasing ridership.

One option is to only make the adult pass transferable. There is often less opportunity for sharing an adult pass in other then limited off-peak times, and passes are often shared only among family members rather that between households, which is a greater possibility with student passes.

Second, a small premium could be charged for a transferable pass, with customers still having the option of using the regular non-transferable pass. In an electronic fare collection environment, the transferable pass is specifically encoded so that the farebox accepts the pass as valid and indicates a transferable pass. In a manual fare collection environment, the transferable pass is simply enhanced with a secure sticker to indicate its transferability.

RECOMMENDATIONS

ENTRA recommends Sudbury Transit adopt a transferable adult monthly pass.

5.6.2 Open Transfer

SERVICE CONCEPT

Sudbury Transit's current transfer system permits a transfer to the next available bus on a different route. In some cases, involving a transfer to a commuter route, this may permit a stop over of considerable length.

Over the past few years, a number of systems have adopted a more flexible transfer policy that permits unrestricted travel on the system for a short period of time, typically 90 minutes or 2 hours. In this system, a passenger boarding with a ticket or case fare would take a transfer that is effectively a two-hour pass, permitting stop-overs, route changes and even return trips, as long as the trip component begins within the specified period.

The theory behind this policy is that the number of people who are attracted to transit by this flexibility will out number those that are currently making this type of trip now. Typically, stop-overs and short-return trips are rare in systems with base 30-minute service such as Sudbury, partly because of the cost and partly because of the inconvenience.

RIDERSHIP IMPACT

The actual ridership impact of such a system is very difficult to predict, but it is expected to be modest. One of the most important factors of this policy is in its marking value, as it appears to be an excellent value-added feature for case and ticket riders. Costs are very low however, and overall revenue impact can be expected to be slightly positive.

RECOMMENDATIONS

ENTRA recommends that Sudbury Transit adopt an open transfer policy, with transfer valid for any travel within the system, for any travel that begins within 90 minutes of issue. Next bus provisions for infrequent commuter trips will still hold.

5.6.3 Seniors Discount

Staff was asked to consider the possibility of extending the seniors discount for transit fares (approximately 30 percent) to all persons aged 55 to 64, in addition to those aged 65 or older. In the absence of a consistent City policy to extend discounts for this age group on all City services, such as recreation facilities, community centers and such, this proposal was evaluated on its

merits, with respect to impacts revenue, compared to expected increases in mobility and ridership.

The Sudbury community profile from the 2001 census indicates this portion of the population to represent approximately 11 percent of the total, and Sudbury projections for 2005 show this value to be approximately 12.5 percent.

In term of ridership, transit travel typically reflects the overall community profile among these age groups (Seniors aged 675 and over typically represent a larger proportion of the *individual riders*, but take fewer trips per person.) This means that applying a 30 percent discount to this group would result in a revenue loss of between 3 percent and 4 percent, or about $225,000 based on 2005 revenue. Offsetting this would be the expected increase in ridership, which is estimated at approximately 20 percent of the fare increase. This means that a 30 percent fare reduction would be expected to drive a ridership increase of about 6 percent among this group, or less than 1 percent of total ridership. Therefore, offsetting revenue from increased ridership would be approximately 25 percent of the revenue loss, or approximately $55,000 for a net decline of $170,000.

As stated, without a clear policy to extend this discount for all city service, the cost of $170,000 for a ridership increase of approximately 35,000 rides, or almost $5.00 per new ride, is not an effective use of the funds. Similar expenditures in other recommended service initiatives, such as service frequency increases would be more effective.

Accordingly, ENTRA recommends that this proposed discount not be implemented.

5.7 Technology Options

In addition to the smartcard or other fare payment opportunities being assessed in the parallel report, ridership in Sudbury could be enhanced by improving the quality and reliability of the trip through a variety of technology options.

5.7.1 Transit Signal Priority

In key locations, transit signal priority (TSP) can be an important element of removing bottlenecks, reducing transit delay and shortening overall travel times. While it is not likely that sufficient savings could be realized to reduce vehicle resources in the short-term, immediate effects could include increased reliability and faster, more attractive travel times, which can help generate additional ridership. In the long term, these savings will help defer expensive schedule changes. Transit signal priority is most effective when separate facilities, such as dedicated lanes, queue jump lanes or other transit-only accommodation is available to permit the bus direct access to the controlled signal.

Key applications for TSP in Sudbury include:

~ Downtown Transit Center exits;

~ shopping centre access points;

~ problem left-turns where delays are frequent; and

~ other corridor opportunities, such as Kingsway, Paris and LaSalle.

In these corridor areas, even without dedicated transit facilities, TSP can still be effective if the network is mostly prioritized allowing small savings at each intersection to be aggregated into meaningful reductions. Several priority pilot projects in other systems have clearly demonstrated that providing TSP in a mixed traffic environment often improves general traffic flow on the mainline with minimal impact on cross-street traffic delay.

Costs associated with TSP (individually controlled and activated) is about $40,000 per intersection.

5.7.2 Automatic Vehicle Location

Automatic Vehicle Location (AVL) is an electronic system allowing transit operations to identify and track the location of each bus A robust AVL system (usually relying on Global Positioning System (GPS) technology) allows a number of transit service enhancements, such as:

- transit signal priority;
- next bus announcements at stops;
- next stop announcements on buses;
- customer information online, or real-time information by telephone; and
- automatic passenger counters.

AVL system costs exclusive of any ancillary features) would range from $15,000 to $20,000 per vehicle. With AVL installed, other technology options become easier to accomplish, for example, APC costs are limited to the on-board installations.

Enhanced dispatch operations are also made possible by AVL, allowing controllers to accurately locate vehicles and make scheduling and dispatch decisions based on this information.

5.8 Other Features

5.8.1 Riders' Guide

The current riders' guide is produced in-house by Sudbury Transit, and is a basic guide to services. However, its presentation of information including both maps and the schedules is difficult to interpret for the inexperienced rider, who should be the intended audience of such a guide.

Sudbury Transit should consider contracting the production of the guide to a private contractor to produce the guide. Several options are available, some at little cost with offsetting advertising, and options also exist to produce the guides in both official languages.

5.8.2 Staffing Requirements

While not strictly within the mandate of this review, general observations of the structure and staffing levels of Sudbury Transit were made throughout the study, as part of the data collection and consultation interaction with staff.

Sudbury Transit's current administration comprises one director with an administrative assistant, operations manager, fleet and maintenance manager and administrative clerk. Currently there are

no specific positions for planning and scheduling nor for marketing.

In comparable systems of this size, these functions are commonly provided, either as full-time or combined positions. For the size and scope of Sudbury Transit's operation, effective planning and marketing are crucial to the on-going development of the system, as well as ridership growth.

During the course of this study, one of the key elements emerging from the consultation with staff and stakeholders was the lack of resources to permit Sudbury Transit to effectively plan for and respond to changes in the transit environment on an on-going basis, including factors such as increasing traffic congestion or growth in development and ridership.

Currently, the Director and Operations Manger assume primary responsibility for these duties, including detailed scheduling functions. These responsibilities are not appropriate to this level, and functions such as long-range planning and strategic marketing cannot allocated sufficient time within this framework.

Sudbury Transit should consider developing combined positions for these functions, including a new position for combined planner/scheduler and a part-time marketing position.

5.9 Long-Term Strategy

In the longer-term, Sudbury Transit should consider a reorganization of its route system to provide more direct services throughout the urban area. This system would comprise:

- a base route network, with basic 30- and 60-minute headways in off-peak periods, and supplementary peak period services to increase reduce headways to 15- or 20-mintes;
- supplementary local routes to provide neighbourhood access and direct connections to minor attractors and generators; and
- commuter routes, with minor adjustments to complement urban services within the urban area.

A concept of this base route network is shown in Exhibit 8, comprising 4 major corridor routes.

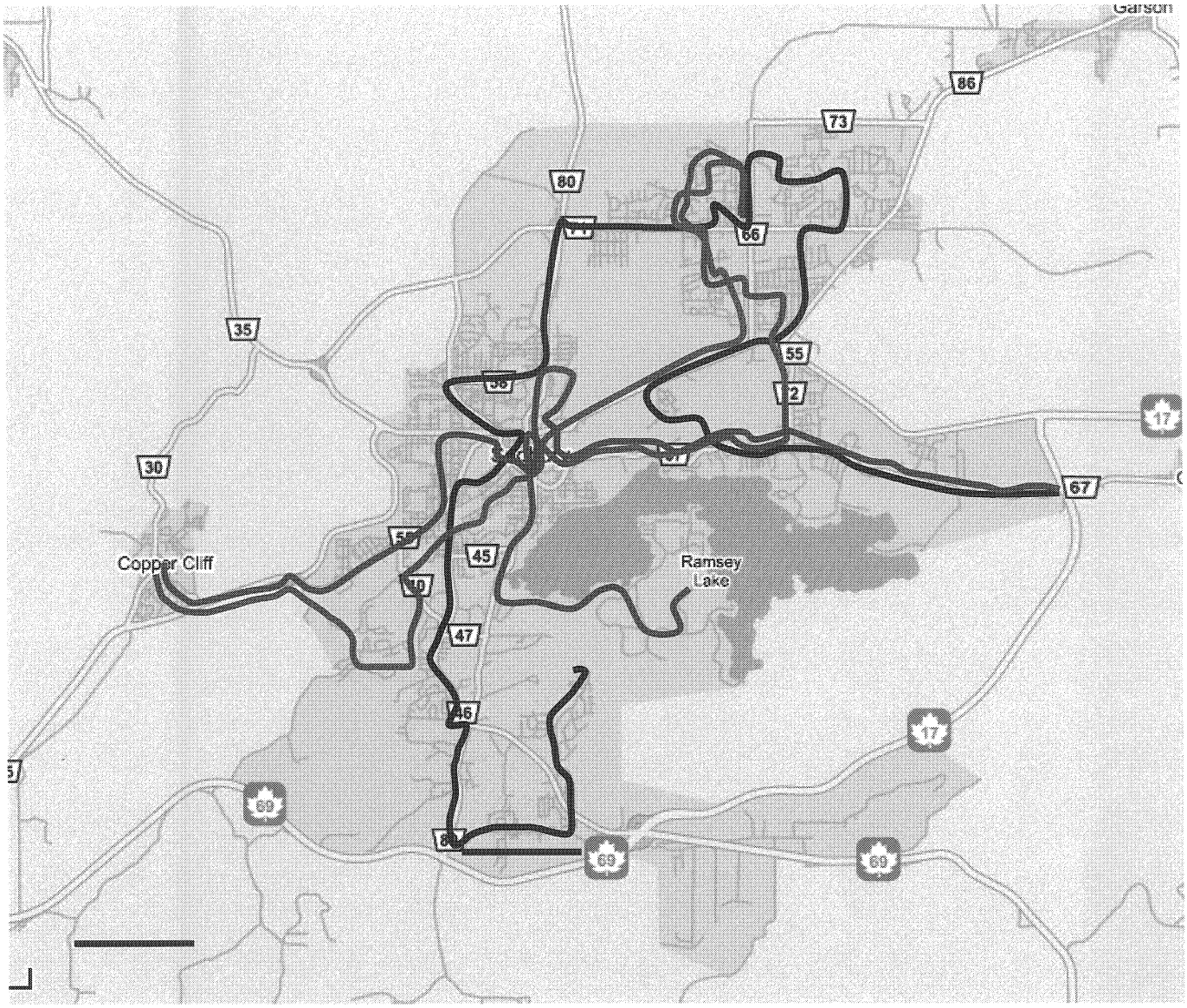

Exhibit 8
Sudbury Transit Riderhsip Growth Strategy
Long-Term Base Route Concept

ENTRA
CONSULTANTS

6. Short-Term Service Components

This section presents a summary of the short-term opportunities and recommendations suggested by the previous analysis, including the application of service standards to existing services, and new and revised strategies to promote ridership growth.

6.1 Existing Service Review

Section 3 of this report examined a number of the routes in the existing system, assessing then using the proposed service standards and recommended analysis framework. This framework uses service standard thresholds to identify poor performing routes and attempts to identify remedial measures that can improve performance to within standards levels. In summary, this analysis suggests the following changes be made in the short-term.

6.1.1 Urban Routes

ROUTE 141/142 – WESTMOUNT/GRANDVIEW/SHOPPING CENTRE

The performance of this route is not only less than the relative assessment threshold for below-average routes, it is also less than the minimum standard requirement for peak routes (based on recommended standards).

Revise to Route 141/142 to serve as a local route continuing to serve the Grandview and Westmount areas connecting through New Sudbury Center in both directions (operating via LaSalle) and no longer connecting to the downtown transit center. Detailed road testing will need to determine if this routing could be completed in 30 minutes, permitting service on this route to be doubled to 30-minute frequency at no cost.

Other route proposals will enhance connections from New Sudbury Center to Downtown.

ROUTE 12 MCKIM

The service Assessment identified Route 12 McKim as a poor performer, but still above minimum performance levels. Also, service on this route provides unique service to the neighbourhood, service levels should not be reduced or adjusted.

6.1.2 Commuter Routes

ROUTE 701 - LIVELY

Route 701 – Lively falls below minimum performance levels in the PM period, and represents the lowest performance in the system.

Discontinuing the 7:30pm outbound and 8:30pm inbound trip 6 days per week would reduce approximately 625 vehicle-hours and save approximately $50,000 annually, and increase the boardings per hour performance for this route to acceptable levels. These trips do not make TransCab connections, so this service would not be affected.

ROUTE 103 CONISTON

Route 103 Coniston falls below the minimum performance levels in the PM period, and has insufficient service in the AM.

Adjusting the first AM trip to continue to the New Sudbury Center, permitting connections to arrive downtown in the AM peak would be a minimal cost solution, adding approximately 75 vehicle-hours per year, at a cost of approximately $5,000. This additional trip would need to attract 2 passengers per trip to increase the AM performance of this route to acceptable levels.

Since additional AM service my enhance PM and evening ridership, discontinuing an evening trip is not recommended at this time. Service on this route should be monitored to assess the impact of the additional AM service.

6.2 Urban Routes Enhancements

Recommendations for urban route enhancements are based on the travel analysis suggesting more direct service, more frequent service in key corridors, and re-alignment of routes to reduce or eliminate detours and diversions.

6.2.1 Shopping Center Access

One of the key areas to address is the issue of shopping center access. Providing attractive service to these centers requires a balance of close access and quick travel times, balancing the needs of passengers destined to the center versus those riding through to other destinations.

In the medium-term, the travel analysis suggests the development of centers such as New Sudbury Centre as a minor hub to service the northeast urban area. This development will provide the opportunity to establish a specific location at the center for transit service, and facilitate rapid access to and from the street.

In the meantime, each particular routing should be reviewed in detail to establish the most direct and convenient routing through the center, avoiding traffic bottlenecks, and protecting the integrity of the route operation. This means avoiding direct access to the storefronts, unless the access can be provided without potential for delay to the transit vehicles.

The service standards suggest that patrons are willing to walk up to 500 metres to a service. However, this is a maximum, and is further reduced in the context of the shopping trip when passengers are likely to have bags and parcels.

