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**MANAGEMENT OF URBAN INFRASTRUCTURE:
RECAPITALIZATION AND EQUILIBRIUM MODELS**

Submitted by:
B.W. Martin, B.A.Sc. (Civil)

in partial fulfilment of the requirements for
the degree of Master of Engineering

Chair, Department of Civil and
Environmental Engineering

Thesis Supervisor

External Examiner

Carleton University
Ottawa, Ontario, Canada

December, 1994

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By

**B.W. Martin, B.A.Sc., (Civil), P.Eng.
University of Ottawa, 1970**

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of Graduate Studies and Research
in Partial Fulfilment of the
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ABSTRACT

This thesis defines urban infrastructure and discusses its importance on the economy as a whole. Examples of the sums of money required to rehabilitate the infrastructure at the international, national and local levels is discussed. The current management and budgeting practices in several Canadian cities are reviewed.

The objectives of this thesis are:

- (1) to define issues in the management of infrastructure, including the need to view the worth of infrastructure as an asset,
- (2) to describe an approach for establishing the minimum funding levels required for supporting strategies and programs, and
- (3) to report the concept of resource allocation under conditions of intersectoral conflicts.

An approach is suggested for establishing minimum funding levels per sector by use of a "Recapitalization Equation". Several examples demonstrating the accuracy of the equation, as a planning model at the international, national, regional and local level, are given.

An equilibrium equation is suggested which relates the Recapitalization Equation to sector needs defined by traditional methods.

An overall infrastructure index is discussed which provides a rough index of the "state of the nation".

A master framework for the budget cycle is presented.

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Performance budgets have a management orientation. Revenues and expenditures are related to work loads and unit costs to achieve efficiency. The emphasis in the performance budgeting format is on how well an agency is utilizing its resources. The measures used include cost per citizen and cost per unit of output.

The project budget is oriented towards planning. Expenditures are presented in the form of programs and activities rather than departmental line items. Program budgeting defines the goals of an agency and classifies organization activities contributing to each goal. Data are presented by product output rather than a formal organization line in order to focus on goals and alternative programs for achieving them.

Both the operating and capital budgets are planned and programmed on multi-year cycles. This requires the appropriate linkages with other management schedules. The capital budget should be linked with a comprehensive infrastructure planning needs assessment process and the official plans.

In the U.S., as Table 2.1 demonstrates, there is a clear correlation between city size and Capital Improvement programs and the measures of sophistication in the implementation of fiscal management procedures.

TABLE 2.1

EXISTENCE OF CAPITAL IMPROVEMENT PROGRAMS (CIP)

Population Strata	Number	% with CIP (Mean)	Year Implemented
10 - 25 000	314	59	1977
25 - 50 000	256	65	1975
50 - 100 000	148	74	1975
100 000 +	121	92	1970
All Cities:	839	68	

SOURCE: (League of Cities, 1983)

CHAPTER 1

ISSUES, RESEARCH OBJECTIVES AND METHODOLOGICAL FRAMEWORK

1.1 Background

Municipal infrastructure categories are numerous as well as diverse. Infrastructure includes works such as roads, lighting, sidewalks, bridges, sewers, water supply and distribution networks, waste collection and disposal facilities, libraries, parks, schools and transit systems. Most of these, along with many other types of infrastructure, are built by municipalities which use a large part of their budgets to operate them.

Infrastructure has also been referred to as being the Life Lines of a city.

FIGURE 1.1
INFRASTRUCTURE IN A TYPICAL STREET
IN A CENTRAL BUSINESS DISTRICT

The health and well being of Canadians depend on basic services like roads, sewers, water supply networks, institutions and transit systems. The importance of infrastructure of the economy and society derives from the flow of service they provide. For example, public works aid:

- **daily movement of people to and from work, school and shopping;**
- **distribution of raw material and intermediate and finished goods throughout the nation's economy;**
- **improvements in the quality of life and a cleaner and safer environment.**

The health of the nation's economy and the stability of society are dependent on the existence of a comprehensive and well maintained infrastructure.

Businesses making decisions on where to locate are now delving deep into details of the living environment and the state of the city's infrastructure, including the average commute time to downtown in minutes. (National Academy of Engineers, 1988)

Indeed, a cause of the decline of the competitive position of the U.S. in the international economy is the low rate of investment in highways, ports and airports which aid in the distribution of goods and services (Aschauer, 1985). In the absence of investment in infrastructure, the competitive position of the Canadian economy can be adversely impacted. Almost one out of every five dollars spent on goods and services is devoted to transportation costs. Improved infrastructure can, therefore, result in efficient transportation and savings to users of transportation.

With the rise in importance of "JUST IN TIME" inventory control the smooth functioning of the transportation system is vital to a nation's productivity. Improving the quality of life in cities will be an important policy objective to which financial resources will need to be targeted if we are to maintain a sustainable infrastructure.

Infrastructure is therefore extremely important for the proper economic functioning of an urban society. In fact, urban society could not exist without the sophisticated urban

infrastructure present in our modern cities. Also, the value of these assets represents considerable sums. The management of these assets therefore is a very important function of municipal government if governments are to avoid leaving the next generation a mountain of rehabilitation costs. This thesis research provides the methodological base so that Cities can

- (1) manage their infrastructure like a business, and
- (2) allocate funds in a rational manner to maintain their assets.

1.2 Definition of the Issues

At the international level, the developing countries have lost precious infrastructure worth billions of dollars through deterioration of their roads. In eighty-five countries that have received **World Bank** assistance for roads, a quarter of the paved roads outside urban areas need reconstruction as do a third of the unpaved roads. This work will cost \$40 billion to \$45 billion. Timely preventive maintenance costing less than \$12 billion could have saved these roads. (World Bank, 1988)

In the U.S. various studies have been conducted which attempt to estimate the annual shortfall between investment requirements and available revenues to attain the necessary rehabilitation work. The estimates vary from \$17.4 billion (Congressional Budget Office 1983) to \$24.6 billion (Joint Economic Committee of Congress 1984) to \$71.7 billion (Associated General Contractors of America, 1983; National Research Council, 1987).

Estimates of the backlog of the maintenance and repair of bridges, streets, and water and sewer systems in the U.S.A. range from less than \$1 trillion to over \$3 trillion. Forty-one percent of the bridges in the U.S. are deficient according to the Federal Highway Administration. Spending on public works decreased from 19.1% of total government expenditures in 1950 to 6.8% in 1984. (National Council on Public Works, 1986)

The U.S. Transportation Department calculates that in 1985, vehicles on U.S. freeways experienced 700 million hours in delays (a number that is expected to rise to 3.9 billion

hours by the year 2005 if no improvements are made). At \$10.00/hour as an opportunity cost, the cost of delay is substantial. The U.S. Federal Highway Administration calculates that delays on urban freeways cost more than \$9 billion in 1984 and will cost \$54 billion by 2005 (Lindley, 1989). This does not account for direct operating costs which as illustrated in Figure 1.2 could amount to over \$1000 per year (1976 dollars), an amount which would be in excess of \$2000 in 1992 dollars.

FIGURE 1.2
DIRECT OPERATING COSTS

Source: Inter City Management Association (1986)

The National Council on Public Works (U.S.A.) looked at this problem in another manner. Warning that the nation's public works are badly in need of attention, the results of the two year study recommended a doubling of funds to help save the nation's crumbling infrastructure. The study graded progress in eight categories of public works.

TABLE 1.1
THE STATE OF PUBLIC WORKS (U.S.A.)

HIGHWAYS	C ⁺
MASS TRANSIT	C ⁻
AVIATION	B ⁻
WATER RESOURCES	B
WATER SUPPLY	B ⁻
WASTEWATER	C
SOLID WASTE	C ⁻
HAZARDOUS WASTE	D

Source: Fragile Foundations. A Report on America's Public Works, by the National Council on Public Works (1986).

In Canada several agencies have attempted to quantify the magnitude of the rehabilitations problem. TRIP/CANADA, a public information committee of the Canadian Construction Association, has, over the last several years, published many reports on the magnitude of the infrastructure rehabilitation problem for the municipal and provincial roadway systems in every province. Although these agencies have a vested interest, the numbers are still worth contemplating. For example, in June 1987, TRIP/CANADA, Ontario Chapter, published a short paper on the evaluation of the sewer systems in Ontario. TRIP/CANADA indicates that 12 000 km of sewer and service connections in Ontario must be reconstructed over the next 70 years at an annual present value cost of \$107 million per year. TRIP/CANADA documents that Ontario residents served by municipal water distribution systems may find these systems unable to deliver a reliably

adequate supply of water because of a rapidly advancing system decay. The TRIP/CANADA reports go on to state that without immediate corrective action, users of these systems face service disruptions caused by breaks, wastage through undetected leaks, and loss of water pressure needed by fire protection services.

TRIP/CANADA estimates that \$141 million is required annually (about 2.5 times the current level) over an extended time frame to rehabilitate the province of Ontario's watermains and related services. The replacement value of the water system in the province is estimated to be \$20 billion (TRIP/CANADA, 1987). Similar studies have been done in other provinces.

The Federation of Canadian Municipalities (FCM) sent a questionnaire to member municipalities across Canada, some 300 in total. Of the 33 Canadian cities with populations of more than 100 000, twenty responded to the questionnaire, including eight with populations over 400 000. The population of the 71 responses (8.8 million) represents almost 50% of the nation's cities over 10 000 persons. The questionnaire method is albeit a crude manner to determine "needs" but the results nevertheless illustrate that a problem of significant proportions exists in Canada. The total cost to upgrade their infrastructure (sewage collection treatment, water distribution and treatment of roads and bridges) is estimated to be approximately \$20 billion dollars in current dollars (Federation of Canadian Municipalities, 1985). This has been referred to by the Mayor of Edmonton as the "BIG FIX".

The Transportation Association of Canada (TAC), in a paper (TAC, September 1987) indicated that to maintain assets at an acceptable level of service (without allowing for growth in demand), would require annual expenditures in the order of \$8 billion. In 1983, expenditures were in the order of \$6.5 billion, i.e., a shortfall of \$1.5 billion annually. It has been estimated by TAC that the total value of federal, provincial and municipal roads is in the order of \$200 billion dollars. Parks Canada as another example has approximately \$3 billion in infrastructure assets, 1/3 of which are roads.

Stated in a different manner public works capital investment as a portion of the gross national product dropped from 4.1 percent in 1965 to 2.3 percent in 1977. In the Province of Ontario, the Ministry of Transportation of Ontario (MTO) has consistently spent less on "roads" relative to the total provincial budget (see Figure 1.3).

FIGURE 1.3
TOTAL MTC BUDGETARY EXPENDITURES
AS A PER CENT OF TOTAL
PROVINCIAL BUDGETARY EXPENDITURES

Source: Ministry of Transportation and Communications, Ontario (1987),
"Public Accounts", Toronto

A recent gallup poll suggests Canadians would be willing to pay \$10/week towards better environmental controls. This is not reflected in a recent survey of sewage treatment plants in Ontario where fully 37% of treatment plants are in non-compliance with provincial standards. See Table 1.2.

TABLE 1.2
1987 NON-COMPLIANCE SUMMARY FOR
SEWAGE TREATMENT PLANTS (S.T.P.)
IN THE PROVINCE OF ONTARIO

Region	Total Number of S.T.P.s	Number of S.T.P.s Assessed	One or More Parameters	*BOD	*SS	*TP
Southwest	104	100	47	3	22	31
West Central	56	53	24	2	6	19
Central	76	68	22	1	2	20
Southeast	67	63	25	5	15	18
Northeast	82	63	16	4	6	10
Northwest	27	24	4	2	2	2
<hr/>						
Total (1987)	412	371	138	17	53	100
			(37%)	(5%)	(14%)	(27%)
<hr/>						
1986	407	362	151	18	47	126
			(42%)	(5%)	(13%)	(35%)

The figures within the parentheses are the percentages of the parameter as compared to plants assessed.

- * Suspended Solids and BOD are assessed on an annual basis. Total Phosphorus is assessed on a monthly basis; one or more months out of compliance means the plant is out of compliance for the year.

It has also been suggested that perhaps governments cannot afford the present infrastructure. That urban transport and maintenance of facilities play a major role in the economic efficiency of cities is evident from the very high economic rates of return that have been achieved mainly from the considerable savings and the reduction in vehicle operating costs. Estimated rates of return have been high for all types of urban projects but particularly for urban transport projects as is evident from Table 1.3. Unfortunately the same type of rigorous economic cost benefit analysis is not performed for a majority of urban Canadian transport projects. It is not expected that rates of return for domestic projects would be as high.

TABLE 1.3
AVERAGE ECONOMIC RATE OF RETURN
FOR URBAN TRANSPORT PROJECTS
1973-1981

<u>Fiscal Year</u>	<u>Rate of Return</u>	<u>Number of Projects</u>
1973	37.0	1
1974	19.5	2
1975	0	0
1976	30.0	1
1977	28.0	1
1978	34.0	2
1979	28.0	1
1980	23.0	1
1981	50.0	1

Source: Urban Transport, A World Bank Policy Study (World Bank, 1986)

There is, therefore, an international, national, provincial and municipal problem of distressing proportions in managing infrastructure. It is apparent that policies and practices that have guided our infrastructure investments of past decades are inadequate to meet the needs of a new century. It has reached a point when a new vision and new directions for infrastructure investments are vitally needed.

The reluctance or inability to incur capital debt may give a misleading impression of the true fiscal conditions of local governments. If capital and repairs are neglected, the general budget may understate the community's real obligation. An accurate determination of the economic well being of local government cannot be made unless information about the status of the infrastructure and the effectiveness of the capital maintenance system is included in the financial statement.

There are both short term and long term measures of fiscal distress. An indicator of short term distress is a government's ability to balance its current budget, that is its ability to pay for a basic package of public services. Long term fiscal distress can be perceived as the long term imbalance between responsibilities and revenues.

Several studies (Grigg, 1988) have suggested the infrastructure issue is more one of portfolio management and that the infrastructure has to be examined in an integrated manner.

Since local government expenditure on public facilities greatly affect both existing and potential business prospects, failure to maintain and/or expand capital infrastructure could curtail the economic vitality and growth of a community.

1.3 Research Objectives

The objectives of this thesis are: (1) to define issues in the management of infrastructure, including the need to view the worth of infrastructure as an asset, (2) to describe a methodology for establishing the funding level required for supporting strategies and programs illustrating the methodology with case studies, and (3) to report the concept of resource allocation under conditions of intersectoral conflict.

1.4 Methodology Framework

Recognizing the need for a systematic process and methodologies for bringing about improvements, this research study was undertaken as illustrated in Figure 1.4.

Following the definition of infrastructure, defining the issues related to infrastructure and its importance to the national economy, a study of management practices in selected regional and local governments was undertaken. These local and regional governments were:

- City of Vancouver
- City of Edmonton
- City of Winnipeg
- City of Toronto
- City of Ottawa
- City of Gloucester
- Regional Municipality of Ottawa-Carleton
- National Capital Commission

The study of asset management practices is a contribution to knowledge in the infrastructure field since little prior research has taken place on this topic.

The main focus of this research is the development of an infrastructure recapitalization model, and verification and testing of the model in real applications of a diverse nature. As a further development of methodology, an equilibrium model is postulated. A review of other depreciation methodologies is also discussed.

A master framework, which includes the budget and program cycles, is discussed using the models developed.

An application of the recapitalization model to the City of Lindsay is presented and discussed.

Conclusions and recommendations highlight the findings of this research designed to deal with a multi-discipline and complex problem.

FIGURE 1.4

FLOW CHART OF STUDY METHODOLOGY

1.5 Thesis Organization

Chapter 1 defines what we mean by municipal infrastructure and discusses the importance of infrastructure in the economy as a whole. Examples of the sums of money required to rehabilitate the infrastructure at the international, national and local level, are provided to illustrate the magnitude of the problem.

Chapter 2 investigates the current management and budgeting practices in several Canadian Cities.

Chapter 3 suggests recapitalization and equilibrium formulae which would provide the minimum funding amounts to maintain our infrastructure to sustainable levels. Examples of the utility of the formulas are provided at the international, national and local government levels.

Chapter 4 describes the program cycle and a budgeting framework which suggests the use of AM/FM/GIS software and incorporates the recapitalization and equilibrium equations into the decision-making process.

Chapter 5 presents conclusions and recommendations as a result of the research undertaken for this thesis. Following the list of references, are worked examples for a typical city.

CHAPTER 2

REVIEW OF CURRENT PRACTICES

2.1 Capital Budgeting in the Public Sector

While it is impossible to generalize about the wide variety of planning, financing, and project management techniques used by various local governments, a number of characteristics that are unique to government organizations are as follows:

- .1 Decision-making in government is dominated by politics and not by economic factors.**
- .2 Managers in government are influenced by the pressures of interest groups to a much greater extent than managers of private businesses.**
- .3 The missions, purposes, and objectives of government agencies are typically greater in number and less specific than those of business organizations.**
- .4 The criteria for decision-making in government have more to do with satisfying the "public good" and with political compromise than with economic factors such as profit and return on investment.**
- .5 Municipal governments seldom use cost-benefit analysis for decision-making.**
- .6 The implementation process in government can take years and involve complex reviews at many levels (including citizen participation). This delays improvements and impedes effectiveness since it means that governments are often following outdated priorities.**
- .7 The historical or replacement value of the infrastructure is seldom mentioned in the books of the corporation, (asset base).**

A key feature of local government budgeting is the requirement that expenditures not exceed revenues. As a result, one objective of budgeting is to ensure that administrators maintain acceptable levels of service delivery while keeping expenditures within legal limits. Increasingly policy for spending envelopes are mandated not to exceed the current inflation rate.

2.2 The Budgeting Environment

The principal actors in the budgeting process are the "budget-spenders" and the "budget-cutters". Budget-spenders view their roles as performing a service; in their budget preparations they give higher priority to meeting professional standards and the demands of constituents than to observing revenue limits. Budget-cutters, usually chief executive officers and elected officials, see their role as holding the line on expenses. They consider the budget a way to meet revenue constraints.

The spenders-versus-cutters dichotomy generates certain universal trends. The three department administrators' goals in budgeting are to (1) defend the base, (2) increase the base, and (3) expand the base. To defend the base means to attempt to preserve the agency's share of total resources at the previous year's level. To increase the base is to receive a larger share of resources for existing activities at the expense of other agencies. To expand the base is to develop new programs.

Many techniques exist to achieve these goals. For example, constituent pressure may be brought to bear on elected officials. It is typical, however, for administrators to request more than they expect to receive. Such requests not only carry the hope of gaining additional funds, but also serve to meet the professional obligation of communicating the true needs of the department.

Elected officials have difficulty allocating resources in this type of environment. The result, therefore, is most often incrementalism -- which is the tendency to look at the prior year's appropriations for police, fire, streets, debt service, and infrastructure as a "given" and to focus only on the changes in an agency budget. Several budgeting methods have been adopted to overcome this tendency, but they have met with only limited success.

2.3 The Purposes of Budgeting

Budgets exist for the purposes of legal control, management information, and planning. As a control tool, budgets prescribe, through a detailed description of proposed expenditures, how much and for what purposes funds may be spent. The purpose of this exercise is to prevent thievery and to ensure that legislative intent is carried out.

Budgets also provide management information to improve efficiency in agency operations. To this end, budgets focus on measurable performance activities. The important concern is the efficient use of resources in achieving desired program results. Finally the budget enables the agency to plan for service requirements. Budgets state the public policy agenda for the future. The period in which the budget is considered presents an ideal opportunity to consider the future implications of current decisions in a comprehensive, organized framework.

2.4 Types of Budgets

The public works director may be required to present two separate budgets. The annual operating budget provides the financial plan for day-to-day, recurring costs of the agency for one year. The capital improvements budget is projected over a longer period to time (usually five years) for capital projects.

Budgets can be presented in several formats. Each attempts to reflect a different policy perspective on decision-making. They have different orientations for management and different criteria for policy makers. The line-item budget is the oldest and most common type of budget format. It allocates specific dollar amounts to each item, or object, of expenditures. Expenditure items are systematically organized into categories or accounts. Line-item budgets are aimed at achieving economy through strict control.

Performance budgets have a management orientation. Revenues and expenditures are related to work loads and unit costs to achieve efficiency. The emphasis in the performance budgeting format is on how well an agency is utilizing its resources. The measures used include cost per citizen and cost per unit of output.

The project budget is oriented towards planning. Expenditures are presented in the form of programs and activities rather than departmental line items. Program budgeting defines the goals of an agency and classifies organization activities contributing to each goal. Data are presented by product output rather than a formal organization line in order to focus on goals and alternative programs for achieving them.

Both the operating and capital budgets are planned and programmed on multi-year cycles. This requires the appropriate linkages with other management schedules. The capital budget should be linked with a comprehensive infrastructure planning needs assessment process and the official plans.

In the U.S., as Table 2.1 demonstrates, there is a clear correlation between city size and Capital Improvement programs and the measures of sophistication in the implementation of fiscal management procedures.

TABLE 2.1
EXISTENCE OF CAPITAL IMPROVEMENT PROGRAMS (CIP)

Population Strata	Number	% with CIP (Mean)	Year Implemented
10 - 25 000	314	59	1977
25 - 50 000	256	65	1975
50 - 100 000	148	74	1975
100 000 +	121	92	1970
All Cities:	839	68	

SOURCE: (League of Cities, 1983)

The planning skill of an infrastructure management organization will ultimately be evident in the capital budget. The preparation of effective annual reports is a work of art. A manager should be able to examine the operating budget, the organization chart and the job descriptions and tell what will happen during the year.