The key to the successful service in these areas is providing direct access to a central location, which can then be connected to store entrances with a convenient, safe and comfortable walking path. This means establishing formal pedestrian paths from the transit stop to store entrances, protected from traffic and parking movements, kept clear of snow and ice and well-lit. Providing these amenities requires the cooperation of mall owners and tenants, but efforts in this area can be rewarded with improved travel times, more reliable service, and quality passenger connections, leading to increased ridership.

6.2.2 Northeast Loop Route

To support other recommended route changes, and increase service in key corridors, ENTRA recommends establishing a north-east loop route, operating via Kingsway and serving the Millennium Center, Barrydowne to Cambrian College and New Sudbury Center, LaSalle and Paris, returning to Downtown.

This service, operated in both directions, would require approximately 60 minutes to complete, and require 4 buses for 30-minute service. This would supplement the existing services in these corridors and support the high demand in these areas.

The service as recommended would require 4 new vehicles and approximately 17,000 vehicle-hours of service annually, at a gross cost of approximately $1.2 million.

6.2.3 Direct Routings

In the short-term, an opportunity to test the concept of direct routes not serving the transit center should be piloted with a selective interline of Route 301 and Route 500, with selected trips operating directly through, without serving the Downtown Transit Center. Cost of this operation would be minimal, if drawn from existing trips.

However, ENTRA recommends that this service be introduced in addition to existing service levels, providing additional service in the corridors, as well as direct convenient connection between Cambrian College, New Sudbury Center, Millennium Center, the hospital, and Laurentian University campus. As an additional service, this route could be operated as a limited stop service, stopping only at the major origins and destinations.

With limited stops and avoiding downtown, this route could be completed in 30 minutes or less, with a round trip time of 60 minutes. This means that 2 buses would be required to provide 30-minute service throughout the day. Operating 12 hours per day (7:00 am to 7:00 pm) six days per week would require 2 vehicles and approximately 7,500 vehicle-hours annually, at a gross cost of approximately $550,000.

6.2.4 Frequency Improvements

Analysis of ridership statistics (boardings per hour), and community consultation suggests that student oriented routes are quite crowded throughout the day. With AM ridership approaching 100 boardings per hour on the major routes: LaSalle, Paris, University, Barrydowne, serving the major corridors and connecting to Laurentian University and the colleges, additional service could be used to reduce crowding, improve service reliability and increase ridership.

Vehicles regularly used as "doubles" or extra trips, should be included in the regular scheduled service. Assuming these vehicles would be reserved for additional support services, service enhancements would require additional vehicles.

- Route 500: 1 peak vehicle to increase frequency to 10 minutes in peak periods during school year - 1,200 hours and gross cost of $90,000 annually
- Route 401 - 1 peak vehicle to increase frequency to 10 minutes in peak periods during school year - 1,200 hours and gross cost of $90,000 annually
- Route 14: 1 peak vehicle to increase frequency to 15 minutes in peak periods during school year - 1,200 hours and gross cost of $90,000 annually

- Route 501: 1 peak vehicle to increase frequency to 15 minutes in peak periods during school year - 1,200 hours and gross cost of $90,000 annually
- Route 301/302: service is increased to 10 minutes in the LaSalle corridor with the introduction of the proposed north-east loop

6.2.5 Other Route Revisions

Other minor route revisions are recommended based on the application of the service standards and the need to reduce running time on key routes, especially those operating in major corridors such as Kingsway, LaSalle, Barrydowne and Paris.

Examples include:

- eliminating the routing on Route 301 via Carmello in all periods, or at a minimum, in peak periods. This portion of the route is within the walking distance standard of service stops on Falconbridge, and the change will provide much needed running time on this route. In off-peak periods, when running time is not as tight, the diversion could remain in place, providing closer access as a trade-off against reduced frequency. However, ENTRA recommends its complete elimination;
- streamlining access in all shopping centers, as described above; and
- potential elimination of the Tulane/Hudson detour, for reasons similar to that of the Carmello routing .

Future requests for this type of diversion should be discouraged, and only implemented where the benefits in terms of new riders gained as a result of the change out weigh the inconvenience to existing through passengers.

6.3 Commuter Routes Enhancements

In addition to the recommendation for Route 103 Conistan, additional AM trips should be introduced on commuter routes to meet the minimum AM service levels in the proposed standards.

ROUTE 702 – AZILDA

Scheduled service is supported by additional AM trips from Azilda north, and no additional action required to meet standards.

ROUTE 703 – CAPREOL/HANMER

Add 1 additional trip to arrive downtown at 8:00am. Inbound trip should operate from Hanmer only, departing Notre Dame at Cote at 7:19am. This will require bringing out 1 bus 1 hour earlier, and may require an additional bus, if interlining opportunities cannot be identified at the detailed scheduling stage. Scheduling options may include using the existing Route 400 Express (departs Downtown at 8:15am), adding 1 hour to this service. This would add approximately 250 vehicle-hours of service annually, at a gross cost of approximately $20,000.

ROUTE 704 - BLEZARD

This route comprises only one AM inbound trip, though the Hanmer area of this route also has access to Route 703. The single trip carries an average of 30 to 40 passengers, indicating support for an additional trip. This additional AM trip is also likely to increase PM trip ridership. An additional AM trip would require approximately 250 vehicle-hours of service annually, at a gross cost of approximately $20,000 annually.

6.4 New Service Opportunties

6.4.1 Airport

Adding service to the Airport via Route 303 would add approximately 8kms one way to this trip, or 16 kilometres per trip, requiring an at least 20 minutes per trip. Accommodating this addition on the daytime trips (6 trips) would add approximately 500 vehicle-hours annually, at a cost of approximately $40,000 annually. To justify this service, the unique airport portion of the trip would need to generate at least 20 rides per day (5,000 annually).

Transit travel to airports is not particularly attractive to air passengers, unless the trip is very frequent and fast. Ottawa for example, provides frequent service and connections to the city center via the transitway that rival speeds by private automobile. The unique portion of the airport trips carries approximately 2 to 3 passengers per trip to and from the terminal.

Often a more lucrative market for major airports is the employee base at the airport. However, this base has to be quite large to support transit service, since airport employment often involves odd shift times that are not the same as passenger travel times, and employees usually require different pick-up and drop-off points remote from the terminal.

Given the level of activity at Greater Sudbury Airport, both in terms of passengers and employees, the availability of good ground transportation in terms of taxis and rental cars, and the distance from the city centre, it is unlikely that this service can be supported.

6.4.2 Small Community Services

In general, the threshold for considering some level of community service for travel within a community, rather than connecting to a larger centre, is about 8,000 to 10,000 people, and thresholds can be lower if the service can be combined with connecting commuter services.

On this basis, community service could likely be supported in Hanmer, and possibly in Chelmsford. Other communities remain too small to support local service based on the population thresholds.

Service in Hanmer could be provided with a small bus circulating locally in the community, on a one-hour cycle, timed to meet the commuter service at Hanmer Mall. The capital and operating plan includes an allowance for this service in 2007.

Operating 12 hours per day, six day per week, this service would require one vehicle and approximately 3,750 vehicle hours, at a gross cost of approximately $275,000. A small community service such as this should be expected to attract approximately 10 boardings per vehicle-hour, or approximately 40,000 boardings annually.

This service could also expect to attract additional ridership to the commuter Route 703, since it provides better access transit access to the community. After some operating experience, select routes could be interlined with the commuter trip, using the larger bus, to provide direct connections.

Service in Chelmsford should be deferred until the experience of the Hanmer service can be assessed. The capital and operating plan includes an allowance for this service in 2008.

6.5 Fare Strategies

6.5.1 Transferable Pass

ENTRA recommends that Sudbury eliminate the non-transferable restriction and photo ID requirements for the full-priced adult monthly pass. Since most adults currently purchasing passes will use them for work-related travel and retain them throughout the day, the transferable pass would primarily be used for additional off-peak trips, when capacity is available in the system.

A transferable pass would likely result in some decline in revenue, as existing passengers are able to use a family member's pass. However, the impact is expected to be small, and should be considered a high quality investment in additional ridership.

With approximately 3,000 adult monthly pass sales, if approximately 20 percent of these are used for additional off-peak trips twice per week, ridership would increase by approximately 10,000 per month, or 125,000 annually. If 20 percent of these trips are existing trips, the revenue foregone would be approximately $45,000, or about $0.35 per trip.

6.5.2 Open Transfer

ENTRA recommends that Sudbury Transit establish an open transfer policy, permitting travel anywhere on the system for a period of two hours from the time the transfer is initially issued. Where the first available connection extends beyond this period (as is the case with some commuter trips), the transfer would also be honored on these trips.

This policy will have a positive effect on the image of the system, permit increased mobility among low-income passengers, and increase ridership. Cost of the initiative is minimal (increased numbers of transfers distributed), and revenue foregone is expected to be close to zero.

6.5.3 SmartCard Opportunities

With the introduction of the smartcard technology recommended in the feasibility study, Sudbury Transit has unlimited flexibility to introduce innovative fare structures to promote ridership. Initially, ENTRAS recommends that Sudbury Transit experiment with:

~ time-of-day pricing, permitting reduced fare off-peak travel between the hours of 9:30 am, and 2:30 pm. This provision should only be introduced once the U-pass is in effect, so that students, who often travel within this period, are not affected, having already received the benefit of the U-pass program

~ targetted marketing campaigns designed to increase customer loyalty, such as frequent user discounts for those not using the card in monthly pass mode, but talking a large number of trips on a particular day.

6.6 Other Strategies

6.6.1 Transit Centre

Staff recently completed a review of security and maintenance at the downtown transit center, and ENTRA supports the recommendations of that review.

Also, specific routing of all routes accessing the downtown transit center should be reviewed, along with the boarding and alighting patterns of passengers within the downtown area, with a view to streamlining routings in the downtown, similar to the recommendations for travel and access to shopping centers.

Specific reductions of loops or diversions in the downtown can make travel to the downtown transit center more direct, making travel times shorter for passengers and deferring expensive running time changes on these routes, improving service reliability throughout the system (and promoting ridership growth), with limited impact on downtown-destined customers.

6.6.2 TransCab

As described in Section 5, ENTRA recommends the elimination of the TransCab premium fare, to improve equity and promote ridership in these low demand areas, with an estimated revenue impact of approximately $35,000, offsetting new transit revenue (from restored ridership) of $14,000 and additional contractor costs of $25000 to $40,000 per year

7. Preferred Strategy Financial Plan

Table 3 shows a summary of the proposed financial plan, based on the elements described in previous sections of this report.

7.1 Operating Costs

This financial plan outlines the costs of the recommended services, beginning in 2006, with staged increases of some elements.

7.1.1 Existing Services Review

This annual amount represents a savings from current costs reflecting service adjustments proposed from the existing service review as described in Section 3.2.3, assumed for implementation in 2006.

7.1.2 Urban Routes

This annual amount includes the proposal for the north-east service revisions described in Section 6.2.2, assumed for implementation in 2007 and the direct route proposal described in Section 6.2.3, proposed for 2008.

7.1.3 Commuter Routes

This annual amount includes the estimated cost of $20,000 each for service enhancements to Route 703 and Route 704, as described in Section 6.3.

7.1.4 New Services

This annual amount includes the estimated cost of introducing community-based service in Valley east, initially in the Hanmer area, with a possible future implementation in the Chelmsford area. This service is assumed for implementation in 2008.

7.1.5 Frequency Increases

This annual amount includes the estimated cost of introducing service increases on major corridors, in support of student ridership as a result of the U-Pass proposal, plus other general service increases. The budget allocation assumes a staged implementation of the proposals outlined in Section 6.2.4, with half introduced in each of 2007 and 2008.

7.1.6 SmartCard System

The SmartCard costs included in the operating cost estimates include the amounts projected for Total Cash flow from the Gooderham Fare Collection Feasibility Study, detailed in Appendix A.

7.1.7 Staff Increases

This amount includes an annual allowance for salaries and benefits related to a new position from planner/scheduler, as described in Section 5.8.2.

7.2 Operating Revenue

7.2.1 Transferable Pass

Implementing a transferable adult pass, as described in Section 6.5.1 will have a limited effect on transit revenue, estimated at $45,000 annually.

7.2.2 TransCab Premium

Eliminating the $2 TransCab premium will result in a loss of revenue of approximately $35,000, based on current ridership of approximately 17,500 trips. This will be offset by increased transit revenue from expected ridership increases in the amount of approximately $14,000 annually.

7.2.3 Revenue from New Services

Revenue from new services is based on proposed implementation dates for new services, and ridership estimates maturing over a period of two years. These estimates are intentionally conservative, and will likely be exceeded, resulting in higher revenue and lower net costs.

7.2.4 U-Pass Revenue

Revenue from the proposed U-Pass program is calculated based on a monthly cost of $25 per student from all three campuses for the period from September to April each year. This amount is net of the current revenue from student passes, tickets and cash during these months. Implementation for the pass program is dependent on the outcome of student referendums, and may not apply to all 3 schools, but is assumed for implementation in September 2007.

7.3 Capital Costs

Capital elements are derived from the current capital plan, provided by Sudbury Transit for replacement and refurbishing of buses, plus service vehicles and major equipment. This includes a planned replacement of the storage and maintenance facility in 2012. Other amounts have been added, as described in these sections.

7.3.1 Expansion Vehicles

Expansion vehicle requirements are based on the vehicle requirements for the services described under Operating Costs, at a unit cost of $425,000 per vehicle, including farebox and radio.

7.3.2 Fareboxes

Farebox requirements are based on the total capital investment for smartcard systems, as described in Appendix A, with partial investment in 2006 and the remainder in 2007.

7.3.3 Other Elements

Other elements include amounts for unspecified improvements in the areas of Terminal upgrade, and ITS technology improvements, assumed for implementation in later years of the plan.

7.4 Funding Sources

Funding sources for net costs (excluding farebox revenue) include provincial gas tax allocation, federal funds from Bill C48 "New Deal for Cities" funding, the Ontario Transit Vehicle Program (OTVP) and municipal reserves.

Table 3 shows the net amounts to be funded from reserves after the application of the various federal and provincial funding programs. Although some provincial funding may be applicable to operating costs, all funds are shown here as applicable to capital costs.

In addition to these amounts, federal Bill C46 funding includes initial amounts of approximately $2 million annually, increases to approximately $10 million annually for a total of approximately $25 million over 5 years. This funding can be used for sustainable infrastructure projects and include transit capital investment. No specific application of these funds has been included in the financial plan.

Table 3
Financial Plan Summary

	2006	2007	2008	2009	2010
Existing Budget Provision (1)	**16,500,000**	**17,700,000**	**18,500,000**	**19,750,000**	**21,000,000**
Incremental Budget Provision(2):					
Existing Service Review	(45,000)	(45,000)	(45,000)	(45,000)	(45,000)
Urban Routes	-	1,200,000	1,750,000	1,750,000	1,750,000
Commuter Routes	40,000	40,000	40,000	40,000	40,000
New Service	-	-	275,000	275,000	275,000
TransCab Contract Additions	-	25,000	30,000	35,000	40,000
Frequency Increases	-	180,000	360,000	360,000	360,000
Smartcard System (3)	-	(5,000)	127,750	172,000	132,500
Staff Increases	30,000	60,000	60,000	60,000	60,000
Incremental Operating Cost	**25,000**	**1,455,000**	**2,597,750**	**2,647,000**	**2,612,500**
Total Gross Operating Provision	**16,525,000**	**19,155,000**	**21,097,750**	**22,397,000**	**23,612,500**
Less:					
Operating revenue					
Budgetted Revenue (1)	6,790,000	6,828,000	7,000,000	7,100,000	7,250,000
Transferable Pass	(45,000)	(45,000)	(45,000)	(45,000)	(45,000)
TransCab Premium	(35,000)	(35,000)	(35,000)	(35,000)	(35,000)
New TransCab Ridership	14,000	14,000	14,000	14,000	14,000
Revenue from New Service (4)	14,000	499,000	1,078,000	1,400,000	1,455,000
Upass(5)	-	375,000	700,000	750,000	800,000
Net Operating Revenue	**6,738,000**	**7,636,000**	**8,712,000**	**9,184,000**	**9,439,000**
	0.408	0.399	0.413	0.410	0.400
Net Operating Costs	**9,787,000**	**11,519,000**	**12,385,750**	**13,213,000**	**14,173,500**
Performance Measures					
Projected Ridership	4,253,000	4,763,000	5,453,000	5,738,000	5,876,000
Projected R/C	0.41	0.40	0.41	0.41	0.40
Projected Boardings per Vehicle hour	34	37	41	43	44
Projected Ridership per capita	26.9	30.0	34.1	35.8	36.4
Capital Costs					
Expansion	-	2,400,000	2,400,000	1,200,000	1,200,000
Replacement (6)	3,675,000	2,600,000	2,600,000	2,500,000	2,500,000
Refurbishing(6)	270,000	187,500	187,500	-	150,000
Fareboxes(7)	1,327,000	1,000,000		-	
Service Vehicles (6)	50,000	-	50,000	-	50,000
Vehicle Hoists	80,000				160,000
Wash Rack/Cleaning System (6)	-	150,000	-	-	-
New garage -2012 (8)	-	-	-	-	100,000
Shelters(9)	10,000	10,000	10,000	10,000	10,000
Terminal Upgrade(9)			250,000		
ITS systems(9)				500,000	500,000
Total Capital Costs	**5,412,000**	**6,347,500**	**5,497,500**	**4,210,000**	**4,670,000**
Transit Funding Sources					
Provincial Gas Tax Allocation (10)	(2,200,367)	(2,708,144)	(2,708,144)	(2,708,144)	(2,708,144)
Federal C48 funds	(675,000)	(675,000)	-	-	-
OTVP Capital Subsidy (11)	(1,102,500)	(780,000)	(780,000)	(750,000)	(750,000)
	-	-	-	-	-
Net Capital Offsets excluding reserves)	**(3,977,867)**	**(4,163,144)**	**(3,488,144)**	**(3,458,144)**	**(3,458,144)**
Net Capital Cost to be funded from reserves	**1,434,133**	**2,184,356**	**2,009,356**	**751,856**	**1,211,856**

Notes:
1. Based on 2005 actual and 2006 budget. Future years based on similar increase
2. All amounts carried forward to future years from first year of implementation
3. Based on Financial Analysis (Total Cash Flow) from Gooderham study
4. New service revenue based on reduced initial ridership, inc reasing over 2 years
5. Based on September 2007 implementation, $25 per student monthly, September-April
6. Based on current capital plan
7. Based on total capital cost from Gooderham study
8. Initial design cost allowance for new garage
9. Future allowance for unspecified improvements
10. 2008 and beyond based on 2007 amount
11. Provincial subsidy up to 33 percent available. Estimates based on 30 percent of vehicle replacement costs

8. Asset Management Plan

This section presents a summary of the recommended Asset Management Plan, supported by additional material included in the separate Technical Appendix. The provisions of this plan have been incorporated into the Financial Plan described in Section 8.

8.1 Context

Sudbury Transit currently maintains a fleet of 54 vehicles, operating approximately 3.5 million kilometres and approximately 150,000 vehicle-hours annually, for an average speed of approximately 23 kph.

Sudbury Transit serves the communities of Greater Sudbury, with a service area population of approximately 130,000. A significant factor is the size of the service area, covering a total of more than 3600 square kilometres. Commuter service operated by Sudbury Transit connects the small urban communities throughout the service area to the main urban center of Sudbury. Services in Sudbury are also affected by the topography of the region, resulting in a considerable variability in grades and limited travel route options. Weather impacts during cold winter months are also a factor affecting operating and maintenance costs.

Municipal objectives for transit in Sudbury are reflected in the draft Official Plan and the recently completed Transportation Master Plan.

- the improvement of fare collection methods;
- the promotion of public transit use through the introduction of transit passes and other tools;
- development of transportation solutions and fare systems that entice students;
- expansion of surface transit routes as part of new subdivision design and in accordance with locations where intensification occurs;
- the improvement of bus stops with better shelters, route information displays, and bus bay construction; and
- improvements to the public transit system consistent with the Greater Sudbury Accessibility Plan.

Transportation Master Plan objectives include:

- ensure that the existing transportation network is maintained in a state of good repair;
- ensure that the transportation network provides safe, convenient and efficient movement for all people and goods in Greater Sudbury;
- support the expansion of the transportation network as demand justifies and
- ensure that improvements occur in a safe, efficient, environmentally sound and aesthetically pleasing manner;

- coordinate the development of Greater Sudbury in order to effectively reduce congestion and the associated environmental impacts;
- promote all travel modes, including public transit, walking and cycling;
- provide affordable, convenient and reliable public transit service that enhances mobility and access;
- consider the needs of the physically challenged in the planning and design of all aspects of the transportation network; and,
- support programs that aim to reduce the environmental impacts of certain modes of transportation.

Effective transit services and infrastructure supported by a well-maintained fleet, equipment and infrastructure, contribute to each of these objectives.

8.2 Outlook

As a resource-based economy, the Sudbury community is subject to variations in commodity prices and world markets for mining products. In recent years, the population has been fairly stable, but transit ridership has been steadily increasing, with additional resources necessary to meet growing demands.

Despite a stable population, internal redistribution of population is still occurring with growth in the outlying communities tending to increase overall travel distances and further tax transit reserves.

Based on the service plan and fare technology review conducted in parallel with this asset management plan, Sudbury Transit's outlook is based on the following assumptions:

- stable, slowly increasing population and employment base;
- increase in service employment, particularly related to health, education and communications;
- increasing fleet requirements to meet increasing ridership per capita performance (target increase of 12 percent);
- introduction of smart-card based fare collection technology in the short-term;
- replacement of aging garage facility in medium-term;
- enhancements to downtown terminal facility in short- and medium-term;
- opportunities for improved communication tools in medium-term, including CAD/AVL, transit signal priority, and automated passenger centers.

Technical assumptions built into the analysis include:

- vehicle-life of 18 years for all vehicles purchased before 1995;
- vehicle-life of 15 years for all newer vehicles;

- spare ratio of 20 percent to meet all service requirements, including replacement of service vehicles, regular maintenance, major maintenance and rebuild/refurbish requirements;
- in-house support for all maintenance functions; and
- low-floor accessibility required for all new purchases.

8.3 Inventory

Table B1 in the Appendix B includes the current inventory of transit and service vehicles maintained by Sudbury Transit. With the recent purchase of three new NovaBus vehicles, the current transit fleet is 54 vehicles, with a maximum age of 18 (3 vehicles) and an average age of 10.4. Based on an 18-year life, the average is slightly high (35 of 54 vehicles are older than 9 years) but based on a target of 15 years, the average is about 38 percent above the target average.

Sudbury also uses 2 vans, 4 service trucks and one car to support operations and maintenance.

Major equipment in the shop comprises:

- five hoists valued at approximately $80,000 each;
  - 2 replaced in 2004,
  - 1 scheduled for replacement in 2006,
  - 2 scheduled for replacement in 2010;
- one wash rack, valued at approximately $125,000 new and scheduled for replacement in 2007;
- interior cleaning vacuum system, valued at approximately $30,000 and requiring replacement in the short-term;
- Municipal Fleet Management Information System software for maintenance management, provided by MTO. This software continues to meet Sudbury Transit's needs, but is assessed to have no current value; and
- diagnostic equipment, associated with each particular vehicle technology. Sudbury Transit includes provisions for required equipment with its vehicle tenders.

8.4 Equipment and Facility Issues

Sudbury Transit's maintenance and storage facility is approaching its useful life, and will require replacement in 2012 or 2013. Capital plans prepared by ST include a budgeted amount of $9 million for a new facility within this period. Based on the replacement timeframe for some of the portable or relocatable equipment, some equipment may be usable in the new facility, but it has been assessed that most major equipment will be replaced within this timeframe, including fleet management software, currently under investigation by the Public Works Department.

Hoists scheduled for replacement in 2006 and 2010 may be the new cartridge style, in which case they could be relocated to the new facility.

8.5 Maintenance Program

Sudbury Transit has an effective, comprehensive maintenance program, slightly hampered by the age of some vehicles that require additional attention (30 percent of the fleet is 15 years or older) and the low spare ratio, which limits scheduling flexibility for maintenance programs.

Sudbury Transit has a commitment to 100 percent since delivery, meeting all provincial and legislation requirements for safety inspections.

Sudbury Transit currently tracks a wide variety of performance measures to monitor the effectiveness of its programs, as well as contributing to preventative maintenance identification, including:

- fuel consumption per vehicle, per kilometer; and
- operating cost per vehicle, per kilometer.

8.6 Capital Plan

The capital plan required to support this asset management plan is detailed in Section 7.

The capital program is defined to meet the needs of Sudbury Transit in:

- accommodating projected and potential ridership growth;
- achieving and maintaining an effective spare ratio to ensure service reliability and optimum preventative maintenance capacity;
- achieving and maintaining an average age of not more than 9 years, with a target of 7.5 years, ensuring comfortable, attractive, safe and reliable vehicles to promote ridership growth;
- maintaining effective maintenance and service facility, accommodating all required functions in-house; and
- meeting all required environmental, safety and accessibility standards.

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Appendix A – Fare Collection Feasibility Study

Appendix A1 - Fare Collection Needs Assessment (Technical Brief C1)

Appendix A2 - Technical And Functional Requirements (Technical Brief C2)

Appendix A3 - Business Case (Technical Brief C3)

Sudbury Transit
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Technical Brief C.1 – Fare Collection Needs Assessment

1. Objectives of the Needs Assessment Process

The objective of the Needs Assessment Phase of the project is to:

- Identify the objectives of the City in renewing Sudbury Transit's fare collection system
- Characterize the elements and costs of the existing fare collection system

The information collected and assessed during this phase of the project will be the basis upon which the functional and technical requirements will be built and the business case will be developed.

2. Methodology

To facilitate the efficient collection of information required for the business case development, a detailed questionnaire was prepared and sent to the transit management prior to the needs assessment interviews to enable the collection of necessary information to be commenced in advance.

The Needs Assessment methodology comprises the following elements:

- Completion of questionnaire prior to interviews
- Interviews with key Sudbury Transit management and staff
- Interviews with selected City staff
- Interviews with selected employers and post-secondary institutions
- Review literature and City website information and publications
- Personal assessment of the system
- Review of provided information
- Determination of the project needs objective and constraints.

3. Observations

3.1 Current Fare Collection Equipment, System and Operating Practices

Sudbury Transit operates a fleet of 54 buses, equipped with registering fareboxes that were supplied in 1989 by Cubic Transit Systems that have now come to the end of their useful service life. Maintenance road calls due to equipment breakdowns and jams are unacceptably frequent. Replacement parts and components are harder and increasingly expensive to source.

The fareboxes currently accept coins and banknotes for cash fare payment and pre-purchased single journey tickets as well as read a magnetic stripe swipe card configured as a period pass. The system was originally conceived for reading and writing to the magnetic stripe to enable a multi-ride ticket to be sold; however, the writing capability of the farebox did not work reliably and the multi-ride ticket plan was abandoned.

Drivers report farebox maintenance problems including inaccurate coin and banknote registration requiring manual entry of bill amount and frequent paper path jams that at the least will require the driver to spend time correcting the jams and potentially will require a maintenance road call and potentially can take the bus out of revenue service. Frequently the driver has to put the farebox on by-pass until it is serviced thereby reducing the reliability of the ridership and revenue information collected.

Drivers also report frequent disputes with passengers over transfer time and pass validity and the requirement to produce photo ID.

The reported weaknesses of the current farebox system include:

- Frequent equipment breakdowns requiring road calls resulting in
    - unacceptably high maintenance costs,
    - schedule delays while problem is corrected, and
    - potentially taking buses out of revenue service
- Poor system accuracy caused by coin registration problems and by driver errors when manually entering banknote denominations
- Failure of magnetic swipe system to write to the card; thereby precluding the issuance of multi-ride tickets
- Relative system inflexibility to accommodate innovative fare structures and policies
- Potential for significant under-recording of transfer ridership
- Potential for drivers' inadvertent acceptance of expired transfers

3.2 Current Fare Collection System Operating Costs

The following information was determined based on the initial answers provided to the preliminary questionnaire and on a detailed review of the financial Information collected during the needs assessment interviews.