The design and presentation of the annual report require careful attention from management. This is management's opportunity to brag about what has been done and how well. This is particularly true with the asset base.

Part of current spending on goods and services goes for the Operation and Maintenance (O&M) and rehabilitation of capital investment in infrastructure. As previously stated the condition of the asset base is very important for productivity of a region. Therefore the declaration of the value of the asset base could be an important argument to the budget spender in funding approval process. A numerical impact that is easily derivable would greatly strengthen the argument for sustained investment.

2.5 Review of Budget Procedures

A review of budget procedures in six Canadian municipalities and one regional municipality and the National Capital Commission was undertaken as part of this research. The municipalities examined were:

- . City of Vancouver
- . City of Edmonton
- . City of Winnipeg
- . City of Toronto
- . City of Ottawa
- . City of Gloucester
- . Regional Municipality of Ottawa-Carleton
- . National Capital Commission

The data for the capital works budgets and the budgeting process for the municipalities was collected for the years 1986, 1987, 1988 and 1989. The data for the budgets is a snapshot of the budgets for the year presented. Although the budgets for the municipalities and financial statement for the National Capital Commission are dated, the budgeting process is essentially the same in 1994.

Two areas of the capital works budget process were of a particular interest. The first was the statement of assets base and the condition and depreciation of the infrastructure. The second was the priority project selection system for maintenance of the asset base. Three of the cities/region surveyed used a formal priority system: Winnipeg, Ottawa and the Regional Municipality of Ottawa-Carleton. A short description of the Budgeting and Capital Works programming follows.

2.5.1 City of Vancouver

To prioritize Capital plan submission from Engineering, Parks, Fire, Civic Buildings and the Library, a six member staff committee is formed consisting of one member each from the City Manager's Office, Finance, Planning, Social Planning, Parks and Engineering. This committee hears brief submission from each department and on each program and then votes on how funding for each program ought to be placed in the five priority levels established by the committee.

The review committee recommends that only the top two priority levels be funded. The intent is to approach the maximum borrowing level established by the Finance Department. Council then reviews the submissions in detail. An example of a typical project with the priority rating system is illustrated in Figure 2.1. There is no mention of the value of the asset nor the impact on the remaining useful life of the asset if these lower priorities are not funded.

FIGURE 2.1

EXAMPLE OF PRIORITY PROJECT FOR VANCOUVER

1987 - 1990 CAPITAL PLAN &
1987 BASIC CAPITAL BUDGET

Project Title
EXTENSION & REPLACEMENT - STEEL TRANSMISSION MAINS

Project No.
I-4

Project Detail History, Timing and Costs (continued)

To remain within the overall 1987-1990 funding allocation set forth in the Long Range Plan, funds have been diverted from the rechlorination program for distribution system modifications.

Total Cost \$6,019,000. Priority #1 \$6,019,000

1987 CAPITAL BUDGET

For the 1987 Budget, only the funding to complete the Powell Street transmission main has been included.

To facilitate the construction of a rechlorination station at Boundary Road and Eton Street it is necessary for the City to take over a portion of the G.V.W.D.'s Boundary Road transmission main supplying City pressure zone 442. The 1770' for 32-inch main is an extension of the City owned Charles Street transmission main transferred to the G.V.W.D. in the late 1920's. The Boundary Road position no longer serves the G.V.W.D. supply systems and is located with the City's boundary, hence the G.V.W.D. is willing to transfer ownership to the City for a nominal fee of \$1.00. The estimated remaining service life of the Boundary Road main is the same as the City's present Charles main; between 20 and 30 years. The transfer of ownership is included in the 1987 Capital Budget as follows:
Boundary Road, Edinburgh to Cambridge Streets, 1700' of 32-inch transmission main.

\$2,519,000.

2.5.2 City of Edmonton

In Edmonton capital budgets are reviewed by a committee of senior managers. This committee prioritizes the five year capital program and recommends a five year capital priority program to the Budget Committee of City Council. It is interesting that the Annual Report for Water and Sanitation includes amounts for depreciation. See Figure 2.2. The historical costs of all assets, including contributions and grants for extension to plan are depreciated over their estimated useful lives. The transportation department does not adopt the same approach. In the transportation department, the value of the asset is not reported.

FIGURE 2.2
EXAMPLE OF FINANCIAL STATEMENT
WATER AND SANITATION CITY OF EDMONTON

**Water and Sanitation
Combined Utilities
Balance Sheet**

December 31, 1986 and 1985
(in thousands of dollars)

	Water System		Sanitary Sewage System		Combined Utilities	
	1986	1985	1986	1985	1986	1985
ASSETS						
Current assets:						
Due from The City of Edmonton	3,779	8,390	932	1,635	4,711	10,025
Accounts Receivable less doubtful accounts	7,788	6,677	4,140	3,514	11,928	10,191
Inventory of materials and supplies at average cost	1,166	1,003			1,166	1,003
Prepaid expenses	24	14	1		25	14
	12,757	16,084	5,073	5,149	17,830	21,233
Deferred charges:						
Debenture discount and expenses less amortization	33	38			33	38
Property accounts:						
Land, buildings and equipment	421,993	373,712	210,936	199,855	632,929	573,567
Less accumulated depreciation	76,113	68,436	46,149	43,087	122,282	111,523
	345,880	305,276	164,787	156,768	510,667	462,044
Construction in progress	3,859	31,673	4,128	4,836	7,987	36,509
	349,739	336,949	168,915	161,604	518,654	498,553
The City of Edmonton Sinking Fund	635	486	611	496	1,246	982
	363,164	353,557	174,599	167,249	537,763	520,806

Figure 2.2 (continued)

	Water System		Sanitary Sewage System		Combined Utilities	
	1986	1985	1986	1985	1986	1985
Current liabilities:						
Accounts payable and accruals	3,263	3,496	1,027	689	4,290	4,185
Accrued interest on long term debt	7,705	7,581	3,538	3,494	11,243	11,075
City customer guarantee deposits	812	721	417	336	1,229	1,057
Current portion of long term debt	4,414	3,951	2,965	2,616	7,379	6,567
	16,194	15,749	7,947	7,135	24,141	22,884
Customer advances	1,354	1,452	52	240	1,406	1,692
Debenture payable	232,314	229,375	107,565	105,160	339,426	359,111
	249,862	246,576	115,564	112,535	365,426	359,111
EQUITY						
The City of Edmonton - December 31	38,833	38,074	4,542	3,705	43,375	41,779
Contributions and grants for extensions to plant	74,469	68,907	54,493	51,009	128,962	119,916
	113,302	106,981	59,035	54,714	172,337	161,695
	\$363,164	\$353,557	\$174,599	\$167,249	\$537,763	\$520,806

2.5.3 City of Winnipeg

The City of Winnipeg uses a Priority rating system to provide a set of criteria by means of which proposed spending programs can be ranked in order of priority on a city wide basis over a whole range of functions and activities (inter and intra sectoral). The ratings are divided into four main groups:

- . Vital services
- . Essential services
- . Standard services
- . Desirable services

There is no mention of the value of the asset in the budget figure nor a statement of the wear and tear if the appropriation is not approved.

FIGURE 2.3

**CITY OF WINNIPEG
PRIORITY RATING SYSTEM**

The System recognizes two basic factors, namely, priority of function (priority grouping) and degree of priority (sub-group rating).

PRIORITY GROUPINGS

<u>PRIORITY POINTS</u>	
Main	Sub

5

A. Vital Services

Those basic elements of essential services which are vital to the day to day domestic, industrial, and commercial life of the City. Capital expenditures within this group would be related to: -

- (1) Winnipeg Hydro generating stations, transmission lines, terminal stations and elements of the distribution system.
- (2) Sewage Disposal Collection System and treatment facilities.
- (3) Water aqueduct reservoirs, pumping stations and trunk feeder mains.

Sub-Group Rating

Could cause a serious imminent disruption of service (should be done without undue delay).	4
Would extend or complete the expected usefulness and/or reliability of a facility (should not be delayed for more than 1 year).	3
Would improve a facility which is at present sub-standard or approaching a high degree of obsolescence (should not be delayed for more than 2 years).	2
Would qualify as a minimum sustaining program-desirable but not absolutely essential (could be delayed for 3 years or more).	1

NOTE: A bonus of up to 2 points may be added to any of the sub-categories 1 to 4 for projects that clearly contribute specifically to the City's declared development objectives.

FIGURE 2.4

**CITY OF WINNIPEG
PRIORITY RATING SYSTEM - ESSENTIAL SERVICES**

PRIORITY POINTS	
Main	Sub

B. Essential Services

3

Those basic services characterized by a high degree of public necessity, convenience and safety. Capital expenditures within this group would be related to: -

- (1) Public Transportation
- (2) Fire and Police Protection
- (3) Garbage Collection & Disposal
- (4) Regional Street System
- (5) Land Drainage

Sub-Group Rating

Could cause a serious imminent disruption of service (should be done without undue delay).

4

Would extend or complete the expected usefulness and/or reliability of a facility (should not be delayed for more than one year).

3

Would improve a facility which is at present sub-standard or approaching a high degree of obsolescence (should not be delayed for more than two years).

2

Would qualify as a minimum sustaining program - desirable but not absolutely essential (could be delayed for three years or more).

1

NOTE: A bonus of up to 2 points may be added to any of the sub-categories 1 to 4 for projects that clearly contribute specifically to the City's declared development objectives

FIGURE 2.5
CITY OF WINNIPEG
PRIORITY RATING SYSTEM - STANDARD SERVICES

PRIORITY POINTS	
Main	Sub

C. Standard Services

2

Those services which would reasonably be expected to be provided to all citizens to the City for their convenience and in accordance with generally accepted standards. Capital expenditures within this group would be related to:

- (1) Residential Street and Lane Construction (Local Improvement or other).

Sub-Group Rating

Could cause a serious imminent disruption of service (should be done without undue delay).

4

Would extend or complete the expected usefulness and/or reliability of a facility (should not be delayed for more than one year).

3

Would improve a facility which is at present sub-standard or approaching a high degree of obsolescence (should not be delayed for more than two years).

2

Would qualify as a minimum sustaining program - desirable but not absolutely essential (could be delayed for three or more years).

1

NOTE: A bonus of up to 2 points may be added to any of the sub-categories 1 to 4 for projects that clearly contribute specifically to the City's declared development objectives

FIGURE 2.6

**CITY OF WINNIPEG
PRIORITY RATING SYSTEM - DESIRABLE SERVICES**

PRIORITY POINTS	
Main	Sub

D. Desirable Services

1

Those services having an aesthetic social, cultural, educational or entertainment value. Capital expenditures within this group would be related to: -

- (1) Parks and Related Facilities
- (2) Recreational Facilities
- (3) Libraries
- (4) Museums

Sub-Group Rating

Could cause a serious imminent disruption of service (should be done without undue delay).

4

Would extend or complete the expected usefulness and/or reliability of a facility (should not be delayed for more than one year).

3

Would improve a facility which is at present sub-standard or approaching a high degree of obsolescence (should not be delayed for more than two years).

2

Would qualify as a minimum sustaining program - desirable but not absolutely essential (could be delayed for three or more years).

1

NOTE: A bonus of up to 2 points may be added to any of the sub-categories 1 to 4 for projects that clearly contribute specifically to the City's declared development objectives

2.5.4 City of Toronto

The Works department undertakes a comprehensive evaluation of all major elements of the City's infrastructure - sewers, watermain, roads and structures. A systematic approach in developing a plan in each of these areas for presentation to City Council, includes recommendations as to programmes that are required to maintain a proper level of service for these facilities, which takes into consideration the following requirements:

- (a) The extent and condition of the existing system.
- (b) Deficiencies.
- (c) Levels of service.
- (d) A staged plan to eliminate deficiencies in order of priority.
- (e) Programmes of preventive maintenance for those items which are not deficient.

In putting the plans together, there are three very important steps considered:

- (1) Make sure the public knows about the plan.
- (2) Propose equitable funding methods to implement the plan.
- (3) Ensure that the plan is politically palatable and capable of support.

With respect to methods followed by the politicians in the City of Toronto to prioritize projects, City Council has established a Budget Review Group, who are responsible to provide recommendations to Council on the budget requests submitted by the various Department Heads within the City of Toronto. The Budget Review Group consists of members of Council, who have been appointed to this Group by City Council. The Group is chaired by a member of the Executive Committee.

The budget requests are referred to this Group, following their consideration by the Standing Committees of City Council. The Budget Review Group, utilizing staff from the Management Services Department of the City (Planning and Budgeting Division), analyzes the budgets received from each of the Departments, reviews same with the Department

Head involved, and ultimately provides recommendations to the Executive Committee in regard to the approval of the budget request.

The Organization Chart illustrated as Figure 2.7 shows the relationship of the Standing Committees of Council and the various Civic Departments.

The functions of the Management Services Department of the City, in which the role played by the Planning and Budgeting Division of this Department is outlined.

Function

The Management Services Department operates under the direction of the Executive Director - Management Services and consists of an Administration Division, a Planning and Budgeting Division, a Personnel Services Division, a Computer and Information Systems Division, a Management Consulting Division, an Equal Opportunity Division, a Job Evaluation Division, and an Occupational Health, Safety, and Rehabilitation Division.

The primary functions of the Department are: to provide service to all departments in developing their internal objectives; budgeting and long-term financial planning; computer services; organization and systems studies; developing and administering personnel and human resource policies; initiating studies and developing policies and programs; administering the Job Evaluation Program; worker health and safety programs; and rehabilitation counselling services.

FIGURE 2.7
CITY OF TORONTO
RELATIONSHIP OF STANDING COMMITTEES OF COUNCIL
AND CIVIC DEPARTMENTS

Source: City of Toronto, Management Services Department

Administration Division

The Administration Division operates under the Director of Administration and has the following responsibilities:

- 1) To provide head office administration and clerical services for the Department. The Director acts as Executive Assistant to the Executive Director.
- 2) To develop, implement and monitor administrative policy and procedures in consultation with Division Directors.
- 3) To co-ordinate the preparation and presentation of the department budget and maintain control over all aspects of it.
- 4) To co-ordinate and monitor corporate programs within the Department including the Equal Opportunity Program, Occupational Health and Safety and Job Evaluation.
- 5) To prepare special reports and studies on corporate issues and submit findings and recommendations to the executive Director.
- 6) To maintain the City's Manual on the Civic Organization.
- 7) To represent the Department on various corporate committees, including the Civic Employees Pension Fund Committee, Job Evaluation Liaison Committee, Occupational Health & Safety Co-ordinating Committee and Administrative Advisory Committee.
- 8) To assist the Salary Review Committee in preparing reports and recommendations to Council regarding the remuneration of Members of Council, Boards and Commissions, and related matters.

Planning and Budgeting Division

The Planning and Budgeting Division for Toronto operates under the supervision of a Director. The responsibilities of the Division are:

- 1) To assist departments and agencies in the preparation of their Operating and Capital Estimates.
- 2) To analyze the various estimates and, through participation in the budget review sessions, make recommendations to the Budget Review Group.
- 3) To aggregate the various expenditure and revenue estimates throughout the budget review phase, make the necessary adjustments, and prepare the budget presentation documents for the Budget Chief.
- 4) To monitor expenditures vis-a-vis appropriations, and effect transfers of appropriations as required.
- 5) To assist in developing criteria for review and evaluation of budgets and, through a management information system, provide the Budget Review Group with information to assess the performance of Departments and Boards.
- 6) To assist in focusing upon program and policy issues within budgets and in relating these issues to the City's goals and objectives.
- 7) To facilitate a longer term program and fiscal planning process in conjunction with the existing budget preparation process.

FIGURE 2.8
PLANNING AND BUDGETING DIVISION
AND PERMANENT ESTABLISHMENT

Source: City of Toronto, Management Services Department

2.5.5 City of Ottawa

An infrastructure management committee was established comprising members of Engineering, Financial Planning and is chaired by a representative of the chief administrative officer's department. A seven hundred million dollar reconstruction is recommended over a twenty to thirty-five year period.

The city is developing a long term corporate plan to deal with an infrastructure management strategy. The strategic model to address this issue was formulated to:

1. define the issue
2. define long term goals
3. consider alternate strategies
4. recommend a course of action
5. develop performance indicator

The linkage between the infrastructure management strategy, and other major strategies is illustrated on Figure 2.9. Priorities are first established by "road needs" followed by the requirement to separate combined sewers. There is an estimated value established for the roads and sewer system.

FIGURE 2.9

LINKAGE BETWEEN INFRASTRUCTURE MANAGEMENT AND THE CAPITAL WORKS BUDGET

Source: City of Ottawa, Office of the Chief Administrative Officer

2.5.6 City of Gloucester

The City of Gloucester "Capital Budget Proposal" does not provide details on the priority system used to select projects. There is however a qualitative note describing the impact if the project does not proceed. It is interesting to note however that the "life expectancy" of the asset is noted. See Figure 2.10 and 2.11 for an example of a road and storm sewer respectively.

FIGURE 2.10

**CORPORATION OF THE CITY OF GLOUCESTER
CAPITAL BUDGET PROJECT DETAIL SHEET -- ROADS**

DEPARTMENT: Trans. - Roads - L.I.

PROJECT NUMBER: 9 YEAR: 1989

Capital Cost Estimate:	\$
Construction	
City Forces	280,000
Contractor	50,000
External Consultants	
Internal Consultants/Planning	
Land Acquisition	
Other Costs	0
Interim Financing	
TOTAL COST	\$330,000

EXPENDITURE PATTERN

Year	Amount	Project Start Date:	1989
1989	330,000		
1990	30,000	Project Completion Date:	1990
1991			
1992			
1993			
		LIFE EXPECTANCY OF ASSET:	20 years
	\$360,000		

NET CHANGES IN OPERATIONS/PROGRAMMING COSTS:	\$
Revenue	
Salaries & Benefits	
Materials	
Services & Rents	
Provision for Reserves	
NET COST	\$0

EXPLANATION OF CHANGES IN OPERATING/PROGRAMMING COSTS:

No change from existing

IMPACT IF PROJECT DOES NOT PROCEED

Road continues to operate as rural section with open ditches

FIGURE 2.11

**CORPORATION OF THE CITY OF GLOUCESTER
CAPITAL BUDGET PROJECT DETAIL SHEET**

DEPARTMENT: Envir. - Storm - Dev.

PROJECT NUMBER: 127 YEAR: 1989

Capital Cost Estimate:	\$
Construction	
City Forces	
Contractor	2,120,000
External Consultants	380,000
Internal Consultants/Planning	
Land Acquisition	
Other Costs	o
Interim Financing	
TOTAL COST	\$2,500,000

EXPENDITURE PATTERN

Year	Amount	Project Start Date:	1989
1989	2,500,000	Project Completion Date:	1989
1990			
1991			
1992			
1993		LIFE EXPECTANCY OF ASSET:	50 years
	\$2,500,000		

NET CHANGES IN OPERATIONS/PROGRAMMING COSTS:	\$
Revenue	
Salaries & Benefits	1,500
Materials	750
Services & Rents	750
Provision for Reserves	
NET COST	\$3,000

EXPLANATION OF CHANGES IN OPERATING/PROGRAMMING COSTS:

Will be assuming stormwater management facilities which will require occasional maintenance work and monitoring.

IMPACT IF PROJECT DOES NOT PROCEED

Inability to proceed with development in the Leitrim Area.

2.5.7 Regional Municipality of Ottawa-Carleton

The Transportation Department of the Regional Municipality of Ottawa-Carleton uses a point system to determine priority listings of existing roads. The criteria used to determine the priority listing includes:

1. Needs rating
2. Bus route rating
3. Economic analysis
4. Project continuation
5. Coordination of work
6. Level of service rating
7. Growth factor rating
8. Location rating

A total score is then calculated. See Figure 2.12.

The budget document is very comprehensive with each department stating its goals and objectives with some measurable performance targets. Some effort is made to define the value of the asset and it is recognized that wear and tear and depreciation ought to be accounted for, albeit somewhat imprecisely, in the budget document. Priority listings for growth related projects "New Links" use different criteria. The calculation for "growth related" construction is calculated using the following criteria:

1. Growth intensity
2. Cost effectiveness
3. System continuity
4. Location factor
5. Commercial/industrial service

FIGURE 2.12

REGIONAL MUNICIPALITY OF OTTAWA-CARLETON
PRIORITY LISTING FOR EXISTING ROADS

1989 CAPITAL BUDGET - TRANSPORTATION DEPARTMENT											
PRIORITY LISTING EXISTING ROADS (Excludes New Links)											
PROJECT NUMBER		CAPITAL BUDGET PRIORITY	NEEDS STUDY RATING	BUS ROUTE RATING	ECONOMIC ANALYSIS	PROJECT CONTINUATION	COORD OF WORK	LEVEL OF SERVICE RATING	GROWTH FACTOR RATING	LOCATION RATING	PROJECT SCORE
30676	St. Joseph Blvd. (Queensway - Jeanne d'Arc)	1	150	85	288	100	60	130	104	26	943
30686	Englewood Road (Farrbank - Robertson)	2	100	79	346	100	50	130	104	26	903
30687	St. Joseph Blvd. (Duford - Tenth Line)	3	125	52	346	100	20	130	104	25	903
30674	Baseline Road (Richmond Rd - Greenbank)	4	50	118	346	100	40	130	78	13	875
	St. Joseph Blvd. (Jeanne d'Arc - Duford)	5	100	104	346		20	130	104	26	800
	Fallowfield Road (Cedarview - Woodroffe)	6	125	92	288		50	130	104	26	816
	Russell Road (Walkley - St. Laurent)	7	75	145	346		20	130	78	13	807
	Hunt Club Road (Bowesville - W/L Airport Pkwy)	8	50	13	346	100	50	130	78	13	780
	Benson Avenue (Heron Rd - Carling)	9	75	145	346			130	78		774
	Montreal Road (Cummings Bridge - Vanier Pkwy)	10	150	91	346			130	52		769

CODE 66 -

Source: Regional Municipality of Ottawa-Carleton
1989 Capital Works - Transportation

2.5.8 National Capital Commission

The National Capital Commission was established by the National Capital Act, 1958. The Commission is a Crown Corporation without share capital named in Schedule C, Part 1 to the financial Administration Act and is an agent corporation. The objects and purposes of the Commission are to prepare plans for and assist in the development, conservation and improvement of the National Capital Region in order that the nature and character of the seat of the government of Canada may be in accordance with its national significance.