#	Information Requested	Value Reported and Determined
1	Annual budget for fare revenues from all fare media	$5,638,670
2	Annual budget for non-fare revenues (e.g. advertising etc.)	$101,000
3	% of annual fare revenue collected/ridership from cash fares	39.2% / 23.8%
4	% of annual fare revenue collected/ridership from prepaid tickets	32.5% / 22.5%
5	% of annual fare revenue collected/ridership from prepaid passes	26.8% / 40.1%
6	Breakdown of 2004 annual fare revenues by fare classifications	Adult - 28.36% Student - 18.71% Special - 15.51% Cash - 23.77% Transfers - 13.65%
7	Annual budget to purchase tickets	$25,000
8	Estimate of value of unsold tickets discarded when new fares are introduced	Kept and reused in later years
9	Annual budget to purchase monthly or other passes	$24,000
10	Estimate of value of unsold monthly passes discarded at end of each month	$500/month $6,000/year
11	Estimate of value of unsold semester passes discarded at end of each semester	NA
12	% commission rate paid to third party merchants for selling tickets	1% paid to third party merchants except the Transit Centre which is paid a flat fee
13	Annual budget for third party commissions	$110,000 to Transit Centre
14	Annual budget for courier costs to distribute fare media to third party merchants	$2992 for admin salaries courier disbursements are extra
15	# FTE's budgeted to manage ticket and pass inventory - order, distribute, reconcile etc.	One FTE
16	Annual salary plus benefits for one of these FTE's	$63,377
17	# FTE's budgeted to collect, count and deposit coins from fareboxes	One half FTE
18	Annual salary plus benefits for one of these FTE's	$35,360

#	Information Requested	Value Reported and Determined
19	# FTE's budgeted to perform maintenance on fareboxes and vault	One quarter FTE
20	Annual salary plus benefits for one of these FTE's	$59,000
21	Annual budget for parts required to maintain fareboxes and vault	$11,500
22	Annual budget for third party services required to maintain fareboxes	Included In Item 21
23	Estimate of frequency of maintenance being required on fareboxes and vault	Avg. 3.5 maintenance calls/day requiring one quarter supervisor FTE @ $65,000/yr
24	Annual budget for secure courier costs to transfer cash to bank	$6,400 - Brinks
25	Annual budget for bank fees charged relative to handling deposits of cash fares	Unknown - will provide
26	Estimate of % rate of transfer fare evasion (e.g. expired, passed to third party etc.)	Unknown, but expected to be significant
27	# years over which investments in fare equipment must be amortized according to City accounting guidelines	There is not guiding City policy
28	% amortization rate or % cost of capital according to City accounting guidelines	There is no guiding City policy
29	Average fare per revenue passenger	$1.55 (2004)
30	Annual revenue passengers	$3,887,243 (2004)
31	Annual total passengers	$4,500,843 (2004)
32	Provide an organization chart of Sudbury Transit that will indicate the responsibilities/positions of individuals involved in fare collection, revenue management, planning, customer service, marketing, accounting, maintenance and general management	Provided
33	Provide a copy of the last two annual financial reports and the current annual budget for Sudbury Transit	Provided
34	Provide a copy of the City of Sudbury's current Strategic Plan; in particular focusing on the aspects of the plan relative to Sudbury Transit, the SMART community initiative and any other aspects of the City services that might be suitable for the adoption of payment for services by smart card	Provided

The distribution of fare media used by passengers, the revenues collected and the pass usage during 2004 are summarized in the following tables:

Fare Media	2004 Ridership	%	%	2004 Revenue	%
Passes	1,806,424	40.1%	46.5%	$ 1,609,410	26.8%
Adult Tickets	871,745	19.4%	22.4%	$ 1,756,743	29.2%
Special Tickets	138,358	3.1%	3.6%	$ 199,541	3.3%
Total Tickets	1,010,103	22.4%	26.0%	$ 1,956,284	32.5%
Cash	1,069,864	23.8%	27.5%	$ 2,358,158	39.2%
Transfers	614,421	13.7%	15.8%		
Charters				$ 17,941	0.3%
Miscellaneous				$ 70,275	1.2%
Total	**4,500,812**	**100%**		**$6,012,068**	**100.0%**
Total Paid	**3,886,391**		**100%**		

2004 Passes	# Annual Passes	%
Passes	6,014	19.1%
Adult Tickets	16,183	51.4%
Special Tickets	9,308	29.5%
Total Annual	**31,505**	**100%**

The approved fare structure in place at Sudbury Transit is detailed in the following table:

Fare Classification	Cash Fare	Bus Ticket Price	Concession Fare Identity Card Price	Bus Pass Price
Adult (12 yrs and older)	$ 2.25	$ 1.75		$ 66.00
Children (5 to 11 yrs)	$ 1.75	$ 1.25		
Infants (4 yrs and under)	Free			
Post Secondary Students	$ 2.25	$ 1.75		$ 60.00
Seniors	$ 1.75	$ 1.25	$ 5.00	$ 41.00
Disabled Persons	$ 1.75	$ 1.25	$ 20.00	$ 41.00

3.3 Current And Future Fare Collection Budgets and Priorities

Sudbury Transit has set the following fundamental objectives for the replacement of its fareboxes;

- provide at least all the fare collection functionality currently available with the existing fareboxes
- reduce the incidence of farebox maintenance road calls that take a bus out of service
- enable more machine readable fare media to reduce the potential for driver/passenger disputes over transfer, photo ID or pass validity.
- provide for the collection of much more accurate and flexibly configurable ridership and revenue records according to a variety of performance measure such as boardings by individual bus stop.
- enable a significant growth in ridership through improved fare and policy flexibility and ridership development and promotion opportunities such as providing multi-ride tickets and potential U-Pass and loyalty programs and time-of-day fares.

While Sudbury Transit had provided for the straight replacement of its existing fareboxes with identical functionality in its 2005 capital budget, it decided to delay this procurement pending consideration of the potential to implement smart cards rather than magnetic swipe cards as fare media and to apply these smart cards for other City revenue collection and access control purposes. In particular, the potential to coordinate with some of the SMART Sudbury initiatives was to be explored.

The farebox replacement budget set aside was $1M or almost $20K per bus; by adding other City functionalities, the budget for a smart card city-card built around transit fare collection capability could increase substantially. In addition, the City desires to be able to consider the procurement of replacement fareboxes from more than one farebox equipment supplier.

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Technical Brief C.2 – Technical and Functional Requirements

1. Objectives of the Technical and Functional Requirements Review Process

The objectives of the Technical and Functional Requirement Review Phase of the project are to:

- Collect, interpret and document Sudbury Transit's specific technical and functional requirements for the new fare collection system, and
- Determine the technology alternatives for which a comprehensive business case should be developed, addressing the financial and non-financial costs and benefits to Sudbury Transit

2. Methodology

Important information required to understand the technical and functional requirements for Sudbury Transit's new fare collection system was collected during several in-depth interviews with transit management and during several round table discussions with transit supervisors, inspectors and operators. These interviews and discussions facilitated the understanding of Sudbury Transit's current operations and revenue management environment and more importantly highlighted key problem areas and opportunities for improvement. This information was then compared with current knowledge of fare collection technologies that are available in the market today to develop alternative technology scenarios for Sudbury Transit to consider.

The particular methodology comprises the following elements:

- Interviews and discussions with transit staff
- Capture and document the fare collection system technical and functional requirements learned through those interviews and discussions
- Detail several technology alternatives to meet aspects of these requirements
- Review parameters and issues relative to each technology alternative considering an operating profile of the system with that technology, how to incorporate the technology and potential operational changes that might result from using the technology
- Test and compare each technology alternative against the documented fare collection system technical and functional requirements
- Select the technology alternatives that most closely meet these requirements for further

business case review

- Consider issues relative to operating lifecycle of each alternative

3. Observations and Analyses

3.1 Observations from Interviews and Discussions

The following observations were made from the management interviews:

- Desired fare system capabilities
    - alter all fare system parameters simply and centrally - for example
        - change transfer validity time period
        - change fare classifications and categories
        - set different numbers of days and different starting days for passes
        - sell different numbers of tickets in a 'ticket book'
        - establish different fare for different times of day
        - establish fare-by-distance (if required in future)
    - easily read transaction history on fare medium in event of disputes
- Required farebox capabilities
    - accept and automatically count, register and record coins - accepting banknotes is desirable but not strictly mandatory
    - record all paid and unpaid ridership (transfers & passes) with minimal driver intervention
    - improve accuracy of information collected and reported
    - improve farebox serviceability to simplify maintenance and reduce road calls
    - be passenger and driver 'friendly'
- Desirable farebox capabilities
    - validate and record transfers electronically
    - eliminate requirement to check photo ID in addition to checking pass validity
    - minimize required driver interaction with farebox
- If a smart card fare medium is selected, the City has declared an intention to consider migrating as many municipal applications to a City-issued transit smart card as is feasible. This means that the system design must contemplate other City uses being added onto the card at a later date. These uses could include payment for municipal services such as parking and recreational services, access to municipal services and programs and support of tourism development efforts.

The following observations were made from round table discussions with drivers, inspectors and supervisors:

- Smaller adult tickets jam more frequently than larger special tickets
- Ticket jams can be caused by angled tickets, damp tickets and long tickets
- $5 bill frequently jams
- Less frequent coin jams
- Frequent farebox breakdowns
- Frequent passenger requests for a 'stopover' transfer - an all-direction time-based transfer
- Frequent passenger requests for a day pass
- Drivers rarely win a dispute with a passenger over transfer time validity - easier to let passenger board than have confrontation
- Inconvenient for customers to produce photo ID and pass - due to expected confrontation, drivers often waive requirement to check photo ID, particularly with seniors
- Drivers do not always check time validity of transfers
- Hard to be certain how reliably drivers key in fare information when farebox is in bypass mode
- Current system central computer software does not accurately keep time - farebox clocks are reset monthly to this often inaccurate central time
- Desirable to have a farebox that issues and reads transfers
- Passengers frequently make mistakes swiping magnetic tickets - better to have insertion reader even though that can be slower

3.2 Summary of Technical and Functional Requirements

Based on observations from these interviews and discussions and on consideration of available fare collection solutions, the following technical and functional requirements for the new fare system have been determined:

- Basic farebox functionality must include:

Farebox Needs to Accept	Farebox Needs to Issue
Passes	
Transfers	
Tickets	Transfer
Coins	Transfer
Banknotes	Transfer

- The farebox must record all paid and unpaid ridership (transfers & passes) and ridership

category accurately and with a minimum of driver intervention

- The farebox must validate, count and record all coin and banknote fare payments
- Cash fare payments will continue to require 'Exact Fare Only' - change will not be given
- The system must be reliable, secure, robust, reasonably simple to maintain and readily available in the marketplace
- The system must be reasonably affordable to operate.
- The core fare system functionality must be to enable single journey tickets to be sold in multiple ticket 'books' for various passenger classifications and time-based period passes to be sold for various passenger classifications and time periods. If an electronic farecard such as a smart card or magnetic stripe card is implemented, an electronic purse on the card may be enabled as an optional and future functionality.
- Fare system parameters must be adjustable both centrally and simply
- The system must be readily upgradeable to accommodate other City payment and access applications

3.3 Transfer Media Technology Alternatives

The following transfer media technologies have been considered in the light of these functional requirements:

1. Paper transfers with manually set expiry time which are torn off by the driver when issued
2. Paper transfers issued by an electronic transfer printer with time indicated automatically and legibly for visual inspection by driver - time could possibly be recorded with a machine readable bar code
3. Magnetic stripe ticket/transfer with date/time validity both encoded and thermally printed which is issued and read by the farebox
4. Disposable smart card or smart ticket with encoded date/time validity which is issued and read by farebox as a transfer

1. Paper Transfers - manually issued by driver

Aspects that Support Requirements	Aspects that do not Support Requirements
Relatively simple to operate	Inaccurate reporting of ridership information
Relatively inexpensive to operate	Driver involvement required for issuing and recording transfers
	Less precise time stamping of transfer
	Continued exposure to transfer fraud and driver/passenger disputes

2. Paper Transfers - issued by electronic transfer printer

Aspects that Support Requirements	Aspects that do not Support Requirements
Less driver involvement with issuing transfers	Driver involvement required for recording transfers
More precise time stamping of transfer at time of issue not time of departure from terminal	Continued exposure to transfer fraud and driver/passenger disputes
Relatively simple to operate	Inaccurate reporting of ridership information
Relatively inexpensive to operate	Bar code transfer reader not widely used in transit - unproven technology with limited expandability

3. Magnetic Stripe Transfers - issued by farebox

Aspects that Support Requirements	Aspects that do not Support Requirements
Less driver involvement in issuing - more precise time stamping at time of issue	Magnetic subsystem adds complexity and increases both capital and operating costs
Machine readable transfer minimizes driver involvement and reduces passenger disputes	
Accurate recording of transfer information	
Inexpensive transfer fare media	
Transfer validity can be visually determined from thermally printed Information on transfer	

4. Disposable Smart card or Smart Ticket - issued by Farebox

Aspects that Support Requirements	Aspects that do not Support Requirements
Less driver involvement in issuing - more precise time stamping at time of issue	Disposable smart card transfer issuing systems are not commonly available in the marketplace so new product development will be required.
Machine readable transfer minimizes driver involvement and reduces passenger disputes	Cost of disposable ticket media is relatively high for purposes of transfer usage
Accurate recording of transfer information	Transfer validity cannot be determined without smart card reading device

3.4 Pass and Ticket Media Technology Alternatives

The following pass and ticket technologies will be considered in the light of these functional requirements:

1. Paper tickets and plastic passes (status quo)
2. Magnetic stripe based tickets and passes
3. Contactless smart card tickets and passes

1. Paper Tickets and Plastic Passes (status quo)

Aspects that Support Requirements	Aspects that do not Support Requirements
Relatively simple and 'low tech'	Inaccurate recording of ridership and fare payment information
Relatively inexpensive to purchase and operate	Substantial driver involvement required
	Passes are not machine-readable
	Tickets are machine-readable only based on ticket length - doesn't discriminate on fare category unless many ticket sizes
	Relatively inflexible - not readily and easily adjustable
	Not readily expandable to other Municipal uses
	Cannot add future e-purse

2. Magnetic Stripe Tickets and Passes

Aspects that Support Requirements	Aspects that do not Support Requirements
Machine-readable passes and tickets means minimal driver involvement in fare payment process and reduced potential for driver/passenger disputes	Magnetic media is less suitable for the future addition of other municipal applications based on both security and capacity
Accurate recording of ridership and fare payment information	Magnetic stripe fare media is more secure than paper media but less secure than smart card fare media
Low cost ticket and pass media	Magnetic fare media operating service life is relatively short

3. Contactless Smart Card Tickets and Passes

Aspects that Support Requirements	Aspects that do not Support Requirements
Smart card fare media is more suitable for the future addition of other municipal applications based on both security and capacity	Smart card fare media is more expensive than magnetic fare media
Machine-readable passes and tickets means minimal driver involvement in fare payment process and reduced potential for driver/passenger disputes	
Accurate recording of ridership and fare payment information	
Smart card fare media expected operating service life is relatively long	

The following table briefly considers these three fare media technologies from the perspective of selected other external criteria.

Ticket and Pass Media	**Security & Audit-ability**	**Lifecycle**	**Complexity**	**Financial**	**Municipal Strategy**
Paper Tickets and Plastic Passes	Negligible security - hard to audit	Nearing end of lifecycle	Simple	Least expensive	Not consistent
Magnetic Stripe	Medium security - some audit	Mid-lifecycle	Less complex - needs rigorous procedures	Low cost media - system cost substantial	Not consistent
Contactless Smart Card	High security - full audit	Early in lifecycle	More complex - needs rigorous procedures	High cost media - system cost substantial	Consistent

3.5 System Technology Alternatives Selected for Further Consideration

Based on this review and these considerations, it is recommended that Sudbury Transit purchase an electronic validating farebox with the following minimum attributes:

- Accepts coins and banknotes
- Issues and accepts magnetic stripe based transfers
- Accepts both magnetic stripe based and contactless smart card based tickets and passes

And it is recommended that the following two fare media alternatives be considered further by developing a detailed business case for each, exploring the financial and non-financial costs and benefits of each:

1. Magnetic stripe based tickets, passes and transfers, and
2. Contactless smart card based tickets and passes and magnetic stripe based transfers

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Technical Brief C.3 – Business Case

1. Objectives of the Business Case Process

The objective of the Business Case Phase of the project is to assess the financial and non-financial costs and benefits of each alternative fare media technology being considered and to make a recommendation to Sudbury Transit for the selection of a fare media and system technology to be implemented based on this assessment.

2. Methodology

The business case process will build upon both the earlier needs assessment work that analysed Sudbury Transit's objectives in renewing its fare collection system and determined the costs of its existing fare collection system and upon the determination of Sudbury Transit's specific technical and functional requirements for the new fare collection system.

To develop the business case and to determine a recommended fare media technology, the following process will be utilized:

- The operating profiles and practices for the current system and for each alternative will be considered including the development of a fare payment matrix and potential fare table for each scenario
- The infrastructure required for each scenario will be determined
- A capital cost estimate for each scenario will be developed
- An operating cost estimate for each scenario will be developed
- An operating cost savings and non-financial benefit profile will be developed for each scenario
- These estimates and profiles will be organized into a summary business case for each scenario
- Based on this business case evaluation, one technology alternative will be recommended to Sudbury Transit for implementation

3. Observations and Analyses

3.1 Summary of Alternatives

As documented in Section 3.5 of Technical Brief C.2, under both alternative technology scenarios, it is recommended that Sudbury Transit equip each of its buses with an automated electronic validating farebox that has the following minimum capabilities:

- Accepts fare payment by coins and banknotes and issues time-stamped and thermally printed magnetic stripe transfers on request,
- Accepts single journey magnetic stripe tickets with a full insertion reader/writer that both magnetically encodes and thermally prints transaction time to enable cancelled ticket to act as a time-stamped transfer,
- Reads time validity of magnetic stripe transfers and cancelled tickets,
- Reads and writes to contactless smart cards.

It is further recommended that Sudbury Transit equip its revenue counting room at its bus garage with a 'through-the-wall' type stationary cash receiving vault with the capability to accept two farebox vaults.

It is recommended that Sudbury Transit consider implementing one of the following two alternative ticketing and pass fare media technologies along with the related system and support software:

1. Magnetic stripe technology applied to all prepaid fare media as follows:
    a. Time-based passes, including both non-reloadable single period passes and reloadable multiple period passes, which are to be read by a read-only magnetic swipe reader and which will be required to be provided on the farebox,
    b. Multiple journey tickets which are to be read and individual rides cancelled by a full insertion magnetic reader/writer/printer, with the time of ticket cancellation and the number of rides left visually indicated by the thermal printer,
    c. Individual journey tickets which are to be read and cancelled by the full insertion magnetic reader/writer/printer, with the time of ticket cancellation visually indicated by the thermal printer,
    d. System software required to handle all fare system configuration, management, modifications and reporting, and
    e. System software required to issue and manage all magnetic stripe-based passes and tickets.
2. Contactless smart card technology applied to all prepaid fare media as follows:
    a. Time-based multiple period passes on reloadable contactless smart cards which are to be read by a contactless smart card reader/writer on the farebox,
    b. Single journey fare payments from an electronic purse on reloadable smart cards which are to be read by a contactless smart card reader/writer on the farebox,

c. Time-based single period passes and single journey tickets purchased in ticket books on non-reloadable 'disposable' smart cards ("smart tickets') which are to be read by a contactless smart card reader/writer on the farebox,

d. System software required to handle all fare system configuration, management, modifications and reporting, and

e. System software required to issue, revalue, hotlist, redeem and manage all smart card-based passes and tickets.

3.2 Operating Profiles and Practices

The operating profiles and practices of the current fare system and proposed fare payment alternatives can be summarized as follows:

3.2.1 Current Fare System

Sudbury Transit currently accepts fare payment on the bus either by coins or banknotes, pre-purchased paper tickets and pre-purchased magnetic stripe monthly passes. Paper based tickets and magnetic stripe based plastic passes can be purchased from the Customer Service Centre or from third party resale agents. Ridership information accuracy and fare flexibility is limited.

The following table summarizes Sudbury Transit's current fare policies.

Current Fare Categories & Rates

Fare Categories	Cash	Tickets	Passes	Concession Fare	Concession Fare
		10 book	Month	Identity Card	Identity Card
				(annual)	(lifetime)
Adults (12 yrs and older)	$ 2.25	$ 17.50	$ 66.00		
Seniors	$ 1.75	$ 12.50	$ 41.00		$ 5.00
Disabled Persons	$ 1.75	$ 12.50	$ 41.00	$ 20.00	
Students	$ 2.25	$ 17.50	$ 60.00		
Child (5 to 11 yrs)	$ 1.75	$ 12.50	NA		
Infant (4 yrs and younger)	Free	Free	NA		

The following table illustrates the typical fare payment process with the current fare system.

Current System - Fare Payment Process

Fare Payment	Patron Class	Patron Action	Patron Display	Driver Action	Driver Display
Cash	All	deposit exact cash fare in FB and show concession ID to driver on request	amount deposited	verify fare classification if less than full adult fare by checking concession ID - provide transfer on request	amount deposited
Paper Transfer	All	surrender transfer to driver	none	verify transfer validity - key in transfer to record ridership but not classification	none
Paper Ticket	All	deposit ticket in FB and show concession ID to driver on request	ticket classification	verify ticket classification and concession ID validity	ticket classification
Plastic Period Pass	All	swipe pass and show photo ID to driver on request	pass classification and validity	verify pass and photo ID validity	pass classification and validity

3.2.2 *Magnetic Stripe Ticketing Technology*

Under this alternative scenario, Sudbury Transit will replace all prepaid paper tickets with magnetic stripe paper tickets and will continue to issue magnetic stripe plastic passes. Tickets and passes will continue to be sold through Sudbury Transit's existing sales distribution channels. The single journey and occasional rider will still be able to pay their fare using cash. Magnetic transfers will be issued on request only for cash fare paying customers.

Prepaid tickets and short duration day passes will be available only in a magnetic stripe paper ticket format which will be validated by insertion into the farebox insertion reader/writer unit. A multiple journey ticket 'booklet' will have the purchased number of prepaid individual journey tickets both encoded on the stripe and printed on the ticket face. Where appropriate, the concession status of a ticket will be both encoded on the stripe and printed on the face. As a ticket is used, both the balance of remaining tickets left is reduced and the time of the transaction is encoded on the stripe and is printed on the ticket face. If a connecting ride within the transfer validity time window is taken, when the ticket is inserted in the reader/writer, the system recognizes the ticket as a valid transfer and does not take off an additional ride. In this way, all transfers will be electronically validated and recorded. In the event of a short duration day pass, if the expiry date of the pass is later than the current date, the pass is accepted as valid.

Prepaid longer duration passes will be available only in a magnetic stripe plastic card format which is read by the swipe pass reader on the farebox. A concession fare classification such as senior or student will be encoded on the stripe and possibly physically printed on the face of the pass. Plastic passes will be configured and loaded at Sudbury Transit and distributed to third party agencies for resale much like the

practice with current passes. To purchase a concession pass, a concession ID must be produced. Magnetic passes will not be reloadable.

If the magnetic card is registered and personalized, the card conceivably could be used as an identifying 'pointer' to a central database containing the record of a purse value that is debited or credited centrally to the registrant; however, given the security limitations of magnetic stripe technology, it is not contemplated at this time to make the magnetic pass into a stored value card with the value stored directly on the card. Paper tickets are planned not to be reloadable and to be single usage only.

Underpinning the entire magnetic stripe ticket AFC system is a card management system capable of keeping track of card distributions and personalized cards.

The following pro-forma fare table has been created to illustrate some of the fare flexibility available to Sudbury Transit from the magnetic ticketing based fare system. The values proposed are for illustration purposes only.

Magnetic Fare Categories & Rates

Fare Categories	Cash Fare	Magnetic Plastic Passes				Magnetic Paper Tickets			
		30 Day	3 month	6 month	Annual	Ticket Books		Day Pass	Multi-Day Pass
						2 ride	10 ride		
Adults (12 yrs and older)	$ 2.50	$ 72.60				$ 4.50	$ 22.00	$ 6.25	TBD
Seniors	$ 2.50	$ 45.10	$ 133.95	$ 253.01	$ 446.49	$ 3.60	$ 18.00	$ 5.00	TBD
Disabled Persons	$ 2.50	$ 45.10	$ 133.95	$ 253.01	$ 446.49	$ 3.60	$ 18.00	$ 5.00	TBD
Students	$ 2.50	$ 66.00	U-Pass			$4.50	$ 22.00	$ 6.25	TBD
Child (5 to 11 yrs)	$ 2.50					$ 3.60	$ 18.00	$ 5.00	TBD
Infants (4 yrs and younger)	Free								

The following table has been created to illustrate a typical fare payment process that could be implemented with magnetic ticketing technology.

Magnetic System - Fare Payment Process

Fare Payment	Patron Class	Patron Action	Patron Display	Validator/Farebox Action	Driver Action	Driver Display
Cash	All	deposit exact cash fare in FB and show concession ID to driver on request	amount deposited	none	verify fare classification if less than full adult fare by checking concession ID - provide magnetic transfer on request	amount deposited
Magnetic Transfer	All	insert transfer into FB insertion reader/writer	transfer validity	returns cancelled transfer to patron	verify transfer validity - system automatically records	transfer expiry date/time
Magnetic Paper - Single & Multi Day Passes	All	insert magnetic pass into FB insertion reader/writer	fare classification - pass validity & expiry date/time	verify pass validity - writes date and time of first use onto magnetic stripe	challenge all invalid passes - check validity of fare classification	pass validity, expiry date/time & fare classification
Magnetic Paper - Ticket Book	All	insert magnetic ticket into FB insertion reader/writer	fare classification - # valid tickets on ticket before & after cancellation	verifies that at least one ride remains on ticket - writes to ticket to cancel one ride indicating date/time so ticket can act as transfer	challenge all invalid tickets - check validity of fare classification	fare classification - # valid tickets on ticket before & after cancellation
Magnetic Plastic - Passes	All	swipe magnetic plastic pass through FB swipe reader	fare classification, pass/transfer validity, ticket	verify pass validity - reports fare classification	challenge all invalid passes - check validity of fare classification	fare classification, pass validity

3.2.3 *Smart Card Ticketing Technology*

Under this alternative scenario, Sudbury Transit will replace all current paper and plastic based prepaid fare media with contactless smart card based tickets and passes. Disposable smart card tickets and passes will be sold and reloadable smart cards re-valued through Sudbury Transit's existing sales and distribution channels. The single journey and occasional rider will still be able to pay their fare using cash. Magnetic transfers will be issued only for cash fare paying customers. The smart card itself will contain a record of the transaction and time and will constitute the 'transfer' for all smart card fare payments.

In an attempt to encourage patrons to switch from cash fare payment to smart card fare payment, Sudbury Transit needs to provide both positive and negative incentives. It is proposed that the cash fare be increased from its current level to provide a financial incentive to use the smart card and it is further proposed that Sudbury Transit consider establishing the cash fare to be the same for all passenger classifications. These higher cash fares can be implemented equitably provided Sudbury Transit still offers fares comparable to current fares for patrons that use smart cards.

With most smart card AFC systems, when their smart card is issued to them, patrons are usually expected to pay a small deposit which is set to cover the replacement cost of the smart card plus the issuance cost. Some jurisdictions make the deposit refundable when/if the smart card is surrendered in good condition, while some jurisdictions treat the deposit as a non-refundable fee. Some jurisdictions issue its citizens their first smart card without deposit and charge a higher fee for replacement cards.

Smart cards can be anonymous or they can be "attached" to an individual. The lowest level of attachment is to register a card serial number to the individual in the central system data base, thereby enabling remaining balance refunds in the event of a lost or stolen card. A higher level of attachment involves personalizing the card to the individual with a name and possibly a biometric such a photo on the card. In the case of reduced fare concession classifications such disabled persons or seniors, such personalization is usually warranted. In the event that a visible biometric is not provided on the smart card, the driver will be expected to verify classification status through checking another ID document, in a process similar to that in place today. Of course, requiring the passenger to produce and the driver to check an additional piece of identification will slow down passenger boarding.

Intermittent passengers and visitors can elect to purchase a day pass or a multiple ride ticket book in a disposable smart card format if they do not wish to obtain a reloadable smart card. The fare cost calculation for a disposable smart card payment should include the cost of the disposable smart card.

Because the farebox reliably 'validates' cash payments, Sudbury Transit could elect to allow passengers to add value to their smart cards on the by inserting a banknote to pay a fare and adding the balance onto the card. To manage boarding times, it may be decided to permit this only at off peak hours. By permitting on-vehicle smart card loads, Sudbury Transit may be able to reduce the number of third party reload locations it will be required to provide, thereby also saving sales commissions.

Passengers will present their smart card in front of the smart card acceptance device (SCAD), also called a reader or validator, to have the smart card read and the correct fare deducted.

The SCAD will interrogate the smart card in the following consistent sequence:

1. First, check for a valid monthly or longer period pass and alert driver about fare classification
2. Then, check for an as-yet-unused valid multi-day pass and writes the expiry date/time on the pass

3. Then, check for valid single journey tickets cancels or invalidates one ticket
4. Finally, check for sufficient funds in the smart card e-purse and deducts the correct amount from the e-purse according to the classification encoded on the smart card.

In the event that a passenger wishes to pay the fare for more than one passenger, Sudbury Transit can enable the driver to override the pass-back protection in the system so as to enable multiple tickets to be cancelled or the amount for multiple fares to be deducted from the e-purse.

The City, with its 'mysudbury.ca/tourism' website, will be able to attract visitors and convention by distributing 2, 3 or 4 day transit passes that will be valid from day of first use to convention attendees and visitors. The Community Development Department could provide 2, 10 and 20 ride ticket 'books' to its clients to support their short term mobility needs. Sudbury Transit can require these organizations and departments to pay for the cost of the transit pass up front or it can invoice them for actual transit usage.

To encourage larger e-purse loads which likely would be an indicator of more frequent smart card usage, the City could establish a load value bonus scheme that provides for a larger bonus for higher load values.

In every event, underpinning the entire smart card AFC system, it is necessary to utilize a capable smart card life cycle management software system.

The following pro-forma fare table has been created to illustrate some of the fare management flexibility available to Sudbury Transit from a smart card based fare system. The values proposed are for illustration purposes only.

Smart Card Fare Categories & Rates

Fare Categories	Cash Fare	Reloadable Smart Cards					Disposable Smart Cards			
		E-Purse	Passes			Ticket Book	Ticket Books		Day	Multi-Day
		Single Journey Fare	30 Day	3 month or semester	Annual	10 ride	2 ride	10 ride	Pass	Pass
Adults (12 yrs and older)	$ 2.50	$ 2.00	$ 72.60			$ 20.00	$ 4.50	$ 22.00	$ 6.25	TBD
Seniors	$ 2.50	$ 1.50	$ 45.10	$ 133.95	$ 446.49	$ 16.00	$ 3.60	$ 18.00	$ 5.00	TBD
Disabled Persons	$ 2.50	$ 1.50	$ 45.10	$ 133.95	$ 446.49	$ 16.00	$ 3.60	$ 18.00	$ 5.00	TBD
Students	$ 2.50	$ 2.00	$ 66.00	U-Pass		$ 20.00	$ 4.50	$ 22.00	$ 6.25	TBD
Child (5 to 11)	$ 2.50	$ 1.50				$ 16.00	$ 3.60	$ 18.00	$ 5.00	TBD
Infants (4 yrs and younger)	Free									

The following table illustrates a typical fare payment process that could be implemented with smart card ticketing technology.