As at March 31, 1986

In the annual report of the National Capital Commission the values of the infrastructure is stated at historical cost. The assets are depreciated as follows:

Buildings	20 years
Roads and Bridges	25 years
Park Landscaping and Improvement	25 years
Festival Equipment	5 years
Equipment	7 to 15 years
Vehicles	4 to 7 years
Equipment and Vehicle Attachments	10 years

On September 1, 1984, the Government proclaimed amendments to the Financial Administration Act which, inter alia, required the Commission prepare its financial statements in accordance with generally accepted accounting principles. The Commission has reviewed its accounting policies and systems and has altered them to comply with the requirements of the Act for the 1985-86 fiscal year. The changes include:

- i) depreciating buildings and equipment and reflecting the depreciation expense in the statement of operations. Previously no depreciation was recorded.
- ii) including gains and losses on disposal of large buildings and equipment in the statement of operations. Previously they were credited or charged directly to equity.

- iii) excluding capitalized expenditures from the statement of operations where they were previously recorded.

The effect of depreciation on the statement of the infrastructure asset base is illustrated as follows:

	Historical Cost	Accumulated Depreciation	1986 Net Book Value	1985 Net Book Value
(in thousands of dollars)				
Land and Buildings				
Greenbelt	\$54,650	\$15,003	\$39,647	\$39,374
Parkways	70,581	30,281	40,300	40,225
Parks	44,690	12,866	31,824	30,565
Bridges and approaches	25,671	11,465	14,206	14,537
Historical sites	15,499	7,029	8,470	8,833
Recreational facilities	13,397	4,330	9,067	8,851
Rental properties	135,514	10,296	125,218	125,751
Unsettled expropriations	1,342	--	1,342	1,069
Administrative and service buildings	10,417	5,237	5,180	5,577
	371,761	96,507	275,254	275,322

2.6 Summary of Procedures

In summary, the capital budgeting process, in the cases presented do not relate to the value of the existing assets. Also, the priority system for ranking projects makes no attempt to compare marginal benefits (MB) to marginal cost (MC) or review the cost of delay. The optimal rehabilitation investment decision occurs when the marginal cost of the investment equals the marginal benefit of the investment. When there is more than one project competing for limited resources, the effect of delaying or advancing each project by one unit of time in relation to doing so with other projects also ought to be examined. See Figure 2.13. In a majority of cases an heuristic approach is adopted, subject to a predetermined global spending envelope that is usually related to a policy statement issued by the council.

The next chapter advances a model to calculate a minimum funding level to maintain municipal infrastructure in a sustainable manner. This is not intended to replace classical feasibility and needs studies but rather to provide benchmark funding levels.

FIGURE 2.13

LOSS IN ECONOMIC EFFICIENCY DUE TO
ADVANCING OR DELAYING A PROJECT BY ONE UNIT OF TIME (1)

CHAPTER 3

RECAPITALIZATION AND EQUILIBRIUM EQUATIONS

3.1 Policy and Methodological Requirements

It is apparent that our older cities have to catch up on a backlog of neglected maintenance. Rehabilitation of infrastructure and therefore supplying basic services is one of the main purposes of municipal government from an allocative efficiency point of view. (Musgrave, 1987) The evolution of public issues is important to study in understanding the infrastructure issue. This evolution can be divided into three phases. Phase 1 is Social Expectations, followed by Phase 2, Political Action, concluded by Phase 3, Legislation. (Marx, 1986)

In managing public infrastructure subsystems, it has been an all too common practice to make decisions based upon annual budgets without regard to longer range trends in system conditions and projected resources. This situation has been exacerbated by the growing fiscal gap between public works funding and the escalating cost demands of a generally deteriorating infrastructure, whereby the agency is obliged to respond to one crisis situation after another. Consequently, projects are not implemented as elements in a planned sequence of system maintenance and improvement.

Maintenance has been neglected in many infrastructure systems since these are easier to defer from one political administration to another. There is more glamour in building new projects than maintaining old ones. It is interesting to note that the railroads were the first large professionally managed corporation in the United States to introduce the concept of depreciation of capital assets, but it was well into the twentieth century before even the railroads were concerned with the problem. (Chandler, 1977)

It is recognized in the literature that effective public works management is the most important ingredient in solving the infrastructure problem. Perhaps new approaches and performance measures are required.

Approaches such as the valuation of assets can be used as an improved technique to systematically address the problem. The second problem is defining the proper expenditure levels. Depreciation is an allocation of the cost of fixed assets. It does not necessarily represent the actual wear and tear, physical conditions or productive ability of the assets involved. There are no uniformly acceptable estimates of useful life. Facility deterioration depends on many major factors including initial design and quality of construction, use of the facility and conditions to which the facility has been exposed. It is, of course, understood that different components of a facility have different useful lives. On the basis of costs of various components, a weighted average estimate of useful life can be determined. (See Table 3-1)

Nevertheless, the private sector uses depreciation as a rough estimate of what must be invested to ensure productive capacity of the facility.

Extrapolation of past trends of investment levels in a particular sector and using a replacement cycle rule of thumb can be used to forecast future needs. Such approaches are necessary in the absence of good information, but are likely to produce a crude estimate of real investment needs. Depreciation can be used as a rough estimate to be modified by an internal list of both intersectoral and intrasectoral needs.

As a basic step, management requires a reorientation of thinking about infrastructure. Cities need to manage their infrastructure like a business manages its assets. The challenge of infrastructure is more one of portfolio management. The questions to be asked therefore are:

- (1) How to properly inventory and define needs?
- (2) What is the "right" sustained funding amount to manage each of the assets?

TABLE 3-1
THE LIFE-SPAN OF INFRASTRUCTURE INVESTMENTS FOR THE THREE MODES OF INLAND TRANSPORT

Parts of the Infrastructure	Railways		Roads		Waterways	
	Installations	Life in Years	Installations	Life in Years	Installations	Life in Years
Land	Land	infinite	Land	infinite	Land	infinite
Earth installations	Earthworks for track	infinite	Earthworks	60-100	Navigation Channel	100
Subsidiary installations	Plantation	25-40	Plantation	15-40	Reinforcement to banks	50-100
	Protective installations	75-100	Protective installations			
Sub- and superstructure	Ballast	30-50	Road foundation	25-50	Basins for water regulation	90-100
	Sleepers	10-30	Bitumen surface	5-25	Protective installations	90-100
	Rails	15-60	Concrete surface	10-35	Bridges, tunnels, dams	100
	Minor fittings	20-50	Shoulders	20-30	Locks, lifting installations	50-100
	Track installations	12-25	Bridges, tunnels	50-100	Anchorage installations	25-80
	Bridges, tunnels	60-100	Intersections	25-10		
	Signal installations	20-25	Signal installations		Signal installations	
Safety installations	Information service	25-40	Information service		Information service	
	Lighting	30-35	Lighting		Lighting	

Source: Georgi, H., (1973)

3.2 Infrastructure Management Systems

The answer to the first issue "How to properly inventory and define needs" is the implementation of an infrastructure management strategy.

A survey of local officials sponsored by the International City Management Association in the U.S. in 1987 revealed that only 60% of U.S. cities and counties have a complete, current infrastructure inventory. Without such basic information, governments at all levels are hard pressed to plan effectively for their capital assets needs. The City of Scarborough, Ontario (population 500 000) for example has introduced a computer database for its 2200 kilometre sewer system. With a replacement value of over two billion dollars, it is estimated that there has been a 5% increase of productivity in the maintenance activity. Due to improved coordination of maintenance and construction, the money spent to implement the system yielded a 33% return on investment. (Gally, 1988)

Infrastructure Management Systems (IMS) hold great potential for aiding decision makers in more efficiently and effectively managing the public infrastructure. The emerging technology and preliminary results point to an expansion of the computer revolution in engineering to upper and mid-management. However, time alone will disclose the degree to which decision makers recognize that potential and dedicate the time and effort necessary to bring IMS into the main stream of asset management.

Technological improvements such as SIMS - Sewer Information Management Systems, WIMS - Watermain Information Management Systems, RIMS - Road Information Management Systems, and GIS - Geographic Information Systems hold great promise to better manage our municipal infrastructure.

In the past, infrastructure information was stored and maintained on hundreds, sometimes thousands, of different map sheets, engineering drawings, schematics and other paper record files. Unfortunately, these map records varied widely in terms of scale, accuracy, completeness, availability and various stages of being up-to-date. They were also limited as to the amount of information that could be shown on them, which often caused a lot

of consultation among employees and very time-consuming field survey verification before the required information could be used. Studies have shown that cities with populations of over 250 000 maintained 50 000 to 100 000 individual maps, dispersed among 20 or more user groups and departments. The cost of maintaining, retrieving and verifying this manual information has risen significantly over the past few years owing to increased labour rates and the demand for up-to-date infrastructure data spurred by recent surges in economic development in many municipalities.

Decision-making today within local governments requires assimilation of accurate information from many different sources and agencies. To effectively manage street paving maintenance programs, utility service systems, and property assessment, local government administrators must have timely and accurate information. They must be able to get it quickly from various maps, drawings and tabular records. This type of infrastructure-related information is usually obtained from numerous and often out-of-date maintenance records files. Local government administrators are seriously looking at the Geographic Information System computer technology which will help them provide more effective levels of service, efficiently handle complex infrastructure management planning problems and reduce operational costs through preventive maintenance programs. The integration of computer infrastructure inventory records, computer-aided engineering and computer mapping applications into one geographical database system enables us to build an intelligent Infrastructure Management Information System (IMIS). IMIS allows important information about municipal resources and facilities such as street networks, traffic signals, land records, engineering, digital terrain modelling and economic development models to be stored in the form of "electronic maps", to be recalled in a matter of seconds and displayed on a graphics computer terminal to promote more informative, timely and productive decisions.

Even a small municipality of 25 000 persons would have infrastructure assets in excess of \$200 million. Small relational database systems which combine CAD/GIS can be obtained including the cost of the software and a 486 basic computer for less than \$20,000 (Canadian). A 10% increase in productivity in managing the corporation's assets would yield substantial returns. These small management systems such as

(FMS/AutoCad) could be extended to include intrasectoral improvements. These techniques would avoid the embarrassing problem of overlaying a road one year to have it reconstructed the following year due to a utility cut. An example of a configuration of identified attribute and variable attribute is illustrated in Figure 3.1. The cardinal rule in maintenance management is knowing when to carry out what type of maintenance or rehabilitation and then carrying out the planned program on time.

Larger municipalities, e.g. City of Nepean and the Regional Municipality of Ottawa-Carleton (RMOC), are using ORACLE based software for their infrastructure database programming. RMOC has installed a Geographic Reference Information System for the management of the regional waterworks infrastructure. The City of Nepean now requests "AS-BUILT" information in a digital format file compatible with the master plan of database management of the infrastructure.

3.3 Recapitalization Equation

An approximation to the second question "What is the right sustained funding level to manage our urban assets" can be obtained by developing and using the Recapitalization Equation.

The factors that form the "building blocks" for the development of the Recapitalization Equation (model) are:

- models of asset deterioration
- standards for asset upgrading
- treatment of inflation and the use of constant dollars
- replacement value of an asset
- design life of the various components of an asset and the overall design life of the asset
- the concept of an account for individual asset maintenance and rehabilitation
- annual funding level for the network

The following sections describe the above factors:

FIGURE 3.1

EXAMPLE CONFIGURATION OF IDENTIFIED
ATTRIBUTE AND VARIABLE ATTRIBUTE IN
A CONNECTED UTILITY NETWORK SYSTEM

3.3.1 Asset Deterioration

Owing to use and environmental conditions, assets such as roads deteriorate over time. In the case of roads, structural integrity and ride quality drop over time. Models have become available through research which can provide the profile of the loss in riding comfort index (measured on scale of 0 to 10) for specified level of equivalent standard axle loads (ESAL's) per year. See Figure 3.2.

FIGURE 3.2

ASSET DETERIORATION

3.3.2 Standards for Asset Upgrading

A variety of asset maintenance and rehabilitation standards are in existence. For roads, these vary from frequent maintenance and resurfacing activities to major rebuilding at less frequent intervals. Two standards are illustrated in Figure 3.3. There is no generally preferred strategy for asset improvement over time.

FIGURE 3.3

STANDARDS FOR ASSET UPGRADING

3.3.3 Treatment of Inflation and the Use of Constant Dollars

In the estimation of costs and savings, the question of the use of constant dollars vs actual dollars has to be addressed. The general practice is to express capital cost for improvement in the constant dollars of a given base year (say this year). The user costs and therefore savings of user costs pose much complexity since these can be expressed in the constant dollars of the base year or alternatively these can be quantified in the current dollars and then brought back to the base year by using a composite rate of interest that covers real interest rate as well as inflation rate. The use of constant dollars is the preferred approach.

The total life cycle costs can be found for any asset upgrading activity and used as a basis for establishing priorities for investment and the year in which improvement should take place, provided that funds are available.

This research provides a mechanism for ensuring that an appropriate funding level can be established so that individual projects and the multi-year program can be implemented without undue costly delays.

3.3.4 The Replacement Value of an Asset

For any year of interest, the replacement value for individual assets as well as for the entire network has to be found. The replacement values are to be expressed in the constant dollars of a base year and over time these values have to be updated according to a change in the construction cost index (i.e. inflation).

Taking the case of one road in the network, the historical cost of its construction has to be known, or market value for its replacement has to be estimated. Should the historical construction cost as well as inflation rate be known, the present cost of replacement (i.e., rehabilitation/rebuilding) can be estimated.

Replacement value (in present worth) $V_R = CR (1 + f_p)^n$

Where CR = cost of building road n years ago

f_p = average inflation in road building industry during the past n years.

Replacement value after two years

(in the constant dollars of today) $= V_R [(1 + f_i)^2] / (1 + f_i)^2 = V_R$

Where V_R = replacement value at present

f_i = average inflation rate in the construction industry over the following two future years.

3.3.5 The Design Life of the Various Components of an Asset and the Overall Design Life

As noted elsewhere in this document, an asset such as a road has many components that will require upgrading at different time intervals. For example, in Ontario, the pavement life may range from 12 to 20 or more years. On the other hand, other parts of the road structure have a much longer life. On a weighted average basis, a design life of 25 years is commonly used for economic analyses.

In this research, it is recognized that road improvements have to be carried out as needed, in accordance with the standards illustrated in Section 3.3.2.

3.3.6 The Concept of an Account for Individual Asset Maintenance and Rehabilitation

On a yearly basis, most assets require some routine maintenance. As noted earlier, over the service life of an asset, the need for rehabilitation arises due to service-related functions and environment-induced decay. In order to pay for maintenance and rehabilitation activities, funds are required but not necessarily available all the time.

Here, the concept of a "depreciation" account is advanced for obtaining funds for facility upgrading. For example, in the case of roads, on the basis of straight line depreciation, funds could be allocated on a yearly basis according to the following formula:

$$FL_R = V_R / N$$

Where V_R = Replacement value in constant dollars

N = Service life in years

For one project, the total accumulated depreciation in constant dollars for N years will amount to V_R .

Given the assurance of funds, this asset can be improved according to any design and implementation strategy, provided that total funds (in constant dollars) do not exceed V_R . For example, if the rehabilitation strategy is to carry out improvements at mid-life and at the end of N years, the accumulated funds are sufficient to cover these activities. Alternatively, if more frequent rehabilitation is intended, say three times during the life of an asset, the replacement value (in constant dollars) can be allocated to routine maintenance as well as to three rehabilitation activities.

The concept of accumulated depreciation and depreciation for a given year is in Figure 3.4. In the case of one project, the accumulated depreciation fund could be used to rehabilitate that particular facility. In the case of a network as described next, the yearly depreciation can be allocated to projects requiring improvements during that year.

FIGURE 3.4
DEPRECIATION

3.3.7 Annual Funding Level for a Network

If the network consists of two facilities with their condition as shown in Figure 3.5, and these are to be improved according to the plan shown in the diagram, the accumulated funds would be allocated to carry the improvements as shown. If a large number of facilities are involved, a multi-year program can be funded with the assurance of funds to cover costs for all projects.

FIGURE 3.5

ANNUAL FUNDING FOR A NETWORK

In the case of the straight line depreciation approach as described above, the salvage value is not taken into account. This is a conservative assumption. It should be recognized, however, that some materials can be recycled and therefore the cost of replacement could be lower than assumed above.

In the calculation of replacement value, land (right-of-way) value is not included since our interest is in replacement of the infrastructure and additional right-of-way is not to be acquired.

As compared to the straight line depreciation approach to estimating the yearly budget (and to accumulate funds in a depreciation account, if necessary), a detailed and time consuming "needs" study approach can be used as well. Major elements of such a study are noted below:

- a) List all projects and establish their projected deterioration profiles.
- b) Estimate cost of improvements on the assumption of various implementation years -- i.e. cost in year n, cost in year n+1, n+2, etc.
- c) Estimate savings/benefits that correspond to the costs shown in (b) above.
- d) Find net benefits and establish the best year of implementation on the basis of maximum net present value (i.e. benefits - costs).
- e) Find out for every year, the projects that are to be undertaken and find their total cost.

This yields an estimate of the required budget. According to this methodology, the budget could fluctuate from year-to-year. In the event that required funds are not provided, projects have to be shifted to the following years.

The use of the constant depreciation formula provides an approximation and is easy to implement. However, it should be stressed that the above noted "needs" methodology is sound and can be used for the choice of projects in conjunction with a budget established by the depreciation concept.

3.3.8 Recapitalization Equation

The recapitalization equation is as follows:

$$\text{F.L.} = C_R \cdot V_R + C_{SS} \cdot V_{SS} + C_{ST} \cdot V_{ST} + C_W \cdot V_W + \dots + C_L \cdot V_L$$

Where:

F.L. = annual funding level

C_R = capitalization factor for roads

$$= \frac{1}{D_R}$$

D_R = design life of roads (in years)

V_R = replacement value of roads

C_{SS} = capitalization factor of sanitary sewers

= $1/D_{SS}$ where D_{SS} is the design life of sanitary sewers (in years)

V_{SS} = replacement value of sanitary sewers

- C_{ST} = capitalization factor for storm sewers
= $1/D_{ST}$ where D_{ST} is the design life of storm sewers (years)
- C_W = capitalization factor for watermain
= $1/D_W$ where D_W is the design life of watermain (years)
- C_L = capitalization factor for libraries
= $1/D_L$ where D_L is the design life of libraries (years)

Four case studies, incorporating the design lives shown in Table 3.2, illustrate the equation's usefulness.

TABLE 3.2
TYPICAL DESIGN LIFE VALUES AND
RECAPITALIZATION FACTORS

	Design Life (years)	Recapitalization Factor
Buildings	20	0.05
Roads and Bridges	25	0.04
Parks Landscaping and Improvement	25	0.04
Vehicles	4 to 7	0.14 to 0.25

Source: (Georgi, 1973)

Case Study 1 calculates the investment level required to maintain our \$200 billion of national roads. The value of our national road network as calculated by TAC (TAC, 1987) is determined to be \$200 billion. The second Case Study shows the effect on a city's budget, in this case the City of Ottawa. The third and fourth Case Studies illustrate the examples of transportation infrastructure.

Case Study 1:

- . Value of federal, provincial and municipal roads in Canada
- \$200 billion
- . Design life approximately 25 years
- . Capitalization ratio = $1/25 = 0.04$

Recommended Annual Expenditure

- = 0.04×200
- = \$8 billion (this is equal to the figure recommended by TAC
(Transportation Association of Canada, 1987).

Case Study 2:

City of Ottawa

Value of roads \$412,000,000

Value of sewers \$780,000,000

Recommended Annual Budget (using the Recapitalization Equation)

- = $\$412,000,000 \times 0.04^a + \$780,000,000 \times 0.02^b$
- = \$16,480,000 \$15,600,000
- = \$32,080,000

Ottawa Budget Request (for 1989 and 1990)

- . Roads \$15.5 million
- . Sewers \$10.7 to \$15 million

Total: \$26.2 to \$30.5 million

(a) design life = 25 years

(b) design life = 50 years

Case Study 3:

The value of arterial roads (RMOC jurisdiction) in the Ottawa-Carleton Region is estimated to be \$2 billion. Using the Recapitalization equation, the minimum funding level to maintain this asset would be:

$$1/25 \times \$2 \text{ billion} = \$80 \text{ million / year}$$

The Region currently spends \$91.5 million on rehabilitation and maintenance. It is noted that a 20 year design life would yield a funding level of \$100 million. (See Figure 3.6) The design life estimated by the exercise would therefore be approximately 22 years.

FIGURE 3.6

REGIONAL MUNICIPALITY OF OTTAWA - CARLETON
WHERE THE MONEY WENT (1986)

BUDGET FOR:		
(i)	MAINTENANCE	\$43.5
(ii)	REHABILITATION	48.0
	TOTAL	<u>\$91.5</u> MILLION

COMPARED TO \$80 MILLION PREDICTED
BY MARTIN - KHAN EQUATION

Case Study 4:

The World Bank estimates the current value of the national road network in Third World countries is \$300 billion. See Table 3.3. Using a recapitalization factor of 0.04 yields a minimum funding level of \$12 billion annually which is exactly the figure predicted by the bank staff (World Bank, 1988).

Another case study to illustrate the usefulness of the equation as a macro planning model is the following example of the inventory of the highway system in the United States.

Case Study 5:

	Route Miles	Replacement Value	Predicted Maintenance Cost
	(1)	(\$000,000)	(billion \$/yr)
Interstate	41 216	41 216	1.648
Primary	259 240	259 240	10.369
Secondary	398 108	199 054	7.962
Urban	124 115	49 646	1.985

\$21.96 billion/year

(1) U.S. Department of Transportation (1983)

This figure is to be compared to the estimated amount of \$23.2 billion/year prepared by the Congressional Budget Office which was calculated on needs. This provides another example of the usefulness of the equation as a planning model in establishing budget at the macro level.

A more detailed look at the highway system is illustrated in Table 3.4.

TABLE 3.3

WORLD BANK BASIC CHARACTERISTICS OF ROAD NETWORK BY REGION

Item	Eastern and Southern Africa	Western Africa		East Asia and the Pacific		South Asia		Europe, the Middle East, and North Africa	Latin America and the Caribbean		Total
		All	Excluding Nigeria	All	Excluding China	All	Excluding India		All	Excluding Brazil and Mexico	
Number of countries	19	20	18	7	6	6	5	14	19	17	85
Area (thousands of square kilometres)	11,050	8,891	7,067	13,184	3,623	5,120	1,922	8,478	18,859	6,374	63,681
GNP, 1984 (billions of dollars)	51.2	104.7	34.3	600.4	281.4	257.5	62.7	338.1	583.9	199.1	1,935.9
Population, 1984 (millions)	201	186	90	1,350	221	1,008	259	232	350	141	3,327
GNP per capita											
Median, 1984 (dollars)	310	290	270	710	785	220	180	1,795	1,190	1,180	-
Average annual growth rate, 1975-85 (percent)	-0.1	-1.0	-0.9	3.4	2.5	2.4	1.8	3.1	0.0	-0.1	-
Total road network											
Length (thousands of kilometres)	588.3	430.9	322.9	1,539.6	571.2	1,680.7	180.7	1,051.0	2,212.1	874.1	7,502.6
Percentage paved	7.7	12.6	10.3	18.1	16.9	31.1	26.7	29.3	11.0	11.8	19.4
Density in kilometres per:											
100 square kilometres	5.3	4.8	4.1	11.7	15.8	32.8	9.4	18.2	11.7	10.4	11.8
1,000 population	2.9	2.3	3.6	1.1	2.6	1.7	0.7	4.5	6.3	6.2	2.3
\$1 million of GNP	11.5	4.1	9.4	2.6	2.0	6.5	2.9	3.1	3.8	4.4	3.9
Main roads											
Length (thousands of kilometres)	180.5	144.5	115.4	450.9	188.6	217.1	89.8	303.7	511.7	193.7	1,818.4
Percentage paved	24.6	37.3	27.8	61.4	52.8	80.3	56.0	74.5	49.2	44.3	56.8
Density in kilometres per:											
100 square kilometres	1.7	1.6	1.4	3.4	5.4	4.2	4.7	4.7	2.7	2.3	2.9
1,000 population	0.9	0.8	1.3	0.3	0.9	0.2	0.3	1.3	1.5	1.4	0.5
\$1 million of GNP	3.7	1.4	3.4	7.8	0.7	0.8	1.4	0.9	0.9	1.0	0.9
Main paved roads											
Length (thousands of kilometres)	46.9	53.9	32.1	276.9	103.8	174.3	50.2	226.3	251.8	85.8	1,030.0
Density (kilometres per 100 square kilometres)	0.8	0.9	0.5	9.5	5.8	7.4	2.3	10.8	6.8	2.0	29.6
Replacement value of main network											
Average cost per kilometre (dollars)											
Paved	255,000	245,000	245,000	300,000	300,000	180,000	180,000	280,000	260,000	260,000	-
Unpaved	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	-
Value (billions of dollars)											
Paved	12.0	13.2	7.9	31.1	31.1	33.1	9.0	63.4	66.5	22.3	268.4
Unpaved	5.7	3.6	3.3	3.7	3.7	1.7	1.6	3.1	10.4	4.3	31.5
Total	17.7	16.8	11.2	90.0	34.9	33.1	10.6	66.4	75.9	26.6	299.9
As a percentage of GNP	34.6	16.1	32.6	15.0	12.4	12.9	16.9	19.7	13.0	13.4	15.5

- Not applicable

Source: (World Bank, 1988)

TABLE 3.4
INTERSTATE HIGHWAY SYSTEM - 1983

State	Mileage	Maintenance Expenditure \$	Maintenance Expenditure using Recapitalization Equation x (\$000)	Actual to Theoretical Difference x (±) (\$000)
Alabama	639	--		
Alaska	1072	--		
Arizona	1021	12709	40840	-28131
Arkansas	419	4513	16760	-12247
California	1443	29710	17720	-28010
Colorado	788	--		
Connecticut	108	--		
Delaware	--	--		
District of Columbia		--		
Florida	927	10639	37080	-26441
Georgia	886	5548	35440	-29912
Hawaii	5	489	200	+289
Idaho	536	4167	21440	-17273
Illinois	1255	29000	50200	-21200
Indiana	854	--		
Iowa	614	7574	24560	-16986
Kansas	654	12545	26160	-13615
Kentucky	579	6493	23160	-16667
Louisiana	519	--	--	--
Maine	282	8255	11280	-3025
Maryland	191	--	--	--
Massachusetts	172	4612	6880	-2268
Michigan	714	20608	28560	-7952
Minnesota	696	7427	27840	-20413

TABLE 3.4
INTERSTATE HIGHWAY SYSTEM – 1983

State	Mileage	Maintenance Expenditure \$	Maintenance Expenditure using Recapitalization Equation x (\$000)	Actual to Theoretical Difference x (±) (\$000)
Mississippi	567	4321	22680	-18359
Missouri	824	8265	32960	-24695
Montana	1089	5596	43560	-37964
Nebraska	444	3249	17760	-14511
Nevada	502	3294	20080	-16786
New Hampshire	164	2106	6560	-4454
New Jersey	128	7286	5120	+2166
New Mexico	913	9562	36520	-26958
New York	881	58599	35240	+23359
North Carolina	578	6788	23120	-16332
North Dakota	533	2940	21320	-18380
Ohio	880	35333	35200	+133
Oklahoma	749	9790	29960	-20170
Oregon	585	6371	23400	-17029
Pennsylvania	1186	29719	47400	-17721
Rhode Island	21	1426	840	+586
South Carolina	647	258	25880	-25622
South Dakota	636	3502	25440	-21938
Tennessee	826	11544	33040	-21496
Texas	2273	11494	90920	-79426
Utah	681	8100	27240	-19140
Vermont	302	3306	12080	-8774
Virginia	799	21551	31960	-10409
Washington	483	6090	19320	-13230

TABLE 3.4
INTERSTATE HIGHWAY SYSTEM – 1983

State	Mileage	Maintenance Expenditure \$	Maintenance Expenditure using Recapitalization Equation x (\$000)	Actual to Theoretical Difference x (±) (\$000)
West Virginia	389	--	--	
Wisconsin	466	6354	18640	-12286
Wyoming	868	10074	34720	-24646

Source: Highway Statistics, U.S. Department of Transportation 1983

Using the recapitalization equation to calibrate the sustainable maintenance expenditure, it is evident which states will have sustainable interstate facilities or alternatively which states can expect tremendous increases in the costs in the movement of goods and services.

Another example to illustrate the usefulness of the equation to the transportation sector planner is to use the recapitalization equation to derive an estimated useful service life assumed for the main paved road network for say all the countries in Africa based on the improved performance of say a 10 year horizon. Comparing the service life so calculated with a standard depreciation handbook value would provide an excellent indicator of at least the status of main road networks. The results of this calculation are presented in Case Study 6.

Case Study 6:

**Proportion of Main Road Network Improved
Compared to Theoretical % Using the Network Recapitalization Equation**

	Portion of Main Road Network Constructed or Improved 1975 - 1984	Theoretical Percentage (i)	Difference
	(%)		(Yrs)
Botswana	51	40	+11
Burundi	57	40	+17
Comoros	16	40	-24
Kenya	50	40	+10
Madagascar	15	40	-25
Malawi	59	40	+19
Rwanda	46	40	+6
Swaziland	70	40	+30
Zaire	25	40	-15
Zambia	25	40	-15
Benin	33	40	-7
Burkina Faso	49	40	+9
Cameroon	54	40	+14
Central African Republic	76	40	+36
Congo	100	40	+60
Cote D'Ivoire	63	40	+23
Gambia	54	40	+14
Guinea	25	40	-15
Guinea Bissau	12	40	-28
Liberia	65	40	+25
Mali	49	40	+9
Mauritania	85	40	+45
Niger	48	40	+8
Nigeria	50	40	+10
Senegal	32	40	-8

Source: (World Bank, 1988)

(i) 10 years @ 4% of network/year

Contrary to popular notions then, it would appear at least for the main paved road network that over 70 percent of the countries in Africa have depreciation schedules well within the 25 year standard. Comoros, Madagascar, Zaire, Zambia, Beni, Guinea, Guinea Bissau and Senegal exceed the accepted design life by considerable amounts. Guinea Bissau, one of the poorest countries in Africa has one of the longest depreciation schedules of 83.3 years, based on the 1975 to 1984 expenditure rates. This is confirmed by personal inspection of the main road network. It is beyond the scope of the present analysis to discuss the reasons and remedies other than to demonstrate the usefulness of the concept for the planning of the transport sector.

The World Bank (Gutman, 1989) indicates a recapitalization approach may overstate the funding levels. But as illustrated in Case Study 4, the amount exactly equals the amount predicted by the Bank.

It is acknowledged however that this method of allocation may sacrifice accuracy to simplicity and may overstate the case depending on the sector that is being analyzed. Table 3.5 suggests design life which can be used for other infrastructure attribute data.

3.4 Other Methods to Calculate Depreciation

Three other methods to calculate depreciation are in common use:

1. The Matheson Formula
2. The Sinking Fund Method
3. The Sum of the Years Digits Method

The Matheson Formula applies a constant percentage or rate of depreciation per year based on the diminishing value of the depreciation in the first period (= kC).

C = First Cost

K = Depreciation Rate

Hence, at the end of the first period Value of Asset = C_1

$$C_1 = C - kC = C \times (1 - k)$$

Depreciation during the second period = kC_1

Value at the end of second period = C_2

$$\begin{aligned} C_2 &= C_1 - kC_1 \\ &= C - kC - kC + Ck^2 \\ &= C - 2kC + Ck^2 \\ &= C \times (1 - 2k + k^2) \\ &= C \times (1 - k)^2 \end{aligned}$$

At the end of N periods:

$$C_N = C \times (1 - k)^N$$

$$(1 - k)^N = C_N / C$$

$$1 - k = (C_N / C)^{1/N}$$

$$N = L$$

$$k = 1 - (C_L / C)^{1/L}$$

$$\text{As } k = 1 - (C_L / C)^{1/L} = 1 - (C_N / C)^{1/N}$$

$$(C_N / C)^{1/N} = (C_N / C)^{1/L} \text{ and } C_N / C = (C_L / C)^{N/L}$$

$$C_N = C \times (C_L / C)^{N/L} \quad (3.4.1)$$

Rarely would the equation be used in this form. The intent is to provide a "planning level" budget on annual basis equal to the depreciation. Therefore to calculate the annual depreciation,

$$D_n = k \times (C \times (1-k)^{n-1}) \quad (3.4.2)$$

An example using this equation would be as follows:

Road constructed in 1983	C = \$10,000,000
Design life	25 years
Depreciation rate	0.04 (i.e. 1/25)

What amount (in 1983 constant dollars) ought we to include in the annual budget in 1993 for this road segment?

$$D_{10} = 0.04 \times (10,000,000 \times (1-0.04)^{10-1})$$

$$= \$277,013 \text{ (in 1983 constant dollars)}$$

Through the use of the inflation factor, the 1993 budget can be estimated. Therefore the depreciation of each road segment in the network would have to be calculated in order to arrive at a minimum funding level for the road sector.

The Sinking Fund method establishes a reserve or depreciation fund by means of a series of equal periodic deposits: the cumulative value of the reserve at any time is equal to the total amount of depreciation. The annual funding level to balance the depreciation in that year would require a detailed calculation on a yearly basis. This would require calculating the total depreciation on a yearly basis, then subtracting the previous years total to derive the current year amount. An example is provided to illustrate the concept.

Value of the road in 1983 \$10,000,000
Depreciation 0.04 (25 year design life)

Calculate the depreciation in 5 years:

(Sinking Fund Equation)

$$D = 5 \times [i / ((1+i)^n - 1)]$$

The annual payment will be:

$$\begin{aligned} D_a &= 10,000,000 \times [0.04 / ((1+0.04)^{0.25} - 1)] \\ &= 240,119 \end{aligned}$$

Therefore the total depreciation to the 5th year will be:

$$\begin{aligned} D_T &= D_a \times [(1+i)^n - 1] / i \\ D_5 &= 240,119 \times 5.4163 \\ &= 1,300,565 \end{aligned}$$

Therefore the total depreciation to the 4th year will be:

$$\begin{aligned} D_4 &= 240,119 \times 4.2465 \\ &= 1,019,659 \end{aligned}$$

Therefore the depreciation for the 5th year is:

$$D_5 - D_4 = 280,905$$

The Sum of Digits method of depreciation is the sum of the years digits of the estimated design life of the facility (e.g. for 10 year design life, the sum of digits would be $1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + 9 + 10 = 55$). In the road example in the previous case, a design life of 25 years was assumed. It is noted that the years are determined by including the year in which the estimate is made.

The amount of depreciation each year is determined by the ratio of:

$$\text{Years of remaining useful life} / \text{Sum of digits}$$

Depreciation using the previous example parameters would therefore be:

$$\begin{aligned} \text{Remaining useful life in year 5} &= 21 \\ \text{Depreciation} &= 21/325 = \$646,153 \end{aligned}$$

Figure 3.7 is a graph which illustrates the depreciation of a facility over the design life using the four methods discussed.

FIGURE 4-1
METHODOLOGICAL FRAMEWORK

The straight line method of allocating depreciation is based on a constant rate of loss of value over the life of the facility. Other methods which could be used are the Matheson Formula where the percent depreciation remains constant, the Sinking Fund method which establishes a depreciation fund by means of an equal periodic deposit, and the Sum of Digits method. These methods reflect a non-uniform profile of depreciation. The use of some of these methods of engineering economy involves rigorous mathematical treatment which is usually far more accurate than the data warrant.

Although approximate, the **Recapitalization** equation (which is the straight line method of depreciation) would provide minimum sustained investment levels for infrastructure rehabilitation. There could be, for example, a statutory requirement not only to carry the value of the municipalities' infrastructure on the "Books" of the municipality, but also to indicate the annual depreciation. During tight financial times, this could be a condition of the experts who perform credit worthiness evaluations of municipalities to ensure sufficient sums are invested in maintaining the assets of the corporation.

Another issue which ought to be addressed is whether the annual funding levels should be calculated using replacement costs or historical costs. Historical costs can be readily updated using the numerous construction cost indices available such as, Statistic Canada Construction cost index, Engineering News Record or the Means Construction cost index.

Using historical costs to establish the funding level minimum could easily be understated by a factor of 2 to 3. To maintain a sustainable infrastructure it is recommended that replacement cost be used to calculate the funding levels using the Recapitalization equation.

3.5 Infrastructure Equalization Equation

The Recapitalization equation is not intended to substitute for Needs Studies or Feasibility Studies using all the usual economic analyses and theories and to evaluate and rank projects and comparing marginal costs to marginal benefits.

The equation recommended is to be used at the macro planning level to establish minimum budgets by sector set to equal the needs determined by more classical and rigorous methods. An equilibrium equation must therefore be used to verify that:

Sum of investments in rehabilitation projects by sector (determined by needs studies)

=

Funding level calculated by Recapitalization Equation

This relationship is called the **Infrastructure Equilibrium Equation**

If this theorem is not observed and the depreciation costs are not being counter-balanced by an equal amount in rehabilitation, the infrastructure necessarily can only deteriorate faster.

3.6 Financing Urban Infrastructure

According to the Canadian Federation of Municipalities, financing urban infrastructure is the foremost problem facing towns and cities. Roads and sewers have traditionally been funded from property taxes.

One technique, suggested by the Commissioner of Transportation of the Regional Municipality of Ottawa-Carleton (Shefflin, 1989) would be to have a partially dedicated gasoline tax. Currently revenues from the gasoline tax go into the **Consolidated Revenue Fund**. A partially dedicated tax of say four cents per litre would go a long way towards paying for the crumbling infrastructure.

Transfer payments from the senior level of government to the municipality could be then executed to the level determined by the value of each municipality's assets and using the **Recapitalization Equation**. As a condition of transfer payments for infrastructure investment, the senior level of government could insist on carrying the asset value on the "Books" of the Corporation. The corresponding depreciation of the asset could also be

calculated using the Recapitalization equation. Senior bureaucrats could then by ratio analyze/compare the quality of the municipal asset base by the use of asset/capita ratio.

With respect to water supply services, Environment Canada, in 1987, undertook a study of municipal water pricing practices and existing rate schedule. In summary, rate making practices failed to meet criteria of cost recovery equity and economic efficiency. If the water utility was viewed as a business, a proper user rate would be established.

As the sanitary sewer accepts the waste generated from the water distribution system, it would also seem reasonable, therefore, to have a minimum of 100% surcharge on the water bill to pay for the sewer. A full cost recovery including depreciation of the asset could be instituted.

Therefore by regarding the road and storm sewer systems as one utility and the water and sewer system as another, proper user fees could be calculated to properly maintain these vital municipal systems.

As the municipalities are creatures of the provinces, the provinces can assume their traditional roles of policing the financial policies of the municipalities. An **Infrastructure Index** equal to the value of assets/capita for each sector could be calculated for each municipality. The management performance of each of the municipalities could then be quantitatively compared and could be used to calculate transfer payments. The sum of the assets/capita could be called an **Aggregated Infrastructure Index**.

By ensuring that funding levels of maintenance are at last equal to the funding levels determined by the **Recapitalization Equation** and the implementation of proper user charges would ensure that the vital municipal infrastructure systems are maintained. It could be a provincial requirement for example, for the municipalities to declare the value of their assets, as well as indicating the mandatory amounts to maintain their assets.

The same formula could be applied to all municipal assets, libraries, municipal buildings, waste treatment plants, trucks, cars, etc.

CHAPTER 4

RECAPITALIZATION MODEL APPLICATIONS AND BUDGET CYCLE

4.1 Framework for Budget Cycle

In Chapter 3 the usefulness of the equation at the macro planning level has been discussed. The purpose of this chapter is to place the **Recapitalization** equation and the **INFRASTRUCTURE EQUILIBRIUM** equation within the framework of the budget cycle and to propose an heuristic method using the models developed. A methodological framework is illustrated in Figure 4.1.

At the outset, infrastructure types of interest that are to be included in improvement programs are defined. Examples include roads and sewers. This step can be regarded as a routine activity of engineering and planning staff. Next is the establishment of gross funding levels in order to address infrastructure needs. Here, the recapitalization model can be used. Additionally, infrastructure needs are studied and independent projects can be characterized on a sector-by-sector basis. In the case of interdependencies, independent projects spanning sectors are to be identified.

For each project, costs and savings (benefits) can be estimated according to year of implementation. The information generated for each project can address the cost-effectiveness and effect of delay in implementation on net savings. Through the use of a programming heuristic method and application of the budget established by the recapitalization equation, a multi-year program can be developed for a given budget. For an example of the cost-effectiveness and multi-year programming heuristic under budget constraints, see Khan and LaFontaine (1986).

One of the contributions of this research is in the form of the Recapitalization Equation which enables the estimation of a uniform (constant dollar) budget for given sectors/networks. On the assumption that the road/sewer network was expanded over time in a nearly uniform manner according to growth in population, it is likely that funds

will be required on a yearly basis over time for asset improvement. According to this assumption, the straight line depreciation approach is more appropriate than other depreciation methods.