Smart Card System - Fare Payment Process

Fare Payment	Patron Class	Patron Action	Patron Display	Validator Action	Driver Action	Driver Display
Cash	All	deposit exact cash fare in FB and show concession ID to driver on request	amount deposited	none	verify fare classification if less than full adult fare by checking concession ID - provide magnetic transfer on request	amount deposited
Magnetic Transfer	All	insert transfer into FB insertion reader/writer	transfer validity	none	verify transfer validity - system automatically records	transfer expiry date/time
Disposable S/C - Single & Multi Day Passes	All	present DS/C to validator	pass validity & expiry date/time	verifies pass validity - writes date and time of first use to S/C	challenge all invalid passes - checks validity of fare classification	pass validity, expiry date/time & fare classification
Disposable S/C - Ticket Book	All	present DS/C to validator	# valid tickets on DS/C prior to & after cancellation	verifies that at least one ride remains on ticket - writes to ticket to cancel one ride	challenge all invalid tickets - checks validity of fare classification	fare classification - # valid tickets on DS/C before & after cancellation
DS/C Transfer	All	present DS/C to validator	pass or transfer expiry date/time	verifies transfer date/time/direction validity	challenge all invalid transfers - checks validity of fare classification	fare classification - transfer expiry date/time
Reloadable S/C - Pass, Ticket & E-Purse	All	present RS/C to validator	fare classification, pass/transfer validity, ticket & e-purse balances	checks first for valid pass - if not, then removes one ticket if available and if not then removes fare appropriate for classification if sufficient funds in e-purse	challenge if invalid pass, no tickets and insufficient funds in e-purse - check validity of fare classification	fare classification, pass/transfer validity, ticket & e-purse balances - amounts deducted
RS/C Transfer	All	present RS/C to validator	fare classification, pass/transfer validity & e-purse balance	verifies transfer date/time/direction validity	challenge all invalid transfers - checks validity of fare classification	fare classification - transfer expiry date/time

3.3 Required System Infrastructure

The electronic validating farebox which is common to each of the two alternative ticketing technology scenarios includes the following system elements:

- Validating Farebox c/w coin and bill validator, magnetic ticket insertion read/write unit, magnetic swipe reader (required with magnetic scenario) , magnetic transfer issuing system, contactless smart card read/write unit (required with smart card scenario), wireless data download/upload system (infrared, W/LAN 802.11 or equivalent), removable cashbox, passenger display
- Driver Control Unit
- Through-the-Wall Vaulting System c/w two receivers
- Data Management System c/w fare collection system configuration tools, report generation tools,
- Installation, Configuration and Commissioning

3.3.1 Magnetic Stripe Ticketing Technology

To implement magnetic stripe based ticketing technology, the following system elements are required:

3.3.1.1 Magnetic Stripe System Hardware and Architecture

- Central System Server - transit application and database server
- Management Workstation(s)
- Ticket Encoding Machine and Workstation
- Customer Service Workstation c/w Ticket Encoding Machine and POS (connected to EFT host)
- Garage W/LAN or Infrared Base Station
- Operating on Sudbury Transit existing Ethernet LAN

3.3.1.2 Magnetic Stripe System Software

- Magnetic Card Lifecycle Management S/W
- Customer Service Centre Management S/W
- Transit Application Business Rules S/W
- System Administration and Equipment Management S/W

3.3.1.3 Magnetic Stripe System Consumables

- Magnetic stripe passes - ANSI/ISO 7813-1987 (54mm x 85.7mm x 0.25mm +/-0.025mm)
- Magnetic stripe tickets and transfers - ANSI/ISO 7813-1987 (54mm x 85.7mm x 0.18mm +/-0.025mm)

3.3.2 ***Smart Card Ticketing Technology***

To implement contactless smart card based ticketing technology, the following system elements are required:

3.3.2.1 Contactless Smart Card System Hardware and Architecture

- Central System Server - transit application and database server
- Management Workstations
- Driver Assignment Workstation c/w smart card R/W unit
- Card Personalization and Printing Workstation
- Customer Service Workstation c/w smart card R/W unit and POS
- Attended Add Value Machines (POS) for remote connectivity by dial up modem
- Potential Unattended Add Value Machines c/w smart card R/W unit for remote connectivity by dial up modem or DSL
- Garage W/LAN or Infrared Base Station
- Operating on Sudbury Transit existing Ethernet LAN
- EFT Host Banking Gateway

3.3.2.2 Contactless Smart Card System Software

- Smart Card Lifecycle Management S/W
- Customer Service Centre Management S/W
- Financial Transaction Processing and Transit Application Business Rules S/W
- System Administration and Network Management S/W
- Equipment Management S/W

3.3.2.3 Contactless Smart Card System Consumables

- Reloadable contactless smart cards - ISO 14443 type A or B for transit only application
- Dual interface contact/contactless smart cards - ISO 7816/14443 type A or B for other municipal applications that may co-exist in the system or with the intention of permitting contact POS readers to load value onto smart cards.
- Disposable contactless smart cards - ISO 14443 type A or B
- Magnetic stripe transfers - ANSI/ISO 7813-1987 (54mm x 85.7mm x 0.18mm +/-0.025mm)

3.4 Capital Cost Considerations

3.4.1 Fare Box Vendors

There are four known vendors of validating fareboxes that serve the Canadian marketplace. A brief profile of each and a vendor comparison table is provided:

3.4.1.1 GFI-Genfare

Website www.gfigenfare.com

GFI is the North American industry leader in the supply of cash accepting registering and validating fareboxes for urban transit bus service. GFI's iconic 'Cents-a-Bill' registering farebox has been an industry mainstay for over 25 years, evolving through DOS and now Windows based operating systems. Equipped with a smart card enabled TRiM unit, the Cents-a-Bill offers much of the functionality now required by Sudbury Transit. GFI has repackaged and extended this functionality with its 'Odyssey' validating farebox which provides all the farebox functionality currently required by Sudbury Transit.

GFI does not offer the smart card management system capability that the City of Greater Sudbury will require to manage the transit smart card (initializing, issuing, personalizing, revaluing, hot-listing, securing and maintaining the patron database) and in due course to apply the transit smart card for other municipal uses. The magnetic card management system offered by GFI will likely not be applicable to other municipal uses.

3.4.1.2 Scheidt & Bachmann

Website www.scheidt-bachmann.com

Founded over 130 years ago, S&B has become a global leader in the design and implementation of automated fare collection systems. North American references include major rail systems for Long Island and Metro-North Railroads in New York and Sound Transit in Seattle and combined rail and bus systems for MBTA in Boston and recently a bus system for Phoenix.

S&B's 'VAREpoint' validating farebox offers all the farebox functionality that Sudbury Transit currently requires at a ballpark price substantially lower than GFI. S&B has far fewer VAREpoint fareboxes in operating revenue service than GFI has with its Odyssey farebox. Nevertheless, S&B has a well deserved and positive industry reputation for excellent product design and solid manufacturing quality throughout its ticket vending and fare collection offering. The VAREpoint farebox has a few unique and innovative features including the ability to alter the bill validator sensitivity settings for different denominations and for the driver to review an image of the bill and to override the VAREpoint selectively. The farebox also can dispense and issue disposable smart card (smart tickets) as transfers, tickets or day passes.

S&B does offer the smart card management system capability that the City of Greater Sudbury will require to manage the transit smart card and likely has the capability to apply the transit smart card for other municipal uses although initial ballpark software prices are quite high.

3.4.1.3 Fare Logistics

Website www.farelogistics.com

Fare Logistics is the new trade style under which Victoria BC based CoinCard International is operating following its recent financial reorganization. CoinCard previously resold a farebox produced by Diamond Manufacturing in Kansas to be used with its proprietary and self-titled capacitive stored value 'CoinCard'.

Under the new management, Fare Logistics has jettisoned the capacitive stored value card in favour of a contactless smart card and has designed a new validating farebox named the 'Canadiana', closely patterned after the Odyssey farebox, which they are having manufactured offshore.

This farebox accepts cash payment by coins only and is supplied without a driver's operating console - Fare Logistics will integrate the Canadiana to a variety of third party driver's units. The Canadiana farebox does not issue magnetic transfers but does issue and read bar code inscribed paper transfers. Their 'Calmsoft' data management system is a newly developed Windows based database management and report generation software system. Calmsoft does not yet support smart card lifecycle management although Fare Logistics is currently working to create this capability. Fare Logistics does not yet offer a through-the-wall vaulting system.

While the Canadiana farebox has most of the functionality required by Sudbury Transit, its unproven operating reliability is a real concern. Of interest is the fact that Fare Logistics claim that their market price for the Canadiana farebox will be 'approximately two thirds' the price charged by competitors. Fare Logistics seems willing to contemplate acting as a device OEM for a system integrator; however, their offering has many current gaps that the integrator will need to bridge.

3.4.1.4 Cubic Transportation Systems

Website www.cubic.com

Cubic Transportation Systems, which is Sudbury Transit's incumbent farebox system provider, seems to have altered its market focus away from serving small to mid market transit providers. Cubic seems primarily to serve only major transit operators, having recently eliminated its mid market sales force. For major USA regional AFC projects involving bus operations, Cubic has partnered with GFI and resold the Odyssey farebox rather than developing its own validating farebox. It continues to provide service and parts for its existing Cubic registering farebox clients; however, often at very high spare parts prices. Cubic does not seem to have invested in developing or improving its current farebox line.

Cubic does have the ability to provide most of the required smart card lifecycle management capability.

It is recommended that Cubic be asked by Sudbury Transit to bid on the new farebox system; however, it is not certain whether they will respond.

3.4.1.5 *Farebox Vendor Comparison Table*

Based on the functionality currently anticipated for the farebox required by Sudbury Transit, the following table will compare the features of the fareboxes provided by these three vendors.

Farebox Attribute 1	Farebox Attribute 2	GFI-Genfare	Scheidt & Bachmann	Fare Logistics	Cubic
Validates (Accepts)	Coins	Yes	Yes	Yes	Yes
	Banknotes	Yes	Yes	No	Yes
	Magnetic tickets	Yes	Yes	Yes	Yes
	Magnetic swipe passes	Yes	Yes	Yes	Yes
	Contactless smart cards	Yes	Yes	Yes	Yes
	Bar coded transfers	No	No	Yes	No
Issues	Magnetic transfers	Yes	Yes	No	No
	Bar coded paper transfers	No	No	Yes	No
	Smart tickets	No	Yes	No	No
	Electronic change	Yes	Yes	No	No
Validation Process	Variable validation sensitivity	No	Yes	No	No
Data Transfer	Infrared	Yes	No	No	Yes
	W/LAN 802.11	No	Yes	Yes	No
	Stored value smart card	No	No	Yes	No
Driver Control Unit	Included with farebox?	Yes	Yes	No	Yes
Smart Card Integration	Ability to integrate S/C Management System? (1/10)*	3	8	3	8
	Willingness to do so? (1/10)*	2	7	6	7
Supply FB as OEM	Willingness to do so? (1/10)*	3	4	7	1
Budget Pricing	Farebox c/w S/C reader	$23,000	US $15,000	$15,300	>$20,000
	Single through-the-wall vault	$54,700	US $40,000	N/O	N/A
	Garage data management S/W	$97,200	US $100,000	N/A	N/A
	Smart card management S/W	N/O	US $725,000	N/O	N/A

* 1 means totally unable or unwilling and 10 means totally able and willing as appropriate to the column, N/O means 'not offered' and N/A means 'not available'

3.4.2 *Capital and One-Time Cost Assumptions*

3.4.2.1 *Capital and One-Time Costs Assumptions - Common*

The following assumptions have been taken in determining the common capital and one-time costs for each of the two alternative ticketing scenarios. It is assumed that ongoing maintenance of the farebox and related equipment will cost 2.5% of capital cost per year. Cost allowances are generously estimated.

	Capital Cost Elements Common to Both Alternatives	Estimated Cost (CDN$)
On-the-Bus Equipment	Validating Farebox c/w coin and bill validator, magnetic ticket insertion read/write unit, magnetic swipe reader, magnetic transfer issuing system, contactless smart card read/write unit, wireless data download/upload system (infrared, W/LAN 802.11 or equivalent), removable cashbox, passenger display	$24,000 each x 56 buses = $1,344,000 allows for 54 bus fleet plus 2 spares
	Driver Control Unit	Included
	Installation of On-the-Bus Equipment	$250 per bus x 50 = $12,500
Garage Equipment	Through-the-Wall Vaulting System c/w two receivers	$55,000 each x 2 = $110,000
	Data Management System c/w fare collection system configuration tools, report generation tools, W/LAN base station as required	$100,000
	Application Server and LAN Upgrades	$30,000
	Installation Garage Equipment	$25,000
	System Configuration and Commissioning	$20,000
	Spare Parts	$100,000
Other	Marketing, training and all other soft costs associated with the launch	$50,000
	Total Common Capital Costs	**$1,791,500**

3.4.2.2 *Capital and One-Time Cost Assumptions - Magnetic Stripe*

- 1 card/pass encoding and issuance location, equipped with a ticket encoder machine @ $28,000 and with issuance software and workstation @ $10,000 = $38,000
- 1 customer service centre workstation equipped with ticket encoding machine @ $28,000 and POS @ $1,000 and with customer service software and workstation @ $5,000 = $34,000
- 2 management workstations @ $1,500 = $3,000
- System integration, installation and commissioning @ $50,000

3.4.2.3 *Capital and One-Time Cost Assumptions – Smart Card*

- Central system server for transit application and database @ $10,000
- System software including smart card lifecycle management, CSC management, transaction processing, system administration and device and network management @ $200,000
- 2 management workstations @ $1,500 = $3,000
- 1 driver assignment workstation @ $2,500
- 1 smart card issuance/personalization location, equipped with a card printer/personalization machine workstation @ $15,000
- 1 customer service centre workstation @ $2,500
- 1 garage wireless 802.11 base station @ $10,000
- 28 attended smart card reload locations, each equipped with a contactless reload/POS device @ $750 = $21,000
- System integration, installation and commissioning @ $100,000

3.4.3 *Capital and One-Time Costs - Magnetic Stripe Ticketing Technology*

Capital and One Time Costs	Value (CDN$)
Total Capital and One-Time Costs Common to each Alternative	$1,791,500
Total Capital and One-Time Costs Unique to Magnetic Ticketing	$125,000
Total Capital and One-Time Costs for Magnetic Ticketing	**$1,916,500**

3.4.4 *Capital and One-Time Costs - Smart Card Ticketing Technology*

Capital and One Time Costs	Value (CDN$)
Total Capital and One-Time Costs Common to each Alternative	$1,791,500
Total Capital and One-Time Costs Unique to Smart Card Ticketing	$364,000
Total Capital and One-Time Costs for Smart Card Ticketing	**$2,155,500**

3.5 Operating Cost Considerations

Operating costs for each of the two alternative ticketing technologies have been estimated over a ten-year operating life-cycle. This is not intended to indicate that ten years is the expected life of the equipment. Rather, it is a useful timeframe for comparisons since it encompasses several lifecycle renewals of the smart cards.

3.5.1 Operating Cost Assumptions

The following assumptions have been taken in determining the operating costs for the two alternative ticketing scenarios:

3.5.1.1 Estimated Card Volumes

For purposes of estimating the initial year card volumes, the following reference approximations will be used - *4M total revenue passengers making 4.5M total boardings generating $6M in operating revenues.* 22.5% of current ridership is based on travel using prepaid tickets and 40.1% on travel using prepaid passes. This translates into 900,000 ticket journeys and 1,604,000 pass journeys annually.

In the event of either ticketing technology, it is assumed that the majority of these passes will be monthly passes and that the average pass holder takes 40 journeys per month. This translates into 133,667 pass journeys per month and 3,342 individual monthly passes. Magnetic passes will not be renewable and will need to be reissued each month. Smart card passes will be renewable and will not require re-issuance.

If we apply a 10% safety factor, this means that 44,100 magnetic passes must be purchased annually. Individual magnetic passes purchased in these annual volumes are estimated to cost 60 cents each. The initial annual cost of these magnetic passes is $26,460.

For smart cards, we will apply the same 10% safety factor and assume that 10% of existing passes will be lost and will need to be replaced per year. It is assumed that the useful service life of a plastic smart card pass is 4 years, meaning that 25% of the passes will need to be replaced per year. This translates into 4,846 reloadable smart cards purchased for passes each year. Given that the City intends to use the transit smart card for other municipal purposes where feasible, it is recommended to use a dual interface combined contactless and contact smart card which in these volumes is expected to cost $10.00 each. The initial annual cost of these reloadable smart card passes is $48,460. It is true that a contactless smart card that would be sufficient for a transit-only implementation would cost half this amount; however, the cost difference is partly offset by being able to specify less expensive contact interface based POS reload devices at the third party merchants.

With respect to tickets, different assumptions are made for each alternative.

In the event of magnetic ticketing, it is assumed that the tickets will be largely sold configured with 10-rides to a ticket and that these tickets are not reloadable after use. The annual 900,000 ticket journeys translate into 90,000 individual tickets or 7,500 tickets per month. Individual magnetic tickets purchased in these annual volumes are estimated to cost 4.6 cents each. The initial annual cost of these magnetic tickets is $4,140.

In the event of smart card ticketing, it is assumed that two-thirds of the ticketing journeys will be paid using tickets on reloadable smart cards that are similar to the pass smart cards and one-third on disposable paper substrate non-reloadable smart cards.

It is assumed that the reloadable smart card responsible for 600,000 ticketing journeys will be offered in a 10-ride per reload configuration generating 60,000 reloads per year or 5,000 per month. If it is assumed that a smart card ticket rider has made the economic decision not to purchase a monthly pass since they make only 20 journeys per month, meaning that they reload their card with two 10-ride purchases each month, this translates into 2,500 reloadable smart cards used as tickets. Applying the same replacement and lifecycle assumptions as for smart card passes, this translates into 3,625 reloadable smart cards purchased for tickets each year. The initial annual cost of these reloadable smart card tickets is $36,250.

With respect to the disposable smart cards responsible for the other 300,000 ticketing journeys, it is assumed that the weighted average will be 6 journeys per ticket translating into 50,000 individual tickets purchased per year. The unit cost of a disposable smart ticket in these small volumes is assumed to be 50 cents. The initial annual cost of these disposable tickets is $25,000.

As a very mature technology, the price of magnetic media is assumed to remain static over the ten years. As a technology early in its lifecycle, the price of smart cards is assumed to decrease by 10% per year.

Even though it is possible that an issuance fee or refundable deposit will be charged for reloadable smart cards, given the economic and demographic profile of many Sudbury Transit riders, such a fee or deposit was not considered in making the business case determination.

3.5.1.2 Assumed Accounting Guidelines

The following accounting guidelines will be followed in developing the financial model:

- Cost of capital - 5%
- Amortization period for fareboxes and equipment - 12 years
- Consumables including smart cards expensed in year of purchase

3.5.1.3 Estimated Fare Fraud Rates

It is determined that the following classes of fraud and fare evasion occur currently on Sudbury Transit and estimates for each class are provided.

1. Invalid transfers - includes boarding without a transfer, presenting an expired transfer, presenting a transfer not based on a continuous journey and presenting a used transfer
    - Assumed to be a significant problem if passengers are allowed to board at the terminal while the driver is on a washroom break - at busy connections, drivers do not always carefully check transfer time validity which is not prominently displayed
    - Prior to implementing electronic transfer issuers, OC Transpo in Ottawa reported that 6% of transfers were found to be invalid.
    - At this rate, with 500,000 unpaid boardings per year, Sudbury Transit is expected currently to suffer 30,000 fraudulent transfers worth $46,500 per year at an average fare of $1.55.
    - With either ticketing technology selection, since magnetic transfer will be used, the incidence of fraudulent transfers will be expected to be minimal.
2. Invalid passes - includes presenting an expired pass, presenting a pass without proper ID and presenting someone else's pass
    - Assumed to be an important class of fare fraud owing to the popularity of passes in Sudbury and the difficulty that drivers experience challenging passengers to produce photo ID -

concession passes can be improperly used by passengers not eligible for concession status - since month of pass validity is clearly printed on the face of the current passes, expired pass fraud should be minimal

- OC Transpo's reported experience of invalid pass usage is 0.9% of adults and 4% of students - in 2004, 51.4% of Sudbury Transit's passes were purchased by students, 19.9% by adults and 28.7% by seniors and special concession passengers. Applying these same fraud rates to Sudbury, if we presume that the senior and concession fraud rate is equal to the adult rate, the expected pass fraud rate in Sudbury would be (4% x 51.4%) + (0.9% x 48.6%) = 2.5%. With 1,604,000 pass journeys per year that fraud rate would equate to 40,100 fraudulent pass journeys worth $62,150 per year at an average fare of $1.55.
- Since the fare collection process for monthly passes with the magnetic ticketing technology alternative is essentially similar to the current process, this fraud rate is expected to continue under the magnetic ticketing alternative. On the other hand, the fare collection process for monthly passes with the smart card ticketing technology alternative is dramatically different involving 100% electronic validation of every pass, this fraud rate is expected to be virtually eliminated by smart card ticketing.

3. Counterfeit tickets - includes presenting tickets other than those issued and sold by Sudbury Transit
   - Assumed not to be a major problem at Sudbury Transit - it is a relatively rare occurrence to discover counterfeit tickets in counting room

3.5.1.4 Estimated Revenue Opportunities

There are a few revenue opportunities available to Sudbury Transit based on implementing smart cards for its fare payment. Since smart cards will be issued and held by passengers for approximately four years before replacement, companies can advertise on one unprinted face of the smart card. Expected fee will be $3 per year per reloadable card issued and 25 cents per disposable card issued each net of printing costs. With 3342 reloadable passes and 2500 reloadable tickets, that represents a revenue stream of $17,400 per year. With 50,000 disposable tickets issued, that represents a revenue stream of $12,500 per year.

While it is technically possible to apply an advertisement to the limited 'open' space on the face of a magnetic pass, it has not been considered in this evaluation.

It is assumed that after two years, the City will be able to establish a merchant loyalty program which will earn annual revenue at the rate of $3 per reloadable card and 25 cents per disposable card. This will generate annual revenues equal to the advertising revenues.

In the future, there is a possibility of an income stream to the City based on 'renting' some of the excess memory on the smart card to other compatible third party applications such as a loyalty application. While this could prove to be interesting, it has not been quantified for this business case determination.

It is very likely that the passenger convenience offered by a smart card fare system coupled with the possibility of developing innovative ridership generating programs based on the fare system flexibility will result in increased ridership and consequently increased revenue. Improved operating information available from the smart card will improve planning and should result in reduced operating costs. These revenue and cost impacts have not been quantified and have not been included in this evaluation.

3.5.2 *Current Annual Operating Costs*

Category	Current Annual Operating Costs	Quantity	Unit Cost	Amount (CDN$)
Fare Media Costs	Purchase tickets			$25,000
	Purchase monthly passes			$24,000
	Purchase and produce Photo IDs	750	Est. $3	$2,250
Media Distribution Costs	Courier costs to distribute media	12	Est. $250	$3,000
	Sales commissions to merchants		1%	$60,000
	Distribution fee to Transit Centre			$110,000
	Staff efforts	1FTE +	$66,369	$66,369
Fare System Operations Costs	Secure courier costs			$6,400
	Bank fees to handle deposits	$2.2M	Est. 0.25%	$5,500
	Coin counting and depositing	0.5 FTE	$35,360	$17,680
	Farebox maintenance	0.25 FTE	$59,000	$14,750
	Farebox maintenance parts			$11,500
	Marketing		Est.	$10,000
	Total			**$356,450**

It is assumed that these annual operating costs would have increased by 2.5% per year.

3.5.3 *Annual Operating Costs - Magnetic Stripe Ticketing Technology*

Category	Initial Annual Operating Costs	Quantity	Unit Cost	Amount (CDN$)
Fare Media Costs	Purchase tickets	90,000	4.6 cents	$4,140
	Purchase monthly passes	44,100	60 cents	$26,460
	Purchase and produce Photo IDs	750	Est. $3	$2,250
Media Distribution Costs	Courier costs to distribute media	12	Est. $250	$3,000
	Sales commissions to merchants		1%	$60,000
	Distribution fee to Transit Centre			$110,000
	Staff efforts	1.5 FTE	$66,369	$99,500
Fare System Operations Costs	Secure courier costs			$6,400
	Bank fees to handle deposits	$2.2M	Est. 0.25%	$5,500

	Coin counting and depositing	0.5 FTE	$35,360	$17,680
	Farebox maintenance	0.25 FTE	$59,000	$14,750
	Farebox maintenance parts			$11,500
	Marketing		Est.	$10,000
	Total			**$371,180**

It is assumed that these annual operating costs will increase by 2.5% per year and that fare revenues and commissions will remain at 2005 levels for comparison purposes.

3.5.4 *Annual Operating Costs - Smart Card Ticketing Technology*

Category	Initial Annual Operating Costs	Quantity	Unit Cost	Amount (CDN$)
Fare Media Costs	Purchase reloadable smart cards passes **	4,846	$10.00	$48,460
	Purchase reloadable smart card tickets **	3,625	$10.00	$36,250
	Purchase disposable smart cards	50,000	50 cents	$25,000
Media Distribution Costs	Courier costs to distribute media	12	Est. $100	$1,000
	Reload commission to merchants		1%	$60,000 *
	Reload and sales fee to Transit Centre			$110,000 *
	Staff efforts	1.5 FTE	$66,369	$99,500
Fare System Operations Costs	Secure courier costs			$6,400
	Bank fees to handle deposits	$2.2M	Est. 0.25%	$5,500
	Coin counting and depositing	0.5 FTE	$35,360	$17,680
	Farebox maintenance	0.25 FTE	$59,000	$14,750
	Farebox maintenance parts			$11,500
	Annual Software Licence Fee	50	$200	$10,000
	Marketing		Est.	$10,000
	Total			**$456,040**

It is assumed that these annual operating costs will increase by 2.5% per year and that fare revenues and commissions will remain at 2005 levels for comparison purposes.

* Reloadable smart cards will be replaced every 4 years with 10% replacement for loss or damage

** Commissions will reduced by 1/4 if card reloads are allowed on the bus at off-peak times.

3.6 Ten-Year Financial Evaluation

3.6.1 Ten-Year Financial Evaluation - Magnetic Stripe Ticketing Technology

Canadian Dollars	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Total
Annual Revenues												
Fraud savings - transfer fraud		46,500	48,825	51,266	53,830	56,521	59,347	62,314	65,430	68,702	72,137	584,872
Advertising revenue												
Total		**46,500**	**48,825**	**51,266**	**53,830**	**56,521**	**59,347**	**62,314**	**65,430**	**68,702**	**72,137**	**584,872**
Capital and One-Time Costs												
On-the-bus and garage equipment	1,741,500	43,538	44,626	45,742	46,885	48,057	49,259	50,490	51,752	53,046	54,372	2,229,267
Card/pass encoder/issuing workstation	38,000	950	974	998	1,023	1,049	1,075	1,102	1,129	1,157	1,186	48,643
Customer service centre with encoder	34,000	850	871	893	915	938	962	986	1,010	1,036	1,062	43,523
Management workstations	3,000											3,000
Integration, installation & commissioning	50,000											50,000
Marketing, training and launch soft costs	10,000	40,000	1,000	1,025	1,051	1,077	1,104	1,131	1,160	1,189	1,218	59,955
Subtotal	1,876,500	85,338	47,471	48,658	49,874	51,121	52,399	53,709	55,052	56,428	57,839	2,434,388
Contingency (10%)	187,650	8,534	4,747	4,866	4,987	5,112	5,240	5,371	5,505	5,643	5,784	243,439
Total	**2,064,150**	**93,871**	**52,218**	**53,523**	**54,862**	**56,233**	**57,639**	**59,080**	**60,557**	**62,071**	**63,623**	**5,112,214**
Annual Operating Costs												
(Current Annual Operating Costs)		(365,361)	(374,495)	(383,858)	(393,454)	(403,290)	(413,373)	(423,707)	(434,300)	(445,157)	(456,286)	(4,093,282)
Purchase of magnetic tickets		4,140	4,140	4,140	4,140	4,140	4,140	4,140	4,140	4,140	4,140	41,400
Purchase of magnetic passes		26,460	26,460	26,460	26,460	26,460	26,460	26,460	26,460	26,460	26,460	264,600
Purchase and production of Photo IDs		2,250	2,306	2,364	2,423	2,484	2,546	2,609	2,675	2,741	2,810	25,208
Courier delivery costs		3,000	3,075	3,152	3,231	3,311	3,394	3,479	3,566	3,655	3,747	33,610
Sales commissions		170,000	170,000	170,000	170,000	170,000	170,000	170,000	170,000	170,000	170,000	1,700,000
Staff effort		99,500	101,988	104,537	107,151	109,829	112,575	115,389	118,274	121,231	124,262	1,114,736
Farebox system operations costs		55,830	57,226	58,656	60,123	61,626	63,167	64,746	66,364	68,023	69,724	625,485
Marketing		10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	100,000
Total		**5,819**	**699**	**(4,548)**	**(9,927)**	**(15,440)**	**(21,091)**	**(26,883)**	**(32,821)**	**(38,906)**	**(45,144)**	**(188,243)**
Total Cash Flow (Gain)	**(2,064,150)**	**(53,190)**	**(4,092)**	**2,291**	**8,895**	**15,728**	**22,799**	**30,118**	**37,694**	**45,537**	**53,658**	
Cumulative Cash Flow	(2,064,150)	(2,117,340)	(2,121,432)	(2,119,141)	(2,110,246)	(2,094,518)	(2,071,719)	(2,041,601)	(2,003,907)	(1,958,370)	(1,904,712)	
10 Year Net Present Value @ 5%	**(1,876,832)**											