The following table shows selected information generated by the multi-year programming methodology. Please note that the use of a uniform annual budget (in constant dollars) that can be estimated from the Recapitalization Equation simplifies the budget approval process and, at the same time, the small deviation from the optimal year of implementation results in a drop of net present value of only about 1%

EXAMPLE OF A FIVE YEAR PROGRAM DEVELOPMENT PROCESS

(All dollar figures are in constant dollars)

<u>Project</u>	<u>Optimal Year of Implementations*</u>	<u>Year of Implementation Under Budget Constraint+</u>
1	3	4
2	3	3
3	5	5
4	2	2
5	1	1
6	1	1
7	5	5
8	4	4
9	1	2
10	3	3
Sum of NPV=\$508,674		Sum of NPV=\$503,697
		Drop in Total NPV=\$1.0%

* According to maximization of Net Present Value criterion.
The range of yearly budget: \$22,450 - \$171,493

+ Result of 7 iterations of Multi-period Programming Algorithm.
The uniform yearly budget = \$100,000 + \$10,000 tolerance

Source: Khan and LaFontaine 1986.

The master framework for the budget cycle is illustrated in Figure 4.2. As noted in Chapter 3, infrastructure cannot be managed if it is not known what is included in the inventory. The process begins with a detailed inventory of the assets by sector. A modern way of documenting this inventory would be to install the data on the RIMS, SIMS and WIMS programs as discussed previously. These programs were developed by the Tri-Committee which consists of representation from the Ontario Good Road Association, the Ontario Association of Municipal Engineers and the Ontario Chapter of the American Public Works Association.

Combining the database management system (DBMS) with intelligent maps in a geo-referenced geographical information system (GIS) would form a powerful tool to permit quick analysis of budgeting conflicts.

Once the inventory of the asset is accomplished, a market value on the asset can be determined. This value can also be updated every year using the Engineering News Record (ENR) construction cost index or the construction cost index published by Statistics Canada.

The recapitalization equation can then be used to determine the depreciation of each element that comprises the sector and summed for the sector. As noted earlier it would not be the intent to substitute a macro planning model for detailed feasibility studies comparing marginal costs and marginal benefits. Individual rehabilitation (including maintenance) projects of infrastructure would be so ranked such that the sum of the individual projects per sector equated to the sum derived from the recapitalization equation.

FIGURE 4-2
MASTER FRAMEWORK FOR BUDGET CYCLE

FIGURE 4-3
THE PROGRAM CYCLE

By equating the needs of the sector by the **INFRASTRUCTURE EQUILIBRIUM EQUATION** to the sum divided by the **Recapitalization equation** would ensure that the infrastructure receives substantial monies to assure prolonged design life.

Of course, policy guidelines with respect to anticipated growth in annual expenditures could be factored in the budgeting process. This is illustrated in "Master Framework for Budget Cycle", Figure 4.2.

Once the final draft of the anticipated levels of expenditure by project by sector has been determined, an overlay of the projects could be prepared using a geographic information system, so that obvious conflicts could be eliminated. This concept is illustrated in Figure 4.4. A final budget document could then be prepared.

FIGURE 4.4

G.I.S. OVERLAYS

DETAIL SEPARATION BY LEVELS

4.2 Application of the Recapitalization Model to the City of Lindsay

An example of applying market value assessment to the municipal asset has been calculated for the entire sewer and road network for the City of Lindsay, Ontario. Each attribute has been assigned a market value. The recapitalization equation has been used to calculate the annual depreciation amount. The sum of depreciation is calculated to derive the minimum spending envelope to maintain the asset for the road and sewer sectors.

A computer program was created in dBase III using the Road Information Management System (RIMS) and the Sewer Information Management System (SIMS) of the City of Lindsay data.

The roadway data consists of 7 fields each containing 593 records.

The structure of the roadway dBase III data file is as follows

TABLE 4.1
STRUCTURE OF "ROADWAY.DBF"

Field No	Field name	Type	Width	Decimal
1	SECTION NAMES	Char	24	-
2	SECTION FROM	Char	34	-
3	SECTION TO	Num	34	-
4	SECTION NUMBER	Num	6	0
5	SECTION LENGTH	Num	6	3
6	REPLACEMENT VALUE	Num	10	2
7	DEPRECIATION VALUE	Char	10	2

TABLE 4.2
ROADWAY REPLACEMENT FORMULA

*REP-VAL	= [Section Length] X [Cost per km]
(Replacement Value)	= [Section Length] X (\$400,000 per km)
**DEP-VAL	= (Replacement cost) + (Design life)
(Depreciation Value)	= (Replacement cost) + 25 years

For the City of Lindsay, the total length of the roadway system is 95,055 km. The replacement value is \$38,022,000. with the annual depreciation (recapitalization amount) equal to \$1,520,880 (in 1990 constant dollars). The detailed results are shown in Appendix 'A'. An inventory of other related infrastructure elements comprising the road network corresponding market values and recapitalization amounts could also be calculated per road section and summed for the total asset value.

Similarly for the sewer system for the City of Lindsay, a dBase III program was written to store the file consisting of 15 fields each containing 1054 records.

The structure of the database is as shown below:

TABLE 4.3
STRUCTURE OF SEWER DATABASE

Field No.	Field Name	Type	Width	Decimal
1	FROMMH	Char	7	-
2	TOMH	Char	7	-
3	NUMOFMH	Num	6	-
4	MHREPVAL	Num	6	-
5	MHDEPVAL	Num	6	2
6	PIPETYPE	Num	2	-
7	DIAMETER	Num	5	-

PM-1 3½"x4" PHOTOGRAPHIC MICROCOPY TARGET
NBS 1010a ANSI/ISO #2 EQUIVALENT

PRECISIONSM RESOLUTION TARGETS

TABLE 4.3
STRUCTURE OF SEWER DATABASE

Field No.	Field Name	Type	Width	Decimal
8	LENGTH	Num	6	2
9	PIPEREPVAL	Num	6	2
10	PIPEDEPVAL	Num	6	2
11	TOTREPVAL	Num	8	2
12	TOTDEPVAL	Num	8	2
13	UP-MH-1	Char	7	-
14	UP-MH-2	Char	7	-
15	UP-MH-3	Char	7	-

The market value of the sewer sector asset was calculated as follows:

MHREPVAL = number of manholes X \$2500 per manhole
(Manhole Replacement Value)

MHDEPVAL = Manhole Replacement value + Design Life
(Manhole Depreciation Value)

PIPEREPVAL = Length X Replacement cost per metre*
(Pipe Replacement Value)

TOTREPVAL = Summation of PIPEREPVAL + MHREPVAL
(Total Replacement Value)

TOTDEPVAL = PIPEDEPVAL + MHDEPVAL
(Total Depreciation Value)

*See Table 4.4 for replacement cost per metre.

TABLE 4.4

SEWER REPLACEMENT COST/METRE

AVERAGE UNIT PRICES FOR

Manholes Sewers	: \$2500 each
--------------------	---------------

150 mm dia	:\$100 per metre
200 mm dia	:\$115 per metre
225 mm dia	:\$118 per metre
250 mm dia	:\$120 per metre
300 mm dia	:\$130 per metre
350 mm dia	:\$140 per metre
375 mm dia	:\$145 per metre
400 mm dia	:\$160 per metre
450 mm dia	:\$170 per metre
500 mm dia	:\$178 per metre
525 mm dia	:\$181 per metre
600 mm dia	:\$242 per metre
675 mm dia	:\$302 per metre
750 mm dia	:\$361 per metre

Using the replacement costs per metre and applying these figures to the sewer system yields a replacement cost (in 1990 dollars) of \$13,040,000. with a corresponding annual depreciation of \$260,000.

Therefore as noted earlier even for a small community such as Lindsay, the market value of the road and sewer network is \$51.06 million (\$38.02 million for roads and \$13.04 million for sewers). The recapitalization of the asset would require an annual investment of \$1.78 million (\$1.52 million for roads and \$.26 million for sewers) to maintain this asset.

The equilibrium equation would predict that if investment in rehabilitation and maintenance did not equal \$1.78 million the asset would prematurely fail.

The allocation of the estimated budget to maintenance and rehabilitation projects can be carried out by using the methodology described earlier in this chapter (see Figures 4.1, 4.2 and 4.3).

As noted in Chapter 3, the Engineering News Record construction cost Index could be used to annually upgrade the replacement cost of the asset base. For example, to upgrade the asset base of Lindsay in the previous example, the ENR ratio of 1992/1990 can be used to determine an approximate replacement value.

$$\text{i.e. from Table 4.5} \quad \frac{4927}{4731} \times \$51,000,000 = \$53,101,648.$$

TABLE 4.5
ENGINEERING NEWS RECORD CONSTRUCTION COST INDEX HISTORY,
1906 - 1992

Annual Average		Annual Average		Annual Average		Annual Average	
1906	95	1928	207	1950	510	1972	1753
1907	101	1929	207	1951	543	1973	1895
1908	97	1930	203	1952	569	1974	2020
1909	91	1931	181	1953	600	1975	2212
1910	96	1932	157	1954	628	1976	2401
1911	93	1933	170	1955	660	1977	2576
1912	91	1934	198	1956	692	1978	2776
1913	100	1935	196	1957	724	1979	3003
1914	89	1936	206	1958	759	1980	3237
1915	93	1937	235	1959	797	1981	3535
1916	130	1938	236	1960	824	1982	3825
1917	181	1939	236	1961	847	1983	4066
1918	189	1940	242	1962	872	1984	4146
1919	198	1941	258	1963	901	1985	4195
1920	251	1942	276	1964	936	1986	4295
1921	202	1943	290	1965	971	1987	4406
1922	174	1944	299	1966	1019	1988	4519
1923	214	1945	308	1967	1074	1989	4615
1924	215	1946	346	1968	1155	1990	4732
1925	207	1947	413	1969	1269	1991	4835
1926	208	1948	461	1970	1381	1992	4927
1927	206	1949	447	1971	1581		

Base: 1913=100

4.3 Implementation Techniques & Technologies

The development of Geographic Information Systems (G.I.S.) began in the 1960's. The 1990's hold great promise in integrating infrastructure management G.I.S., automated mapping (A.M.) and facility management (F.M.). The evolution of G.I.S/A.M.F.M. systems is illustrated in Figure 4.5.

As noted in Chapter 3, Infrastructure Management Systems (IMS) hold great potential for aiding decision makers in more efficiently and effectively managing the public infrastructure. The emerging technology and preliminary results point to an expansion of the computer revolution in engineering to upper and mid-management.

Municipal public works managers face the increasingly challenging job of improving customer service within and often inadequate budgets. A crucial step toward becoming more efficient is better information management. The challenge of the coming decade will be the successful marriage of engineering, maintenance management and G.I.S. applications with expert system technologies. An integrated approach to system development will provide means to efficiently assimilate and distribute applications across all departments.

In the coming decade of infrastructure management, a coordinated effort among all departments will be required. This means data must be shared and distributed in a timely manner to those who can utilize this information. Traditionally, technology has been implemented first by purchasing hardware, second by acquisition of the software and lastly obtaining the data to run the application.

Interestingly, however, is that the data for infrastructure management probably have a shelf life of at least 50 years if not one hundred, the software perhaps has a design life of five years and the hardware, optimistically, three years.

In implementing these new technologies, efforts must be placed on the applications and end uses through properly designed and executed feasibility studies. Many of the failures

to implement the sophisticated technologies have resulted from the concentration on the hardware (design life of 3 years) and software (design life of 5 years) without looking at the long term data needs to run these innovations.

To accomplish the integration of applications, agencies will be required to develop strategic plans to merge applications into a common structure and common applications environment.

Significant advances are also being accomplished in the area of Expert Systems to assist in many areas of infrastructure management. Expert systems, such as PARADIGM, utilize a set of user-defined rule-based parameters to support intelligent decision making. PARADIGM represents the Pavement Rehabilitation Analysis and Design Mentor, a proposed set of interacting expert systems for local highway agencies.

An expert infrastructure management system can be developed which would relate extrapolation of historical data, with the recapitalization and equilibrium equations developed as part of this research.

Aside from expert system technology, database management technology will allow municipalities to combine engineering maintenance and administrative data with G.I.S. coverage. Analysis of various factors can then be used to estimate remaining useful life of a structure (thereby providing a database to obtaining better estimates of depreciation), expected frequency of failure and cost effectiveness of various rehabilitation options.

FIGURE 4.5
SYSTEMS INTEGRATION

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The current practice of civil engineering is being shaped by infrastructure renewal. This effect is expected to accelerate in the future. Large sectors of Canada's transportation infrastructure such as roads, airports, ports, waterways and public transportation have reached their design life. Even if maintained on a regular basis, such structures reach a point when major renewal in the form of extensive repairs or complete reconstruction becomes necessary. In either case, costly remedial action for an extensive network of transportation facilities represents a huge financial outlay. Deferring investments or reliance on stop-gap measures will shift the burden of inevitable investments to future generations. Meanwhile, recognizing that the quality of transportation infrastructure affects the cost of transporting goods and passengers, the competitiveness of the industries and services will be compromised (Porter, 1990). It is essential for Canada to upgrade transportation infrastructure in a most cost-effective way. The challenges of infrastructure renewal on a sustained basis call for technical, managerial and financial ingenuity.

Infrastructure renewal requires expertise in planning and programming (i.e., management), design, materials, construction methods, and environmental factors. While other activities have been carried out in the context of new infrastructure, the treatment of environmental factors is new and gaining importance. In renewing infrastructure, civil and environmental engineers are expected to appreciate society's environmental concerns, be environmentally knowledgeable in terms of avoiding adverse effects and in developing solutions to expected problems. In the case of materials, rapid technology changes are occurring which will have a profound effect on infrastructure renewal.

The main focus of this research is on the principles and methods of managing the infrastructure renewal endeavours.

As a basic step, management requires a reorientation of thinking about infrastructure. Various jurisdictions need to manage their infrastructure like a business manages its assets. The challenge of infrastructure management requires answers to the following questions:

- How to inventory and define needs?
- What is the "right" sustained funding amount to manage each of our assets?

As for the inventory part of the first question, it requires the development of a number of computerized information systems. Some of these are: Infrastructure Management Systems (IMS), Road Information Management Systems (RIMS) and Geographic Information Systems (GIS). These hold great promise to better manage infrastructure. The integration of computerized infrastructure inventory records, computer-aided engineering and computer mapping applications into one geographic database system enables us to build an intelligent Infrastructure Management Information System (IMIS). Such a system allows important information about municipal resources and facilities such as street networks, traffic control installations, land records, engineering, digital terrain modelling and economic development models to be stored in the form of "electronic maps", to be recalled in a matter of seconds and displayed on a graphic computer terminal to promote more informative, timely and productive decisions. A number of municipalities have already taken steps to implement such systems.

Infrastructure "upgrading" needs are usually carried out by taking into account the projected physical condition of the infrastructure. The practice of the identification of "needs" for rehabilitation is diverse. Also, there is little uniformity in evaluating needs of competing sectors or interdependent projects within and between sectors. In very few cases, benefit-cost analysis is used in establishing the feasibility of investments. Likewise, the economic effect of delay in implementing projects is rarely checked.

A review of budgeting procedures was carried out for six Canadian municipalities (i.e., Vancouver, Edmonton, Winnipeg, Toronto, Ottawa, and Gloucester [Ontario]), one regional municipality (i.e., Ottawa-Carleton) and the National Capital Commission. Two areas of

the capital works budgeting process were of particular interest. The first was the statement of asset base and the condition and depreciation of the infrastructure. The second was the priority project selection system for maintenance of the asset base.

Three of the jurisdictions surveyed use a formal priority system: Winnipeg, Ottawa and the Regional Municipality of Ottawa-Carleton (RMOC). In summary, the capital budgeting process followed by the case cities does not relate to the value of the existing assets. Also, the priority system for ranking projects makes no attempt to compare marginal benefits to marginal cost or review the cost of delay. In a majority of cases, an heuristic approach is adopted, subject to a predetermined global spending envelope that is usually related to a policy statement issued by the council.

In recent years, a number of studies have projected the physical condition of highway/road infrastructure and highlighted the need for a systematic process and methodologies for identifying candidates for improvement. The overall problem is recognized to be multifaceted and complex. The issues involved range from government budgetary practices to a highly technical problem of projecting the condition of infrastructure in the absence of timely improvement.

The implications of not improving transportation infrastructure are loss of productive time and wasted fuel and emissions due to congestion. Also, road infrastructure in very good condition (i.e., smooth new pavement) has much less direct operating cost per vehicle-km as compared to infrastructure in very poor condition (i.e., rough broken pavement or rough gravel). The World Bank studies show that the estimated rates of return have been high for all types of urban infrastructure but particularly for urban transportation projects.

Urban governments have come to acknowledge the importance of making timely improvements to their infrastructure. The same concept is now gaining acceptance with government agencies responsible for extra-urban infrastructure -- particularly highways. A Canadian National Highway System Proposal included elements of infrastructure renewal as well as capacity expansions. As for the cost of renewal, a price tag of \$8 billion was assigned following needs studies by provincial officials.

According to new initiatives in 1994, the federal government has agreed to spend about \$2 billion over the next five years on projects to upgrade Canada's transportation and communications infrastructure. Also, the Minister responsible for the Treasury Board has announced the vigorous pursuit of the tri-party (federal, provincial and municipal governments) cost sharing of a national program to improve the urban infrastructure.

Underfunding of infrastructure renewal is a serious problem. It is acknowledged by many policy experts that the health of a nation's economy and the stability of society are profoundly affected by the existence of a comprehensive and well maintained infrastructure (Reich, 1992).

In the case of urban areas, infrastructure is also very important for the proper economic functioning of an urban society. From a social resource perspective, the value of infrastructure assets represents considerable sums. The management of these assets therefore is a very important function of municipal governments.

At the international level, studies show that the developing countries have lost precious infrastructure worth billions of dollars through deterioration of their roads. In eighty-five countries that have received World Bank assistance for roads, a quarter of the paved roads outside urban areas need reconstruction as do a third of the unpaved roads. The cost of upgrading has been estimated to be \$40 billion to \$45 billion. It is useful to note that timely preventive maintenance costing less than \$12 billion could have saved these roads.

Most government agencies state the fiscal squeeze as the reason for deferring infrastructure improvements. There is a compelling reason to take a long term view in developing management strategies. The reluctance or inability to incur capital debt at present may give a misleading impression of the true fiscal conditions of local governments. If capital and repairs are deferred/neglected, the general budget may seriously understate the community's real obligation.

A new approach is described here for answering the second question: What is the "right" sustained funding amount to manage infrastructure assets? It is based on the business principles of: (a) market values and (b) recycling capital (i.e., renewing depreciated assets). A recapitalization model and an equilibrium concept are described which are intended to expedite the budgeting process in the form of estimating a minimum funding level to maintain municipal infrastructure in a sustainable manner. This is not intended to replace classical feasibility and needs studies but rather to provide bench mark funding levels. A description of the other elements of the methodological framework, namely, cost-effectiveness study (including the effect of delay in implementation) and programming heuristics, is beyond the scope of this research. Likewise, sources of funds and user charges cannot be analyzed.

In managing public infrastructure subsystems, decisions were commonly based upon annual budgets without regard to longer range trends in system conditions and projected resources. This has led to the growing fiscal gap between public works funding and the escalating cost demands of a generally deteriorating infrastructure. Faced with such a situation, public agencies are obliged to respond to one crisis situation after another. Given the lack of well defined strategies, projects are not implemented as elements in a planned sequence of system maintenance and improvement.

It is argued that effective public works management is the most important ingredient in solving the infrastructure problem. The growing practice of valuing assets provides an important building block to systematically address the problem. The second problem is defining the proper expenditure levels. The concept of depreciation of an asset is used here to estimate the magnitude of funds that have to be invested in the infrastructure. The private sector uses depreciation as a rough estimate of what must be invested to ensure productive capacity of the facility. As discussed in this thesis, a model based on this concept comes close to approximating the answers obtained from very costly and time consuming "needs" studies.

The sustained funding level for each sector (i.e., transportation) can be obtained by multiplying the capitalization factor (defined as $1/\text{design life of facility in years}$) with the replacement value of the facility.

The estimates obtained from the recapitalization model can be used to verify that the sum of investments in rehabilitation projects by sector (determined by detailed needs studies) and should be approximately equal to the funding level calculated by the model. If this balance is not maintained, and the depreciation costs are not being counter-balanced by an equal amount in rehabilitation, our infrastructure can only deteriorate faster.

5.2 Recommendations

5.2.1 Public Works Management

Management has been identified as a key issue with respect to the state of the nation's infrastructure. In the United States, a trend is developing such that an increasing percentage of public works administrators/commissioners are no longer engineers but rather graduates in public or business administration (APWA, 1990). In the United States, management was identified as a public works issue as early as the 1960s (APWA, 1976). To respond to this issue, to complement their engineering education, those who aspired to top management positions in the public works field were encouraged to pursue graduate studies in public administration or to enrol in a specialized program such as the one offered at the University of Pittsburgh. The Graduate Center of Public Works Engineering and Administration at the University of Pittsburgh was established in 1965 to develop professional skills in management, planning and system analysis.

It has been shown that even a small municipality such as Lindsay can have assets of more than fifty million dollars. At the beginning of the 1980s (Bird, 1983), there were over 4,000 local governments in Canada each managing tens of millions of dollars in urban infrastructure assets.

Given the importance of the infrastructure to the nation's economy, and the size of investment it represents, it is recommended that a task force be established with representation of the Federal, provincial and municipal levels of governments and the universities to study the establishment of a graduate school - as a "national centre of excellence" - which would offer a specialized graduate course in public works administration. The curriculum would be a mixture of public administration and engineering. The program could include:

- Facilities Management (Building Science)
- Transportation Management
- Infrastructure Management (Works)
- Economics and Public Policy
- Municipal and Environmental Law
- Systems Engineering (GIS, SIM, WIMS, IMS)
- Thesis/Project

5.2.2 Management at the Provincial Level

Canada's constitution makes clear that the provinces have exclusive responsibility for municipal institutions. Municipal governments have traditionally depended on the provinces for subsidies and transfer payments (MTO, MOE, etc.), to maintain part of the infrastructure. The federal government has also, since the 1950s supported a host of municipal infrastructure projects. Funds were first made available by Canada Mortgage and Housing Corporation (Neighbourhood Improvement Program) and by special winter works programs (Savoie, 1990). The Canadian Federation of Municipalities has been lobbying the federal government to participate in the "Big Fix" with the federal government paying one-third the costs with the provinces and municipality sharing equally in the remainder. This program is partially being funded as part of the "Red Book" (1994) program developed by the current Liberal government. It is recommended that if any transfer payments, cost sharing or subsidies occur for infrastructure development or maintenance from the senior level of governments to the municipalities, that a management system be instituted which declares the asset value on the books of the

municipal corporation, that the corresponding depreciation be calculated in accordance with the recapitalization equation developed and corresponding sinking funds be established to equal the calculated depreciation of the asset, (the equilibrium equation).

Just as the Ontario Municipal Board oversees the financial soundness of each municipality under its jurisdiction, it is recommended that these duties be expanded to include the management of the municipalities' asset base - its infrastructure. It is the duty of the province to ensure that the municipalities are managed effectively and efficiently. An "Infrastructure Index" which ranks the "Worth Per Capita" of each municipality would provide an index of the state of the municipal infrastructure. This could be pursued such that ratio analysis per municipality could be analyzed as if it were a franchise. Ratios could be developed which compare staffing levels per capita, per department, office space per staff member per capita, etc. In this way a comparison of the management of both the physical and human infrastructure for the effective and efficient delivery of municipal services can be assessed. In this time when many people believe Canadian have too much government, this exercise would be extremely useful and rewarding.

5.2.3 Replacement Costs

In calculating the depreciation using the recapitalization equation, it is recommended that replacement cost be used.

5.2.4 Management Systems

It has been shown (Gally, 1988) that investment in information management systems improves productivity. It is recommended that the province initiate a prototype study of a typical municipality such as Lindsay to implement an integrated data base management system which includes SIMS (Sewer Information Management System), WIMS (Water Information Management System), RIMS (Road Information Management System), and GIS (Geographic Information System). This prototype investigation would establish the replacement value of all the infrastructure for the City of Lindsay, establish the sectoral budgets, compare with the policy guidelines established by councils, and finally compare

with the equilibrium equation. The entire data base could then be linked to a desk-top GIS which would provide a visual check of intra-sectoral conflicts of current rehabilitation and maintenance projects. Many municipalities in Ontario have initiated the individual programs of RIMS, SIMS, WIMS, but none have integrated their systems to calculate the replacement value of their infrastructure nor the corresponding depreciation. Nor have the municipalities used this information in a formal manner in establishing their annual and five year capital budgets.

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Appendix A

**APPLICATION OF RECAPITALIZATION MODEL
TO THE CITY OF LINDSAY**

STRUCTURE OF "ROADWAY.DBF" FILE

Re: Structure of "Roadway.dbf" file

The data for the City of Lindsay is stored in the DBase III file, named as "Roadway.dbf". The file consists of 7 fields, each containing 553 records.

The structure of the database is as shown below:

Field No.	Field Name	Type	Width	Decimal
1	SEC-NAME	Char	24	-
2	SEC-FROM	Char	34	-
3	SEC-TO	Num	34	-
4	SEC-NUM	Num	6	0
5	SEC-LEN	Num	6	3
6	* REP-VAL	Num	10	2
7	** DEP-VAL	Char	10	2

* REP-VAL	= (Section Length) * (Cost per km length) = (Section Length) * (\$400,000 per km)
** DEP-VAL	= (Replacement cost) / (Design life) = (Replacement cost) / 25 yrs

The aggregate figures are stored in the memory variables as shown below:

(1)	TOT-LEN.MEM	: Total roadway length in kilometres
(2)	TOT-REP.MEM	: Total Replacement cost, \$
(3)	TOT-DEP.MEM	: Total Depreciation Value in \$/year

In addition, the file "ROADWAY.FRM" contains the database in a report format.

Encl: . A Hardcopy of the existing data structure
. A Floppy containing the above files.

(ROADWAY DATA FOR LINDSAY)

Section Name	From	To	Section No.	Len (km)	Repl. Value	Depn. Value
ADELAIDE ST N	KENT ST W	FAIR AVE	1064	0.281	112,400.00	4,496.00
ADELAIDE ST N	FAIR AVE	BOND ST	1066	0.142	56,800.00	2,272.00
ADELAIDE ST N	BOND ST	COLBORNE ST S	1067	0.235	94,000.00	3,760.00
ADELAIDE ST N	COLBORNE ST S	REGENT ST	1069	0.142	56,800.00	2,272.00
ADELAIDE ST N	REGENT ST	ELGIN ST	1070	0.142	56,800.00	2,272.00
ADELAIDE ST N	ELGIN ST	POTTINGER ST	1071	0.142	56,800.00	2,272.00
ADELAIDE ST N	POTTINGER ST	SANDERLING CR	1072	0.311	124,400.00	4,976.00
ADELAIDE ST N	SANDERLING CR	KENT ST W	1074	0.170	68,000.00	2,720.00
ADELAIDE ST S	KENT ST W	ROOSEVELT ST	1041	0.110	44,000.00	1,760.00
ADELAIDE ST S	ROOSEVELT ST	GLENELG ST W	1042	0.161	64,400.00	2,576.00
ADELAIDE ST S	GLENELG ST W	VIMY RD	1043	0.209	83,600.00	3,344.00
ADELAIDE ST S	VIMY RD	DURHAM ST W	1044	0.090	36,000.00	1,440.00
ADELAIDE ST S	DURHAM ST W	GEORGE ST W	1045	0.238	95,200.00	3,808.00
ADELAIDE ST S	GEORGE ST W	MARY ST W	1047	0.200	80,000.00	3,200.00
ADELAIDE ST S	MARY ST W	KENT ST W	1048	0.172	68,800.00	2,752.00
ALBERT ST N	KENT ST W	PEEL ST	1194	0.142	56,800.00	2,272.00
ALBERT ST N	PEEL ST	WELLINGTON ST	1195	0.142	56,800.00	2,272.00
ALBERT ST N	WELLINGTON ST	BOND ST	1196	0.142	56,800.00	2,272.00
ALBERT ST N	BOND ST	FRANCIS ST	1197	0.142	56,800.00	2,272.00
ALBERT ST N	FRANCIS ST	COLBORNE ST W	1198	0.092	36,800.00	1,472.00
ALBERT ST N	COLBORNE ST W	REGENT ST	1199	0.142	56,800.00	2,272.00
ALBERT ST N	REGENT ST	ELGIN ST	1200	0.142	56,800.00	2,272.00
ALBERT ST N	ELGIN ST	POTTINGER ST	1201	0.142	56,800.00	2,272.00
ALBERT ST N	POTTINGER ST	LINDWAY PL	1202	0.163	65,200.00	2,608.00
ALBERT ST N	LINDWAY PL	SANDERLING CR	1203	0.151	60,400.00	2,416.00
ALBERT ST S	KENT ST W	RUSSEL ST W	1204	0.128	51,200.00	2,048.00
ALBERT ST S	RUSSEL ST W	GLENELG ST W	1205	0.142	56,800.00	2,272.00
ALBERT ST S	GLENELG ST W	MELBORNE ST W	1206	0.142	56,800.00	2,272.00
ALBERT ST S	MELBORNE ST W	DURHAM ST W	1207	0.124	49,600.00	1,984.00
ALBERT ST S	DURHAM ST W	GEORGE ST W	1208	0.273	109,200.00	4,368.00
ALBERT ST S	GEORGE ST W	MARY ST W	1210	0.156	62,400.00	2,496.00
ALBERT ST S	MARY ST W	S ROAD LIMIT	1211	0.233	93,200.00	3,728.00
AMELIA ST	MARY ST W	S.END	1214	0.156	62,400.00	2,496.00
ANDREW DR	WILSON AVE	WILSON AVE	1215	0.263	105,200.00	4,208.00
ANGELINE ST N	KENT ST W	COLBORNE ST W	1217	0.652	260,800.00	10,432.00
ANGELINE ST N	COLBORNE ST W	REGENT ST	1222	0.142	56,800.00	2,272.00
ANGELINE ST N	REGENT ST	ELGIN ST	1223	0.154	61,600.00	2,464.00
ANGELINE ST N	ELGIN ST	POTTINGER ST	1224	0.130	52,000.00	2,080.00
ANGELINE ST N	POTTINGER ST	OAK ST	1225	0.142	56,800.00	2,272.00
ANGELINE ST N	OAK ST	NORTHLIN PK	1226	0.292	116,800.00	4,672.00
ANGELINE ST N	NORTHLIN PK	DAVID DR	1228	0.152	60,800.00	2,432.00
ANGELINE ST N	DAVID DR	ORCHARD PK RD	1229	0.320	128,000.00	5,120.00
ANGELINE ST N	ORCHARD PK RD	N TOWN LIMIT	1231	0.200	80,000.00	3,200.00

(ROADWAY DATA FOR LINDSAY)

Section Name	From	To	Section No.	Len (km)	Repl. Value	Depn. Value
ANGELINE ST S	KENT ST W	ROOSEVELT ST	1239	0.110	44,000.00	1,760.00
ANGELINE ST S	ROOSEVELT ST	HOWARD AVE	1240	0.142	56,800.00	2,272.00
ANGELINE ST S	HOWARD AVE	DURHAM ST W	1241	0.313	125,200.00	5,008.00
ANGELINE ST S	DURHAM ST W	MARY ST W	1243	0.440	176,000.00	7,040.00
ANGELINE ST S	MARY ST W	WILSON AVE	1246	0.124	49,600.00	1,984.00
ANGELINE ST S	WILSON AVE	S TOWN LIMIT	1247	0.660	264,000.00	10,560.00
APPLEWOOD CR	ORCHARD PK	EDGEWOOD DR	1261	0.258	103,200.00	4,128.00
APPLEWOOD CR	EDGEWOOD DR	ELAINE DR	1263	0.077	30,800.00	1,232.00
ARDMORE AVE	ALBERT ST S	ADELAIDE ST S	1111	0.258	103,200.00	4,128.00
ARMOUR CT	ST DAVID ST	WESTEND	1113	0.063	25,200.00	1,008.00
AUK TRAIL	ANGELINE ST S	NW BEND	2296	0.133	53,200.00	2,128.00
AUK TRAIL	NW BEND	ADELAIDE ST S	2297	0.311	124,400.00	4,976.00
BAY ST	VIMY RD	DURHAM ST W	1026	0.086	34,400.00	1,376.00
BAY ST	DURHAM ST W	S END	1027	0.117	46,800.00	1,872.00
BERTIE ST	ST PATRICK ST	ST PETER ST	1030	0.182	72,800.00	2,912.00
BEVERLY ST	ST. DAVID ST	ST GEORGE ST	1023	0.188	75,200.00	3,008.00
BIRCH CT	OAK ST	OAK ST	1264	0.495	198,000.00	7,920.00
BOND ST	LINDSAY ST N	WILLIAM ST N	1102	0.000	0.00	0.00
BOND ST	WILLIAM ST N	CAMBRIDGE N	1103	0.174	69,600.00	2,784.00
BOND ST	CAMBRIDGE N	VICTORIA AVE	1104	0.103	41,200.00	1,648.00
BOND ST	VICTORIA AVE	SUSSEX ST N	1105	0.103	41,200.00	1,648.00
BOND ST	SUSSEX ST N	ALBERT ST N	1106	0.172	68,800.00	2,752.00
BOND ST	ALBERT ST N	ADELAIDE ST N	1107	0.258	103,200.00	4,128.00
BRENDA CT	LOGIE ST	EAST END	1267	0.054	21,600.00	864.00
BROAD ST	ANGELINE ST S	WEST END	1268	0.070	28,000.00	1,120.00
BROCK ST	PARKSIDE DR	GEORGE ST E	1141	0.212	84,800.00	3,392.00
BROCK ST	GEORGE ST E	MARY ST E	1143	0.204	81,600.00	3,264.00
BROCK ST	MARY ST E	S TOWN LIMITS	1145	0.179	71,600.00	2,864.00
CAMBRIDGE ST N	KENT ST W	PEEL ST	1279	0.142	56,800.00	2,272.00
CAMBRIDGE ST N	PEEL ST	WELLINGTON ST	1280	0.142	56,800.00	2,272.00
CAMBRIDGE ST N	WELLINGTON ST	BOND ST	1281	0.144	57,600.00	2,304.00
CAMBRIDGE ST N	BOND ST	FRANCIS ST	1282	0.142	56,800.00	2,272.00
CAMBRIDGE ST N	FRANCIS ST	COLBORNE ST W	1283	0.092	36,800.00	1,472.00
CAMBRIDGE ST S	KENT ST W	RUSSELL ST W	1284	0.124	49,600.00	1,984.00
CAMBRIDGE ST S	RUSSELL ST W	GLENELG ST W	1285	0.142	56,800.00	2,272.00
CAMBRIDGE ST S	GLENELG ST W	MELBOURNE ST	1286	0.142	56,800.00	2,272.00
CAMBRIDGE ST S	MELBOURNE ST	DURHAM ST W	1287	0.132	52,800.00	2,112.00
CAMBRIDGE ST S	DURHAM ST W	GEORGE ST	1288	0.224	89,600.00	3,584.00
CAREW PARK RD	COLBORNE ST W	REGENT ST	1115	0.000	0.00	0.00
CAREW PARK RD	REGENT ST	ELGIN ST	1116	0.000	0.00	0.00
CAREW PARK RD	ELGIN ST	POTTINGER ST	1117	0.000	0.00	0.00
CAROLINE ST	KING ST	QUEEN ST	1020	0.070	28,000.00	1,120.00
CAROLINE ST	QUEEN ST	COLBORNE ST E	1021	0.330	132,000.00	5,280.00

(ROADWAY DATA FOR LINDSAY)

Section Name	From	To	Section No.	Len (km)	Repl. Value	Depn. Value
CEDAR CT	ELGIN ST	ELGIN ST	1062	0.317	126,800.00	5,072.00
CHURCHILL CR	WILLIAM ST N	POTTINGER ST	1109	0.296	118,400.00	4,736.00
COLBORNE ST E	LINDSAY ST N	ST PAUL ST	1317	0.188	75,200.00	3,008.00
COLBORNE ST E	ST PAUL ST	ST PATRICK ST	1318	0.182	72,800.00	2,912.00
COLBORNE ST E	ST PATRICK	ST PETER ST	1320	0.181	72,400.00	2,896.00
COLBORNE ST E	ST PETER	ST DAVID	1322	0.183	73,200.00	2,928.00
COLBORNE ST E	ST DAVID	ST GEORGE ST	1324	0.189	75,600.00	3,024.00
COLBORNE ST E	ST GEORGE ST	VERULAM RD	1326	0.322	128,800.00	5,152.00
COLBORNE ST W	LINDSAY ST N	SCUGOG RIVER	1295	0.000	0.00	0.00
COLBORNE ST W	SCUGOG RIVER	WILLIAM ST N	1296	0.116	46,400.00	1,856.00
COLBORNE ST W	WILLIAM ST N	CAMBRIDGE N	1297	0.174	69,600.00	2,784.00
COLBORNE ST W	CAMBRIDGE N	VICTORIA AVE	1299	0.103	41,200.00	1,648.00
COLBORNE ST W	VICTORIA AVE	SUSSEX ST N	1300	0.103	41,200.00	1,648.00
COLBORNE ST W	SUSSEX ST N	ALBERT ST N	1301	0.172	68,800.00	2,752.00
COLBORNE ST W	ALBERT ST N	ADELAIDE ST N	1303	0.258	103,200.00	4,128.00
COLBORNE ST W	ADELAIDE ST N	ANGELINE ST N	1305	0.263	105,200.00	4,208.00
COLBORNE ST W	ANGELINE ST N	HERITAGE WAY	1307	0.290	116,000.00	4,640.00
COLBORNE ST W	HERITAGE WAY	HWY 35	1308	1.050	420,000.00	16,800.00
COMMERCE PLACE	COMMERCE RD	SOUTH END	1119	0.100	40,000.00	1,600.00
COMMERCE RD	KENT ST W	SW BEND	1189	0.246	98,400.00	3,536.00
COMMERCE RD	SW BEND	SE BEND	1191	0.349	139,600.00	5,584.00
COMMERCE RD	SE BEND	S END	1192	0.186	74,400.00	2,976.00
CORNEIL ST	SANDERLING C	VICTORIA AVE	1329	0.289	115,600.00	4,624.00
COTTINGHAM CR	LINDSAY ST N	LINDSAY ST N	1331	0.275	110,000.00	4,400.00
CRANDALL ST	JOHN ST	NORTH END	1025	0.170	68,000.00	2,720.00
CRESCENT CT	ADELAIDE ST N	EAST END	1114	0.092	36,800.00	1,472.00
CRESTWOOD AVE	ORCHARD PK RD	VICTORIA AVE N	1333	0.317	126,800.00	5,072.00
DALE ST	DURHAM ST W	SOUTH END	2127	0.000	0.00	0.00
DANIEL CT	LINDSAY ST N	WILLIAM ST N	1335	0.167	66,800.00	2,672.00
DAVID DR	ANGELINE ST N	HOPKINS RD	1337	0.265	106,000.00	4,240.00
DAVID DR	HOPKINS RD	LINWOOD RD	1339	0.101	40,400.00	1,616.00
DAVID DR	LINWOOD RD	47m W	1340	0.047	18,800.00	752.00
DEANE ST	GEORGE ST E	MARY ST E	1346	0.183	73,200.00	2,928.00
DEANE ST	MARY ST E	S TOWN LIMIT	1348	0.175	70,000.00	2,800.00
DENNISTON ST	ST PAUL ST	ST PATRICK ST	1356	0.150	60,000.00	2,400.00
DENNISTON ST	ST PATRICK ST	ST PETER ST	1358	0.000	0.00	0.00
DERMOTT ST	ST PETER ST	ST DAVID ST	1361	0.185	74,000.00	2,960.00
DIVISION ST	LINDSAY ST S	DUKE ST	1363	0.126	50,400.00	2,016.00
DIVISION ST	DUKE ST	WOLFE ST	1364	0.138	55,200.00	2,208.00
DIVISION ST	WOLFE ST	SCUGOG RIVER	1365	0.145	58,000.00	2,320.00
DOMINION DR	ST. GEORGE ST	JEFFERSON BLD	1366	0.100	40,000.00	1,600.00
DOMINION DR	JEFFERSON BLD	ST. JAMES ST	1367	0.060	24,000.00	960.00
DOMINION DR	ST. JAMES ST	E END	1368	0.062	24,800.00	992.00

(ROADWAY DATA FOR LINDSAY)