3.6.2 *Ten-Year Financial Evaluation – Smart Card Ticketing Technology*

Canadian Dollars	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Total
Annual Revenues												
Fraud savings - transfer fraud		46,500	48,825	51,266	53,830	56,521	59,347	62,314	65,430	68,702	72,137	584,872
Fraud savings - invalid passes		62,150	65,258	68,520	71,946	75,544	79,321	83,287	87,451	91,824	96,415	781,716
Loyalty program revenue				29,900	31,395	32,965	34,613	36,344	38,161	40,069	42,072	285,518
Advertising revenue		29,900	31,395	32,965	34,613	36,344	38,161	40,069	42,072	44,176	46,385	376,079
Total		**138,550**	**145,478**	**182,651**	**191,784**	**201,373**	**211,442**	**222,014**	**233,115**	**244,770**	**257,009**	**2,028,185**
Capital and One-Time Costs												
On-the-bus and garage equipment	1,751,500	43,788	44,882	46,004	47,154	48,333	49,542	50,780	52,050	53,351	54,685	2,242,068
Central system server	10,000	250	256	263	269	276	283	290	297	305	312	12,801
Customer service centre workstation	2,500											2,500
Management workstations	3,000											3,000
Driver assignment workstation	2,500											2,500
Smart card personalization workstation	15,000	375	384	394	404	414	424	435	446	457	468	19,201
28 attended card reload devices	21,000											21,000
System software	200,000											200,000
Integration, installation & commissioning	100,000											100,000
Marketing, training and launch soft costs	10,000	40,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	68,000
Subtotal	2,115,500	84,413	47,523	48,661	49,827	51,023	52,249	53,505	54,793	56,112	57,465	2,671,070
Contingency (10%)	211,550	8,441	4,752	4,866	4,983	5,102	5,225	5,350	5,479	5,611	5,747	267,107
Total	**2,327,050**	**92,854**	**52,275**	**53,527**	**54,810**	**56,125**	**57,474**	**58,855**	**60,272**	**61,724**	**63,212**	**5,609,247**
Annual Operating Costs												
(Current Annual Operating Costs)		(365,361)	(374,495)	(383,858)	(393,454)	(403,290)	(413,373)	(423,707)	(434,300)	(445,157)	(456,286)	(4,093,282)
Purchase of reloadable smart card passes		48,460	4,361	3,925	35,327	3,179	2,862	25,754	2,318	2,086	18,774	147,047
Purchase of reloadable smart card tickets		36,250	3,263	2,936	26,426	2,378	2,141	19,265	1,734	1,560	14,044	109,997
Purchase of disposable smart cards		25,000	22,500	20,250	18,225	16,403	14,762	13,286	11,957	10,762	9,686	162,830
Courier delivery costs		3,000	3,075	3,152	3,231	3,311	3,394	3,479	3,566	3,655	3,747	33,610
Sales commissions		127,500	127,500	127,500	127,500	127,500	127,500	127,500	127,500	127,500	127,500	1,275,000
Staff effort		99,500	101,988	104,537	107,151	109,829	112,575	115,389	118,274	121,231	124,262	1,114,736
Farebox system operations costs		55,830	57,226	58,656	60,123	61,626	63,167	64,746	66,364	68,023	69,724	625,485
Software license fee		10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	
Marketing		10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	100,000
Total		**50,179**	**(34,583)**	**(42,901)**	**4,529**	**(59,063)**	**(66,973)**	**(34,288)**	**(82,586)**	**(90,339)**	**(68,550)**	**(524,576)**
Total Cash Flow (Gain)	**(2,327,050)**	**(4,483)**	**127,786**	**172,025**	**132,445**	**204,311**	**220,941**	**197,447**	**255,429**	**273,386**	**262,347**	
Cumulative Cash Flow	(2,327,050)	(2,331,533)	(2,203,747)	(2,031,722)	(1,899,277)	(1,694,965)	(1,474,025)	(1,276,578)	(1,021,149)	(747,763)	(485,416)	
10 Year Net Present Value @ 5%	**(935,624)**											

3.7 Non Financial Benefit Considerations

The following non-financial benefits have been determined for the two alternative ticketing technology alternatives. The benefits that will be realized by replacing and modernizing the fareboxes will be common to both alternatives so only the benefits that are unique to each alternative will be addressed here.

3.7.1 Non-Financial Benefits – Magnetic Stripe Ticketing Technology

- Virtual elimination of transfer fraud,
- Magnetic fare media is relatively inexpensive, and
- Adapting to magnetic ticketing technology involves only modest change from current system meaning simpler passenger acceptance.

3.7.2 Non-Financial Benefits – Smart Card Ticketing Technology

- Virtual elimination of transfer and pass fraud,
- Availability of accurate ridership and enriched fare system performance information,
- Greatly enhanced flexibility to adjust fares and create innovative marketing and fare policies,
- Ability to add other applications to the system relatively simply such as:
    - Municipal e-purse to pay for parking or other municipal services,
    - Secure access to municipal services, and
    - Non-municipal applications such as loyalty, employer and campus that can provide revenue.
- Ability to assist with a U-Pass referendum by providing an enriched suite of other services on the transit smart card,
- Enhancement of the perceived 'quality of life' in Sudbury through a 'high tech' payment card - makes riding transit more 'chic' and is fully supportive of both the City's growth and development objectives and its progressive 'mysudbury.ca' and related initiatives,
- As more passengers pay their fares with the smart card, cash will be used less and the reduced costs to operate the cash based system can be passed on through fare savings,
- Potential for ridership growth through ease of use - simple to recharge monthly passes by telephone and on the Internet thereby avoiding need to line up and pay in person, and
- Long service life for smart cards - expected to last up to four years before replacement.

3.8 Business Case Analysis Quantitative Results

Based on the preceding analyses, the following Summary of Financial Implications for each of the ticketing technology alternatives has been determined

Summary Financial Implication	Magnetic Ticketing	Smart Card Ticketing
Capital and One-Time Costs	$ 2,064,150	$ 2,327,050
Year One Annual Financial Impact		
Increased Operating Costs (Savings)	$ 5,819	$ 50,179
Increased Operating Revenue	$ 46,500	$ 138,550
Financial Metrics		
10 Year NPV c/w Farebox & Garage Equipment	$ (1,876,832)	$ (935,624)
10 Year NPV w/o Farebox & Garage Equip't	$ (218,261)	$ 732,471
% Ridership Increase Req'd to Breakeven *		2.90 %

This table highlights the dramatically better 10 Yr NPV of the cash flow for the AFC system using smart card fare media rather than magnetic fare media. Indeed, isolated from the farebox procurement decision, the 10 Yr NPV for smart card fare media is positive whereas for magnetic fare media, it is negative.

The following calculation can be used to determine the improvement in ridership performance that Sudbury Transit would need to achieve in order to recover the costs of updating its fare collection system and implementing smart card fare payment.

- Capital and one-time costs (less marketing) for smart card system = $2,054,150
- Annual cost to amortize @ 5% over 12 years = $227,984
- Year One Annual Revenues = $138,550
- Year One Annual Operating Costs = $50,159 + $40,000 = $90,159
- Net Annual Operating Cost Increase = $227,984 + $90,159 - $138,550 = $179,593
- @ $1.55 per ride, this increase represents an increase of 115,866 rides that would be required to break even,
- This in turn represents a 2.90% increase above the current 4 million annual rides that would be required to break even.

4. Conclusion and Recommendation

Based on the preceding analysis, it is recommended that Sudbury Transit pursue the following strategy with respect to the procurement of a new fare collection system:

1. Purchase new validating fareboxes for its bus fleet and related garage equipment and systems with the following minimum functionality:
    a. Accept fare payment by coins, banknotes, and contactless smart cards,
    b. Issue and accept (read) magnetic transfers,
    c. Upload/download fare transaction data wirelessly c/w garage base station,
    d. Secure the collection of cash with through-the-wall vault receivers, and
    e. Manage the farebox system configuration, operation and report generation.
2. Implement smart cards for transit fare payment, initially replacing all prepaid tickets and passes and then offering payment from an electronic purse on the card. It is recommended that the City issue more expensive dual interface contactless/contact or 'combi' smart cards with a view to simplifying the required POS reload infrastructure and to accommodating future municipal and other uses of the card. The analysis and comparison between magnetic and smart card ticketing technologies clearly indicates that smart card technology is the preferred ticketing alternative for Sudbury Transit for the several compelling reasons.
    a. Overwhelmingly advantageous non-financial benefits
    b. A more favourable 10-Year NPV for the complete system,
    c. A positive 10-Year NPV for the ticketing technology addition to the base farebox investment, whereas the corresponding 10-Year NPV for magnetics is negative,
    d. If the capital costs are amortized appropriately, Sudbury Transit needs only to increase its ridership by less than 3% to be able to break even on its investment.
3. Progressively use these smart cards for other municipal services as both a secure method of validating qualified residents' entitlement to access municipal services and as a method of paying for municipal services such as parking or recreation fees from the e-purse on the card as an integral part of the City's progressive 'mysudbury.ca' initiative.
4. Progressively use smart cards for selected non-municipal services through two strategies:
    a. Consider adding selected non-municipal applications that would enhance the perceived value of the card to passengers/citizens and support cross incentives to drive transit ridership. These could include a merchant loyalty points program that provides enhanced benefits for regular transit riders or shopping discounts based on displaying the card. It could include both frequent rider and frequent shopper loyalty schemes. It could include extensions to the U-Pass and employer E-Pass program that could be part of the card.
    b. Consider enabling other applications to 'rent' space on the Sudbury Card to install and operate their application, with appropriately secure firewalls. Examples would include campus applications for physical and logical access and e-purse payment.

City of Sudbury – Sudbury Transit

Ridership Growth Strategy and Asset Management Plan

Appendix B – Fleet Roster

ROSTER OF VEHICLES - BUSES

FLEET #	MAKE	YEAR BUILT	YEAR ACQ.	SERIAL #	Purchase Price	Remaining Life
740	New Flyer	2004	2004	2FYD2LV074U026469	$368,825.00	14 years
741	New Flyer	2004	2004	2FYD2LV034U026470	$368,825.00	14 years
742	New Flyer	2004	2004	2FYD2LV054U026471	$368,825.00	14 years
743	New Flyer	2004	2004	2FYD2LV074U026472	$368,825.00	14 years
744	New Flyer	2004	2004	2FYD2LV094U026473	$368,825.00	14 years
745	New Flyer	2004	2004	2FYD2LV004U026474	$368,825.00	14 years
871	MCI	1987	1987	2G9YT82W2H3024062	$160,123.00	None
872	MCI	1987	1987	2G9YT82W4H3024063	$160,123.00	None
873	MCI	1987	1987	2G9YT82W6H3024064	$160,123.00	None
882	MCI	1988	1988	2G9YT82WGH3024128	$160,123.00	1 year
883	MCI	1988	1988	2G9YT82W8H3024129	$160,123.00	1 year
884	MCI	1988	1988	2G9YT82W6J3024426	$160,123.00	1 year
885	MCI	1988	1988	2G9YT82W8J3024427	$160,123.00	1 year
886	MCI	1988	1988	2G9YT82WXJ3024428	$160,123.00	1 year
892	MCI	1989	1989	2AUYT82J9K3000387	$190,000.00	2 years
894	MCI	1989	2003	1M82CTJY8KP050078	$56,500.00	2 years
902	MCI	1990	2003	2AUYT82J6L3000428	$70,500.00	3 years
903	ORION	1990	2003	2B1569775L6030130	$70,500.00	4 years
905	ORION	1990	1990	2B1569775L5030232	$189,984.00	2 years
907	ORION	1990	1990	2B1569770L5030234	$189,984.00	2 years
908	ORION	1990	1990	2B1569770L5030235	$189,984.00	2 years
909	ORION	1990	1990	2B1569772L5030236	$189,984.00	2 years
911	ORION	1991	1991	2B1569771M5030794	$239,609.00	3 years
912	ORION	1991	1991	2B1569770M5030799	$239,609.00	3 years
913	ORION	1991	1991	2B1569770M5030804	$239,609.00	3 years
914	ORION	1991	1991	2B1569778M5030808	$239,609.00	3 years
915	MCI	1991	2003	2AUYT82J7M3000228	$80,500.00	3 years

ROSTER OF VEHICLES - BUSES

FLEET #	MAKE	YEAR BUILT	YEAR ACQ.	SERIAL #	Purchase Price	Remaining Life
921	ORION	1992	1992	2B1569773N5031091	$218,775.00	4 years
922	ORION	1992	1992	2B1569777N5031093	$218,775.00	4 years
923	ORION	1992	1992	2B1569770N5031095	$218,775.00	4 years
924	ORION	1992	1992	2B1569777N5031112	$218,775.00	4 years
925	ORION	1992	1992	2B1569772N5031115	$218,775.00	4 years
941	ORION	1994	1994	2B1569773R6031950	$256,312.00	6 years
942	ORION	1994	1994	2B1569776R6031957	$256,312.00	6 years
943	ORION	1994	1994	2B1569779R6031967	$256,312.00	6 years
944	ORION	1994	1994	2B1569778R6031975	$256,312.00	6 years
951	New Flyer	1995	1995	2FYD2LL14SU015857	$402,020.00	6 years
952	New Flyer	1995	1995	2FYD2LL18SU015858	$402,020.00	5 years
953	New Flyer	1995	1995	2FYD2LL18SU015859	$402,020.00	6 years
954	New Flyer	1995	1995	2FYD2LL18SU015860	$402,020.00	4 years
955	New Flyer	1995	1995	2FYD2LL18SU015861	$402,020.00	6 years
971	NOVA	1997	1998	2NUYL82K8V3000157	$392,211.00	7 years
972	NOVA	1997	1998	2NUYL82K8V3000158	$392,211.00	7 years
973	NOVA	1997	1998	2NUYL82K8V3000159	$392,211.00	7 years
974	NOVA	1997	1998	2NUYL82K8V3000160	$392,211.00	7 years
975	NOVA	1997	1998	2NUYL82K8V3000161	$392,211.00	7 years
981	ORION VI	1999	1999	1VH669P75X6600055	$362,175.00	8 years
982	ORION VI	1999	1999	1VH669P77X6600056	$362,175.00	8 years
983	ORION VI	1999	1999	1VH669P77X6600058	$362,175.00	8 years
984	ORION VI	1999	1999	1VH669P77X6600059	$362,175.00	8 years
985	ORION VI	1999	1999	1VH669P77X6600060	$362,175.00	8 years
VANS						
710	DODGE	1997	1997	2B5WB35Z7VK590113	$31,620.00	1 year
715	DODGE	1997	1997	2B5WB35Z9VK590114	$31,620.00	1 year
SERVICE TRUCK						

720	FORD	1997	1997	1FTHF36H2VEC23036	$36,970.00	5 years
725	FORD	2003	2003		$26,000.00	4 years
730	FORD	2003	2003		$26,000.00	4 years
191	FORD					