Section Name	From	To	Section No.	Len (km)	Repl. Value	Depn. Value
DON CT	ALBERT ST N	WEST END	1360	0.108	43,200.00	1,728.00
DUKE ST	DURHAM ST E	GEORGE ST E	1369	0.211	84,400.00	3,376.00
DUKE ST	GEORGE ST E	DIVISION ST	1371	0.083	33,200.00	1,328.00
DUKE ST	DIVISION ST	MARY ST E	1372	0.078	31,200.00	1,246.00
DUNSFORD CT	SANDERLING CR	EAST END	1101	0.148	59,200.00	2,368.00
DURHAM ST E	LINDSAY ST S	DUKE ST	1384	0.120	48,000.00	1,920.00
DURHAM ST E	DUKE ST	WOLFE ST	1385	0.121	48,400.00	1,936.00
DURHAM ST E	WOLFE ST	GEORGIAN ST	1386	0.328	131,200.00	5,248.00
DURHAM ST W	LINDSAY ST S	CAMBRIDGE ST	1373	0.367	146,800.00	5,872.00
DURHAM ST W	CAMBRIDGE ST	HAMILTON ST	1376	0.157	62,800.00	2,512.00
DURHAM ST W	HAMILTON ST	ALBERT ST W	1378	0.252	100,800.00	4,032.00
DURHAM ST W	ALBERT ST S	ADELAIDE ST	1380	0.258	103,200.00	4,128.00
DURHAM ST W	ADELAIDE ST S	ANGELINE ST S	1382	0.257	102,800.00	4,112.00
DYANA DR	POTTINGER ST	DANIEL CT	1389	0.196	78,400.00	3,136.00
EASTVIEW RD	SCUGOG RIVER	LOGIE ST	1391	0.084	33,600.00	1,344.00
EASTVIEW RD	LOGIE ST	VERULAM RD S	1392	0.000	0.00	0.00
EDGEWOOD DR	ORCHARD PK RD	APPLEWOOD DR	1395	0.181	72,400.00	2,896.00
EDGEWOOD DR	APPLEWOOD DR	N TOWN LIMIT	1396	0.118	47,200.00	1,888.00
EDWIN ST	SANDERLING CR	ROGERS RD	1401	0.057	22,800.00	912.00
EDWIN ST	ROGERS RD	ELAINE DR	1402	0.160	64,000.00	2,560.00
EGLINGTON ST	SCUGOG RIVER	LINDSAY ST N	1403	0.168	67,200.00	2,688.00
EGLINGTON ST	LINDSAY ST N	WILLIAM ST N	1404	0.168	67,200.00	2,688.00
EGLINGTON ST	WILLIAM ST N	VICTORIA AVE	1405	0.297	118,800.00	4,752.00
EGLINGTON ST	VICTORIA AVE	LORI BLVD	1407	0.114	45,600.00	1,824.00
EGLINGTON ST	LORI BLVD	SANDERLING CR	1408	0.083	33,200.00	1,328.00
ELAINE DR	ORCHARD PK RD	EDWIN ST	1409	0.156	62,400.00	2,496.00
ELAINE DR	EDWIN ST	N END	1410	0.138	55,200.00	2,208.00
ELGIN ST	E END	WILLIAM ST N	1411	0.134	53,600.00	2,144.00
ELGIN ST	WILLIAM ST N	VICTORIA AVE	1413	0.297	118,800.00	4,752.00
ELGIN ST	VICTORIA AVE	ALBERT ST N	1415	0.295	118,000.00	4,720.00
ELGIN ST	ALBERT ST N	ADELAIDE ST N	1417	0.258	103,200.00	4,128.00
ELGIN ST	ADELAIDE ST N	ANGELINE ST N	1419	0.263	105,200.00	4,208.00
ELGIN ST	ANGELINE ST N	ELM CT	1421	0.295	118,000.00	4,720.00
ELGIN ST	ELM CT	OAK ST	1423	0.326	130,400.00	5,216.00
ELLESMURE LANE	KENT ST W	NORTH END	1425	0.000	0.00	0.00
ELM CT	ELGIN ST (E)	ELGIN ST (W)	1426	0.364	145,600.00	5,824.00
FAIR AVE	ALBERT ST N	ADELAIDE ST N	1428	0.258	103,200.00	4,128.00
FAIRVIEW CT	ADELAIDE ST N	EAST END	1430	0.000	0.00	0.00
FLAVELLE CR	ANGELINE ST N	NORTHLIN PK	1431	0.000	0.00	0.00
FLEETWOOD RD	VERULAM RD N	ST GEORGE ST	2981	0.356	142,400.00	5,696.00
FLEETWOOD RD	ST GEORGE ST	ST DAVID ST	2982	0.188	75,200.00	3,008.00
FOUND AVE	WILLIAM ST N	KAREN DR	1433	0.226	90,400.00	3,616.00
FOUND AVE	KAREN DR	VICTORIA AVE	1434	0.088	35,200.00	1,408.00

(ROADWAY DATA FOR LINDSAY)

Section Name	From	To	Section No.	km (km)	Repl. Value	Depn. Value
FRANCIS ST	SCUGOG RIVER	WILLIAM ST N	1034	0.078	31,200.00	1,248.00
FRANCIS ST	WILLIAM ST N	CAMBRIDGE ST	1035	0.174	69,600.00	2,784.00
FRANCIS ST	CAMBRIDGE ST	VICTORIA AVE	1037	0.103	41,200.00	1,648.00
FRANCIS ST	VICTORIA AVE	SUSSEX ST	1038	0.103	41,200.00	1,648.00
FRANCIS ST	SUSSEX ST N	ALBERT ST M	1039	0.172	68,800.00	2,752.00
FROST PL	MARY ST W	NORTH END	1435	0.056	22,400.00	896.00
GEORGE ST E	LINDSAY ST S	DUKE ST	1446	0.125	50,000.00	2,000.00
GEORGE ST E	DUKE ST	WOLFE ST	1447	0.137	54,800.00	2,192.00
GEORGE ST E	WOLFE ST	SCUGOG RIVER	1448	0.255	102,000.00	4,080.00
GEORGE ST E	SCUGOG RIVER	LOGIE ST	1450	0.065	26,000.00	1,040.00
GEORGE ST E	LOGIE ST	BROCK ST	1451	0.328	131,200.00	5,248.00
GEORGE ST E	BROCK ST	VERULAM RD S	1454	0.300	120,000.00	4,800.00
GEORGE ST W	LINDSAY ST S	JAMES ST	1436	0.259	103,600.00	4,144.00
GEORGE ST W	JAMES ST	HAMILTON ST	1438	0.265	106,000.00	4,240.00
GEORGE ST W	HAMILTON ST	ALBERT ST S	1440	0.251	100,400.00	4,016.00
GEORGE ST W	ALBERT ST S	ADELAIDE ST S	1442	0.000	0.00	0.00
GEORGE ST W	ADELAIDE ST S	ANGELINE ST S	1444	0.000	0.00	0.00
GEORGIAN ST	DURHAM ST E	MELBOURNE ST	1456	0.141	56,400.00	2,256.00
GEORGIAN ST	MELBOURN ST	BLENELG ST E	1457	0.141	56,400.00	2,256.00
GEORGIAN ST	GLENELG ST E	RUSSELL ST E	1458	0.142	56,800.00	2,272.00
GEORGIAN ST	RUSSELL ST E	SCUGOG RIVER	1459	0.156	62,400.00	2,496.00
GLENELG ST E	LINDSAY ST S	MILL ST	1467	0.101	40,400.00	1,616.00
GLENELG ST E	MILL ST	ST LAWRENCE	1468	0.101	40,400.00	1,616.00
GLENELG ST E	ST LAWRENCE	HURON ST	1469	0.103	41,200.00	1,648.00
GLENELG ST E	HURON ST	SIMCOE ST	1470	0.101	40,400.00	1,616.00
GLENELG ST E	SIMCOE ST	GEORGIAN ST	1471	0.101	40,400.00	1,616.00
GLENELG ST E	GEORGIAN ST	WATER ST	1472	0.100	40,000.00	1,600.00
GLENELG ST E	WATER ST	SCUGOG RIVER	1473	0.074	29,600.00	1,184.00
GLENELG ST W	LINDSAY ST S	WILLIAM ST S	1460	0.173	69,200.00	2,768.00
GLENELG ST W	WILLIAM ST S	CAMBRIDGE ST	1462	0.173	69,200.00	2,768.00
GLENELG ST W	CAMBRIDGE ST	VICTORIA AVE	1463	0.103	41,200.00	1,648.00
GLENELG ST W	VICTORIA AVE	SUSSEX ST S	1464	0.114	45,600.00	1,824.00
GLENELG ST W	SUSSEX ST S	ALBERT ST S	1465	0.173	69,200.00	2,768.00
GLENELG ST W	ALBERT ST S	ADELAIDE ST S	1466	0.258	103,200.00	4,128.00
HAMILTON ST	DURHAM ST W	GEORGE ST W	1474	0.224	89,600.00	3,584.00
HAMILTON ST	GEORGE ST W	MARY ST W	1476	0.204	81,600.00	3,264.00
HAMILTON ST	GEORGE ST W	S END	1477	0.000	0.00	0.00
HAZEL ST	ST JAMES ST	E END	1482	0.095	38,000.00	1,520.00
HENRY ST	ADELAIDE ST N	JANE ST	1120	0.120	48,000.00	1,920.00
HERITAGE WAY	COLBORNE ST W	S END	1483	0.253	101,200.00	4,048.00
HILLSIDE DR	SCUGOG RIVER	LOGIE ST	1509	0.088	35,200.00	1,408.00
HILLSIDE DR	LOGIE ST	RICHARDSON CT	1510	0.162	64,800.00	2,592.00
HILLSIDE DR	RICHARDSON CT	VERULAM RD	1511	0.243	97,200.00	3,888.00

(ROADWAY DATA FOR LINDSAY)

Section Name	From	To	Section No.	Len (km)	Repl. Value	Depr. Value
HOPKINS RD	DAVID DR	RICHARD AVE	1513	0.140	56,000.00	2,240.00
HOWARD AVE	ADELAIDE ST S	ANGELINE ST S	1515	0.258	103,200.00	4,128.00
HUDSPETH CT	COTTINGHAM	SOUTH END	1517	0.055	22,000.00	880.00
HUGHES CT	MARY ST W	EAST END	1518	0.156	62,400.00	2,496.00
HURON ST	DURHAM ST E	MELBOURNE ST	1519	0.141	56,400.00	2,256.00
HURON ST	MELBOURNE ST	GLENELG ST E	1520	0.142	56,800.00	2,272.00
HURON ST	GLENELG ST	RUSSELL ST E	1521	0.142	56,800.00	2,272.00
HURON ST	RUSSELL ST E	RIDOUT ST	1522	0.134	53,600.00	2,144.00
HURON ST	RIDOUT ST	KENT ST E	1523	0.042	16,800.00	672.00
JAMES ST	CAMBRIDGE ST	GEORGE ST W	1531	0.226	90,400.00	3,616.00
JAMES ST	GEORGE ST W	MARY ST W	1533	0.204	81,600.00	3,264.00
JAMES ST	MARY ST W	S END	1535	0.192	76,800.00	3,072.00
JANE ST	KENT ST W	HENRY ST	1540	0.104	41,600.00	1,664.00
JEFFERSON BLVD	QUEEN ST	DOMINION DR	1541	0.214	85,600.00	3,424.00
JOAN PK CT	HOPKINS RD	N END	1543	0.083	33,200.00	1,328.00
JOHN ST	ST PAUL ST	ST PATRICK ST	1032	0.181	72,400.00	2,896.00
KAREN DR	FOUND AVE	SILLIAM ST N	1545	0.364	145,600.00	5,824.00
KARI CT	LORI BLVD	EAST END	1548	0.054	21,600.00	864.00
KAWARTHA DR	LOGIE ST	VERULAM RD	1550	0.404	161,600.00	6,464.00
KENT ST E	LINDSAY ST N	MILL ST	1059	0.101	40,400.00	1,616.00
KENT ST E	MILL ST	HURON ST	1060	0.120	48,000.00	1,920.00
KENT ST E	HURON ST	SIMCOE ST	1061	0.150	60,000.00	2,400.00
KENT ST W	LINDSAY ST	SILLIAM ST	1553	0.194	77,600.00	3,104.00
KENT ST W	WILLIAM ST	CAMBRIDGE ST	1555	0.194	77,600.00	3,104.00
KENT ST W	CAMBRIDGE ST	VICTORIA AVE	1557	0.135	54,000.00	2,160.00
KENT ST W	VICTORIA AVE	SUSSEX ST	1558	0.120	48,000.00	1,920.00
KENT ST W	SUSSEX ST	ALBERT ST	1559	0.194	77,600.00	3,104.00
KENT ST W	ALBERT ST	ADELAIDE ST	1561	0.280	112,000.00	4,480.00
KENT ST W	ADELAIDE ST	ANGELINE ST	1563	0.278	111,200.00	4,448.00
KENT ST W	ANGELINE ST	COMMERCE RD	1565	0.895	358,000.00	14,320.00
KENT ST W	COMMERCE RD	W TOWN LIMITS	1571	0.209	83,600.00	3,344.00
KING ST	LINDSAY ST N	CAROLINE ST	1579	0.083	33,200.00	1,328.00
KING ST	CAROLINE ST	ST PAUL ST	1580	0.100	40,000.00	1,600.00
KING ST	ST PAUL ST	ST PATRICK ST	1581	0.202	80,800.00	3,232.00
KING ST	ST PATRICK ST	ST PETER ST	1583	0.203	81,200.00	3,248.00
KING ST	ST PETER ST	ST DAVID ST	1585	0.181	72,400.00	2,896.00
KING ST	ST DAVID ST	ST GEORGE ST	1587	0.184	73,600.00	2,944.00
KING ST	ST GEORGE ST	ST JAMES ST	1589	0.182	72,800.00	2,912.00
KING ST	ST. JAMES ST	VERULAM RD S	1591	0.125	50,000.00	2,000.00
KIRKCONNEL RD	NORTHLIN PK	SYLVESTER DR	1592	0.000	0.00	0.00
LANG CT	NORTHLIN PK	EAST END	1600	0.000	0.00	0.00
LINDSAY ST N	KENT ST	SCUGOG BRIDGS	1603	0.052	20,800.00	832.00
LINDSAY ST N	SCUGOG BRIDGE	WELLINGTON ST	1604	0.131	52,400.00	2,096.00

(ROADWAY DATA FOR LINDSAY)

Section Name	From	To	Section No.	len (km)	Repl. Value	Depos. Value
LINDSAY ST N	WELLINGTON ST	BOND ST	1605	0.141	56,400.00	2,256.00
LINDSAY ST N	BOND ST	COLBORNE ST E	1606	0.230	92,000.00	3,680.00
LINDSAY ST N	POTTINGER ST	EGLINGTON ST	1608	0.420	168,000.00	6,720.00
LINDSAY ST N	EGLINGTON ST	COTTINGHAM CR	1611	0.216	86,400.00	3,456.00
LINDSAY ST N	COTTINGHAM CR	N TOWN LIMITS	1612	0.464	185,600.00	7,424.00
LINDSAY ST S	KENT ST E	RUSSELL ST	1618	0.193	77,200.00	3,088.00
LINDSAY ST S	RUSSEL ST	GLENELG ST	1619	0.141	56,400.00	2,256.00
LINDSAY ST S	GLENELG ST	MELBOURNE ST	1620	0.141	56,400.00	2,256.00
LINDSAY ST S	MELBOURNE ST	DURHAM ST	1621	0.141	56,400.00	2,256.00
LINDSAY ST S	DURHAM ST	GEORGE ST	1622	0.227	90,800.00	3,632.00
LINDSAY ST S	GEORGE ST	MARY ST	1624	0.202	80,800.00	3,232.00
LINDSAY ST S	MARY ST	SCUGOG RIVER	1626	0.522	208,800.00	8,352.00
LINDSAY ST S	SCUGOG RIVER	LOGIE ST	1630	0.136	54,400.00	2,176.00
LINDSAY ST S	LOGIE ST	S TOWN LIMITS	1632	0.120	48,000.00	1,920.00
LINDWAY PL	ALBERT ST N	ALBERT ST N	1640	0.347	138,800.00	5,552.00
LINWOOD RD	DAVID DR	RICHARD AVE	1643	0.175	70,000.00	2,800.00
LLOYD PL	ROGERS RD	WEST END	1645	0.092	36,800.00	1,472.00
LLOYD ST	VIMY RD	NORTH END	1646	0.000	0.00	0.00
LOF RD	UNIROYAL RD	E END	1000	0.023	9,200.00	368.00
LOGIE ST	RIVERVIEW RD	MARYKNOLL AVE	1647	0.124	49,600.00	1,984.00
LOGIE ST	MARYKNOLL AVE	KAWARTHA DR	1648	0.108	43,200.00	1,728.00
LOGIE ST	KAWARTHA DR	EASTVIEW RD	1649	0.145	58,000.00	2,320.00
LOGIE ST	EASTVIEW RD	HILLSIDE DR	1650	0.147	58,800.00	2,352.00
LOGIE ST	HILLSIDE DR	PARKSIDE DR	1651	0.193	77,200.00	3,088.00
LOGIE ST	PARKSIDE DR	GEORGE ST E	1652	0.252	100,800.00	4,032.00
LOGIE ST	GEORGE ST W	MARY ST E	1654	0.242	96,800.00	3,872.00
LOGIE ST	MARY ST E	S BEND	1656	0.792	316,800.00	12,672.00
LOGIE ST	S BEND	LINDSAY ST S	1661	0.126	50,400.00	2,016.00
LORI BLVD	VICTORIA AVE	EGLINGTON ST	1662	0.334	133,600.00	5,344.00
LORI BLVD	EGLINGTON ST	VICTORIA AVE	1665	0.305	122,000.00	4,880.00
MADILL CR	WILSON AVE	N.W. BEND	1668	0.259	103,600.00	4,144.00
MADILL CR	N.W. BEND	MARY ST W	1670	0.199	79,600.00	3,184.00
MAIN ST	DURHAM ST W	SOUTHERLY	2128	0.000	0.00	0.00
MAPLE CR	ANGELINE ST S	WEST END	1018	0.292	116,800.00	4,672.00
MARGARET AVE	ELGIN ST	POTTINGER ST	1672	0.121	48,400.00	1,936.00
MARY ST E	LINDSAY ST S	WOLFE ST	1694	0.284	113,600.00	4,544.00
MARY ST E	SCUGOG RIVER	LOGIE ST	1697	0.155	62,000.00	2,480.00
MARY ST E	LOGIE ST	DEANE ST	1698	0.205	82,000.00	3,280.00
MARY ST E	DEANE ST	BROCK ST	1700	0.273	109,200.00	4,368.00
MARY ST E	BROCK ST	VERULAM RD	1702	0.326	130,400.00	5,216.00
MARY ST W	LINDSAY ST S	JAMES ST	1673	0.278	111,200.00	4,448.00
MARY ST W	JAMES ST	HAMILTON ST	1675	0.284	113,600.00	4,544.00
MARY ST W	HAMILTON ST	ALBERT ST S	1677	0.250	100,000.00	4,000.00

(ROADWAY DATA FOR LINDSAY)

Section Name	From	To	Section No.	Len (km)	Repl. Value	Depr. Value
MARY ST W	ALBERT ST S	ADELAIDE ST S	1679	0.278	111,200.00	4,448.00
MARY ST W	ADELAIDE ST S	ANGELINE ST S	1681	0.277	110,800.00	4,432.00
MARY ST W	ANGELINE ST S	WILSON AVE	1683	0.390	156,000.00	6,240.00
MARY ST W	WILSON AVE	HUGHES CT	1683	0.235	94,000.00	3,760.00
MARY ST W	HUGHES CT	W END	1688	0.153	61,200.00	2,448.00
MARYKNOLL AVE	LOGIE ST	SW BEND	1704	0.408	163,200.00	6,528.00
MARYKNOLL AVE	SW BEND	RIVERVIEW RD	1707	0.087	34,800.00	1,392.00
McDONAGH DR	ANGELINE ST S	MAPLE CR	1708	0.298	119,200.00	4,768.00
MELBOURNE ST E	LINDSAY ST S	MILL ST	1719	0.101	40,400.00	1,616.00
MELBOURNE ST E	MILL ST	ST LAWRENCE	1720	0.100	40,000.00	1,600.00
MELBOURNE ST E	ST LAWRENCE	HURON ST	1721	0.104	41,600.00	1,664.00
MELBOURNE ST E	HURON ST	SIMCOE ST	1722	0.100	40,000.00	1,600.00
MELBOURNE ST E	SIMCOE ST	GEORGIAN ST	1723	0.101	40,400.00	1,616.00
MELBOURNE ST E	GEORGIAN ST	SCUGOG RIVER	1724	0.140	56,000.00	2,240.00
MELBOURNE ST W	LINDSAY ST S	WILLIAM ST S	1711	0.173	69,200.00	2,768.00
MELBOURNE ST W	WILLIAM ST S	CAMBRIDGE ST	1713	0.173	69,200.00	2,768.00
MELBOURNE ST W	CAMBRIDGE ST	VICTORIA AVE	1715	0.103	41,200.00	1,648.00
MELBOURNE ST W	VICTORIA AVE	SUSSEX ST S	1716	0.114	45,600.00	1,824.00
MELBOURNE ST W	SUSSEX ST S	ALBERT ST S	1717	0.173	69,200.00	2,768.00
MIDLAND DR	VICTORIA AVE	ORCHARD PK RD	1725	0.307	122,800.00	4,912.00
MILL ST	DURHAM ST E	MELBOURNE ST	1050	0.141	56,400.00	2,256.00
MILL ST	MELBOURNE ST	GLENELG ST	1051	0.142	56,800.00	2,272.00
MILL ST	RLENELG ST	RUSSELL ST	1052	0.142	56,800.00	2,272.00
MILL ST	RUSSELL ST	RIDOUT ST	1053	0.132	52,800.00	2,112.00
MILL ST	RIDOUT ST	KENT ST E	1054	0.042	16,800.00	672.00
MT HOPE ST	ST PETER ST	ST DAVID ST	1732	0.190	76,000.00	3,040.00
MT HOPE ST	ST DAVID ST	VERULAM RD	1734	0.544	217,600.00	8,704.00
NEEDHAM ST	SCUGOG RIVER	ST PATRICK ST	1738	0.185	74,000.00	2,960.00
NEEDHAM ST	ST PATRICK ST	ST PETER ST	1739	0.181	72,400.00	2,896.00
NEEDHAM ST	ST PETER ST	ST DAVID ST	1741	0.186	74,400.00	2,976.00
NEEDHAM ST	ST DAVID ST	ST GEORGE ST	1743	0.189	75,800.00	3,024.00
NEEDHAM ST	ST GEORGE ST	VERULAM RD	1745	0.361	144,400.00	5,776.00
NORDALE CT	ORCHARD PK RD	NORTH END	1749	0.075	30,000.00	1,200.00
NORTHLIN PK RD	S END	FLAVELLE CR	1760	0.000	0.00	0.00
NORTHLIN PK RD	FLAVELLE CR	KIRKCONNEL	1761	0.000	0.00	0.00
NORTHLIN PK RD	KIRKCONNEL	ANGELINE ST N	1763	0.000	0.00	0.00
NORTHLIN PK RD	ANGELINE ST N	ADELAIDE ST N	1764	0.170	68,000.00	2,720.00
NORTHLIN PK RD	ADELAIDE ST N	WELDON CT	1766	0.093	37,200.00	1,488.00
NORTHLIN PK RD	WELDON CT	ORCHARD PK RD	1767	0.290	116,000.00	4,640.00
OAK ST	ANGELINE ST N	ELGIN ST	1769	0.358	143,200.00	5,728.00
OLIVER CT	EGLINGTON ST	SOUTH END	1750	0.097	38,800.00	1,552.00
ORCHARD PK RD	ANGELINE ST N	NORDALE CT	1779	0.207	82,800.00	3,312.00
ORCHARD PK RD	NORDALE CT	NORTHLIN PK RD	1781	0.137	54,800.00	2,192.00

(ROADWAY DATA FOR LINDSAY)

Section Name	From	To	Section No.	Len (km)	Dept. Value	Depos. Value
ORCHARD PK RD	NORTHLIN PK RD	ROGERS RD	1782	0.204	81,600.00	3,264.00
ORCHARD PK RD	ROGERS RD	SANDERLING CR	1784	0.086	34,400.00	1,376.00
ORCHARD PK RD	SANDERLING CR	VICTORIA AVE	1785	0.208	83,200.00	3,328.00
ORCHARD PK RD	VICTORIA AVE	WILLIAMS ST N	1787	0.306	122,400.00	4,896.00
PARKING LOT	LINDSAY ST S	YORK ST N	2150	0.000	0.00	0.00
PARKING LOT	CAMBRIDGE ST	VICTORIA AVE	2152	0.000	0.00	0.00
PARKING LOT N	CAMBRIDGE ST	VICTORIA AVE N	2156	0.000	0.00	0.00
PARKING LOT S	CAMBRIDGE ST	VICTORIA AVE N	2154	0.000	0.00	0.00
PARKSIDE DR	SCUGOG RIVER	LOGIE ST	1121	0.087	34,800.00	1,392.00
PARKSIDE DR	LOGIE ST	BROCK ST	1122	0.200	80,000.00	3,200.00
PARKSIDE DR	BROCK ST	VERULAM RD	1124	0.289	115,600.00	4,624.00
PARKWAY AVE	ALBERT ST N	ADELAIDE ST	1790	0.260	104,000.00	4,160.00
PARKWAY AVE	ADELAIDE ST	ROSEMARY	1792	0.090	36,000.00	1,440.00
PEARSON ST	WILSON AVE	S END	1793	0.065	26,000.00	1,040.00
PEEL ST	YORK ST N	WILLIAM ST N	1797	0.062	24,800.00	992.00
PEEL ST	WILLIAM ST N	CAMBRIDGE ST	1798	0.174	69,600.00	2,784.00
PEEL ST	CAMBRIDGE ST	VICTORIA AVE	1800	0.103	41,200.00	1,648.00
PEEL ST	VICTORIA AVE	SUSSEX ST	1801	0.103	41,200.00	1,648.00
PEEL ST	SUSSEX ST	ALBERT ST	1802	0.172	68,800.00	2,752.00
POTTINGER ST	LINDSAY ST N	WILLIAM ST	1804	0.167	66,800.00	2,672.00
POTTINGER ST	WILLIAM ST	VICTORIA AVE	1806	0.297	118,800.00	4,752.00
POTTINGER ST	VICTORIA AVE	ALBERT ST	1809	0.295	118,000.00	4,720.00
POTTINGER ST	ALBERT ST	ADELAIDE ST	1811	0.258	103,200.00	4,128.00
POTTINGER ST	ADELAIDE ST	ELGIN PK	1813	0.075	30,000.00	1,200.00
PR. ELIZ. CR	ST PETER ST	ST PETER ST	1815	0.182	72,800.00	2,912.00
PURDY CT	NORTHLIN PK	N/W END	1821	0.000	0.00	0.00
QUEEN ST	LINDSAY ST	CAROLINE ST	1822	0.083	33,200.00	1,328.00
QUEEN ST	CAROLINE ST	ST PAUL ST	1823	0.080	32,000.00	1,280.00
QUEEN ST	ST PAUL ST	ST PATRICK	1824	0.182	72,800.00	2,912.00
QUEEN ST	ST PATRICK	ST PETER ST	1826	0.181	72,400.00	2,896.00
QUEEN ST	ST PETER ST	ST DAVID ST	1828	0.181	72,400.00	2,896.00
QUEEN ST	ST DAVID ST	ST. GEORGE ST	1830	0.184	73,600.00	2,944.00
QUEEN ST	ST. GEORGE ST	ST JAMES ST	1832	0.182	72,800.00	2,912.00
QUEEN ST	ST JAMES ST	VERULAM RD	1834	0.125	50,000.00	2,000.00
REDWING ST	SANDERLING CR	NORTHLIN PK	1841	0.297	118,800.00	4,752.00
REGENT ST	LINDSAY ST N	WILLIAM ST N	1843	0.075	30,000.00	1,200.00
REGENT ST	WILLIAM ST N	VICTORIA AVE	1845	0.297	118,800.00	4,752.00
REGENT ST	VICTORIA AVE	ALBERT ST	1848	0.295	118,000.00	4,720.00
REGENT ST	ALBERT ST	ADELAIDE ST	1851	0.258	103,200.00	4,128.00
REGENT ST	ADELAIDE ST N	ANGELINE ST	1853	0.135	54,000.00	2,160.00
RICHARD AVE	HOPKINS RD	W END	1855	0.290	116,000.00	4,640.00
RICHARDSON CT	HILLSIDE DR	SOUTH END	1193	0.084	33,600.00	1,344.00
RIDOUT ST	LINDSAY ST S	MILL ST	1863	0.101	40,400.00	1,616.00

(ROADWAY DATA FOR LINDSAY)

Section Name	From	To	Section No.	Len (km)	Repl. Value	Depos. Value
RIDOUT ST	MILL ST	ST LAWRENCE	1864	0.100	40,000.00	1,600.00
RIDOUT ST	ST LAWRENCE	HURON ST	1865	0.101	40,400.00	1,616.00
RIDOUT ST	HURON ST	SIMCOE ST	1866	0.100	40,000.00	1,600.00
RIDOUT ST	SIMCOE ST	GEORGIAN ST	1867	0.101	40,400.00	1,616.00
RIDOUT ST	GEORGIAN ST	SCUGOG RIVER	1868	0.030	12,000.00	480.00
RIVERVIEW RD	ST PETER ST	ST DAVID ST	1005	0.202	80,800.00	3,232.00
RIVERVIEW RD	ST DAVID ST	ST GEORGE ST	1007	0.178	71,200.00	2,848.00
RIVERVIEW RD	ST GEORGE ST	ST JAMES ST	1009	0.202	80,800.00	3,232.00
RIVERVIEW RD	ST JAMES ST	VERULAM RD	1011	0.145	58,000.00	2,320.00
ROGERS RD	ORCHARD PK RD	PARK	1874	0.223	89,200.00	3,568.00
ROOSEVELT ST	ADELAIDE ST	ANGELINE ST S	1877	0.258	103,200.00	4,128.00
ROSELYN CT	ROSEMARY DR	SOUTH END	1870	0.135	54,000.00	2,160.00
ROSEMARY DR	PARKWAY AVE	NORTHLIN PK	1879	0.224	89,600.00	3,584.00
RUSSELL ST E	LINDSAY ST S	MILL ST	1881	0.101	40,400.00	1,616.00
RUSSELL ST E	MILL ST	ST LAWRENCE	1882	0.100	40,000.00	1,600.00
RUSSELL ST E	ST LAWRENCE	HURON ST	1883	0.102	40,800.00	1,632.00
RUSSELL ST E	HURON ST	SIMCOE ST	1884	0.100	40,000.00	1,600.00
RUSSELL ST E	SIMCOE ST	GEORGIAN ST	1885	0.101	40,400.00	1,616.00
RUSSELL ST E	GEORGIAN ST	WATER ST	1886	0.101	40,400.00	1,616.00
RUSSELL ST W	LINDSAY ST S	WILLIAM ST S	2040	0.173	69,200.00	2,768.00
RUSSELL ST W	WILLIAM ST S	CAMBRIDGE ST	2043	0.173	69,200.00	2,768.00
RUSSELL ST W	CAMBRIDGE ST	VICTORIA AVE	2046	0.103	41,200.00	1,648.00
RUSSELL ST W	VICTORIA AVE	SUSSEX ST S	2048	0.114	45,600.00	1,824.00
RUSSELL ST W	SUSSEX ST S	ALBERT ST S	2050	0.173	69,200.00	2,768.00
SAMUEL PL	MIDLAND DR	NORTH END	1888	0.063	25,200.00	1,008.00
SANDERLING CR	ADELAIDE ST	ALBERT ST N	1889	0.260	104,000.00	4,160.00
SANDERLING CR	ALBERT ST	EGLINGTON ST	1891	0.133	53,200.00	2,128.00
SANDERLING CR	EGLINGTON ST	REDWING ST	1892	0.000	0.00	0.00
SANDERLING CR	REDWING ST	ORCHARD PK RD	1893	0.000	0.00	0.00
SANDERLING CR	ORCHARD PK RD	EDWIN ST	1895	0.205	82,000.00	3,280.00
SANDERLING CR	EDWIN ST	N TOWN LIMITS	1897	0.164	65,600.00	2,624.00
SHORT AVE	ST PETER ST	ST DAVID ST	1901	0.183	73,200.00	2,928.00
SHORT AVE	ST DAVID ST	ST GEORGE ST	1903	0.189	75,600.00	3,024.00
SIMCOE ST	DURHAM ST E	MELBOURNE ST	1906	0.141	56,400.00	2,256.00
SIMCOE ST	MELBOURNE ST	GLENELG ST	1907	0.141	56,400.00	2,256.00
SIMCOE ST	GLENELG ST E	RUSSELL ST E	1908	0.142	56,800.00	2,272.00
SIMCOE ST	RUSSELL ST E	RIDOUT ST	1909	0.136	54,400.00	2,176.00
SIMCOE ST	RIDOUT ST	KENT ST E	1910	0.042	16,800.00	672.00
SINCLAIR ST	SANDERLING CR	VICTORIA AVE	1911	0.245	98,000.00	3,920.00
SIOUX ST	DURHAM ST E	SOUTH END	1913	0.084	33,600.00	1,344.00
ST DAVID ST	RIVERVIEW RD	KING ST	1922	0.134	53,600.00	2,144.00
ST DAVID ST	KING ST	QUEEN ST	1923	0.071	28,400.00	1,136.00
ST DAVID ST	QUEEN ST	SHORT AVE	1924	0.321	128,400.00	5,136.00

(ROADWAY DATA FOR LINDSAY)

Section Name	From	To	Section No.	Len (km)	Repl. Value	Depr. Value
ST DAVID ST	SHORT AVE	COLBORNE ST E	1926	0.095	38,000.00	1,520.00
ST DAVID ST	COLBORNE ST E	MOUNT HOPE ST	1927	0.401	160,400.00	6,416.00
ST DAVID ST	MOUNT HOPE ST	NEEDHAM ST	1930	0.196	78,400.00	3,136.00
ST DAVID ST	NEEDHAM ST	DERMOTT ST	1931	0.246	98,400.00	3,936.00
ST DAVID ST	DERMOTT ST	FLEETWOOD RD	1933	0.203	81,200.00	3,248.00
ST DAVID ST	FLEETWOOD RD	N END	1934	0.207	82,800.00	3,312.00
ST GEORGE ST	RIVERVIEW RD	KING ST	1943	0.130	52,000.00	2,080.00
ST GEORGE ST	KING ST	QUEEN ST	1944	0.073	29,200.00	1,168.00
ST GEORGE ST	QUEEN ST	DOMINION DR	1945	0.214	85,600.00	3,424.00
ST GEORGE ST	DOMINION DR	COLBORNE ST E	1947	0.207	82,800.00	3,312.00
ST GEORGE ST	NEEDHAM ST	BEVERLY ST	1949	0.165	66,000.00	2,640.00
ST GEORGE ST	BEVERLY ST	FLEETWOOD RD	1950	0.282	112,800.00	4,512.00
ST GEORGE ST	FLEETWOOD RD	N END	1952	0.108	43,200.00	1,728.00
ST JAMES ST	RIVERVIEW RD	KING ST	1954	0.125	50,000.00	2,000.00
ST JAMES ST	KING ST	QUEEN ST	1955	0.073	29,200.00	1,168.00
ST JAMES ST	QUEEN ST	DOMINION DR	1956	0.214	85,600.00	3,424.00
ST LAWRENCE ST	DURHAM ST E	MELBOURNE ST	1958	0.141	56,400.00	2,256.00
ST LAWRENCE ST	MELBOURNE ST	GLENELG ST E	1959	0.142	56,800.00	2,272.00
ST LAWRENCE ST	GLENELG ST E	RUSSELL ST E	1960	0.142	56,800.00	2,272.00
ST LAWRENCE ST	RUSSELL ST E	RIDOUT ST	1961	0.133	53,200.00	2,128.00
ST LAWRENCE ST	RIDOUT ST	KENT ST E	1962	0.042	16,800.00	672.00
ST. PATRICK ST	KING ST	QUEEN ST	1963	0.070	28,000.00	1,120.00
ST. PATRICK ST	QUEEN ST	JOHN ST	1964	0.122	48,800.00	1,952.00
ST. PATRICK ST	JOHN ST	COLBORNE ST E	1965	0.278	111,200.00	4,448.00
ST. PATRICK ST	COLBORNE ST E	DENNISTON ST	1967	0.356	142,400.00	5,696.00
ST. PATRICK ST	DENNISTON ST	NEEDHAM ST	1970	0.243	97,200.00	3,888.00
ST. PATRICK ST	NEEDHAM ST	N END	1972	0.135	54,000.00	2,160.00
ST PAUL ST	KING ST	QUEEN ST	1976	0.070	28,000.00	1,120.00
ST PAUL ST	QUEEN ST	JOHN ST	1977	0.124	49,600.00	1,984.00
ST PAUL ST	JOHN ST	COLBORNE ST E	1978	0.271	108,400.00	4,336.00
ST PAUL ST	COLBORNE ST E	DENNISTON ST	1980	0.361	144,400.00	5,776.00
ST PAUL ST	DENNISTON ST	N END	2126	0.063	25,200.00	1,008.00
ST PETER ST	SCUGOG RIVER	KING ST	2001	0.141	56,400.00	2,256.00
ST PETER ST	KING ST	QUEEN ST	2002	0.071	28,400.00	1,136.00
ST PETER ST	QUEEN ST	PR ELIZ CR (N)	2003	0.220	88,000.00	3,520.00
ST PETER ST	PR ELIZ CR (N)	COLBORNE ST E	2004	0.190	76,000.00	3,040.00
ST PETER ST	COLBORNE ST E	DENNISTON ST	2007	0.356	142,400.00	5,696.00
ST PETER ST	DENNISTON ST	NEEDHAM ST	2010	0.242	96,800.00	3,872.00
ST PETER ST	NEEDHAM ST	DERMOTT ST	2012	0.247	98,800.00	3,952.00
ST PETER ST	DERMOTT ST	N END	2014	0.340	136,000.00	5,440.00
STAPLES CR	WILSON AVE	N END	2017	0.050	20,000.00	800.00
SUNSET ST	ANGELINE ST S	E END	1126	0.185	74,000.00	2,960.00
SUSAN CT	VICTORIA AVE N	E END	2018	0.084	33,600.00	1,344.00

(ROADWAY DATA FOR LINDSAY)

Section Name	From	To	Section No.	Len (km)	Repl. Value	Depn. Value
SUSSEX ST N	KENT ST W	PEEL ST	1128	0.142	56,800.00	2,272.00
SUSSEX ST N	PEEL ST	WELLINGTON ST	1129	0.142	56,800.00	2,272.00
SUSSEX ST N	WELLINGTON ST	BOND ST	1130	0.142	56,800.00	2,272.00
SUSSEX ST N	BOND ST	FRANCIS ST	1131	0.142	56,800.00	2,272.00
SUSSEX ST N	FRANCIS ST	COLBORNE ST W	1132	0.092	36,800.00	1,472.00
SUSSEX ST S	KENT ST W	RUSSELL ST W	1993	0.125	50,000.00	2,000.00
SUSSEX ST S	RUSSELL ST W	GLENELG ST W	1994	0.142	56,800.00	2,272.00
SUSSEX ST S	GLENELG ST W	MELBOURNE ST	1995	0.142	56,800.00	2,272.00
SUSSEX ST S	MELBOURNE ST	DURHAM ST W	1996	0.126	50,400.00	2,016.00
SYLVAN CR	ALBERT ST S	WEST END	2019	0.173	69,200.00	2,768.00
SYLVESTER DR	NORTHLIN PK	KIRKCONNEL	1997	0.000	0.00	0.00
SYLVESTER DR	KIRKCONNEL	DAVID DR	1999	0.000	0.00	0.00
UNIROYAL RD	KENT ST W	LOF RD	1985	0.690	276,000.00	11,040.00
UNIROYAL RD	LOF RD	S END	1989	0.260	104,000.00	4,160.00
VERULAM RD N	QUEEN ST	COLBORNE ST E	2053	0.000	0.00	0.00
VERULAM RD N	COLBORNE ST E	MT HOPE ST	2056	0.000	0.00	0.00
VERULAM RD N	MT HOPE ST	FLEETWOOD DR	2059	0.000	0.00	0.00
VERULAM RD N	FLEETWOOD DR	N TOWN LIMITS	2064	0.000	0.00	0.00
VERULAM RD S	QUEEN ST	KAWARTHA DR	2081	0.000	0.00	0.00
VERULAM RD S	KAWARTHA DR	HILLSIDE DR	2085	0.000	0.00	0.00
VERULAM RD S	HILLSIDE DR	GEORGE ST E	2087	0.000	0.00	0.00
VERULAM RD S	GEORGE ST	MARY ST E	2090	0.000	0.00	0.00
VERULAM RD S	MARY ST E	S TOWN LIMITS	2092	0.000	0.00	0.00
VICTORIA AVE N	KENT ST W	PEEL ST	1079	0.142	56,800.00	2,272.00
VICTORIA AVE N	PEEL ST	WELLINGTON ST	1080	0.142	56,800.00	2,272.00
VICTORIA AVE N	WELLINGTON ST	BOND ST	1081	0.142	56,800.00	2,272.00
VICTORIA AVE N	BOND ST	FRANCIS ST	1082	0.142	56,800.00	2,272.00
VICTORIA AVE N	FRANCIS ST	COLBORNE ST W	1083	0.920	368,000.00	14,720.00
VICTORIA AVE N	COLBORNE ST W	REGENT ST	1084	0.142	56,800.00	2,272.00
VICTORIA AVE N	REGENT ST	ELGIN ST	1085	0.142	56,800.00	2,272.00
VICTORIA AVE N	ELGIN ST	POTTINGER ST	1086	0.142	56,800.00	2,272.00
VICTORIA AVE N	POTTINGER ST	LORI BLVD (S)	1087	0.182	72,800.00	2,912.00
VICTORIA AVE N	LORI BLVD (S)	EGLINGTON ST	1088	0.218	87,200.00	3,488.00
VICTORIA AVE N	EGLINGTON ST	ORCHARD PK RD	1089	0.270	108,000.00	4,320.00
VICTORIA AVE N	ORCHARD PK RD	FOUND AVE	1091	0.158	63,200.00	2,528.00
VICTORIA AVE N	FOUND AVE	N TOWN LIMITS	1092	0.281	112,400.00	4,496.00
VICTORIA AVE S	KENT ST W	RUSSELL ST W	1075	0.114	45,600.00	1,824.00
VICTORIA AVE S	RUSSELL ST W	GLENELG ST W	1076	0.122	48,800.00	1,952.00
VICTORIA AVE S	GLENELG ST W	MELBOURNE ST	1077	0.142	56,800.00	2,272.00
VICTORIA AVE S	MELBOURNE ST	DURHAM ST W	1078	0.128	51,200.00	2,048.00
VIMY RD	ALBERT ST S	ADELAIDE ST S	1160	0.258	103,200.00	4,128.00
WATER ST	MELBOURNE ST	GLENELG ST E	2022	0.142	56,800.00	2,272.00
WATER ST	GLENELG ST E	RUSSELL ST E	2023	0.142	56,800.00	2,272.00

(ROADWAY DATA FOR LINDSAY)

Section Name	From	To	Section No.	Len (km)	Repl. Value	Depn. Value
WATER ST	RUSSELL ST E	SCUGOG RIVER	2024	0.073	29,200.00	1,168.00
WELDON CT N	WELDON CT	NE BEND	2077	0.260	104,000.00	4,160.00
WELDON CT S	NORTHLIN PK	SANDERLING CR	2074	0.450	180,000.00	7,200.00
WELLINGTON ST	LINDSAY ST N	SCUGOG RIVER	1133	0.000	0.00	0.00
WELLINGTON ST	SCUGOG RIVER	WILLIAM ST N	1134	0.000	0.00	0.00
WELLINGTON ST	WILLIAM ST N	CAMBRIDGE ST	1135	0.174	69,600.00	2,784.00
WELLINGTON ST	CAMBRIDGE ST	VICTORIA AVE	1137	0.103	41,200.00	1,648.00
WELLINGTON ST	VICTORIA AVE	SUSSEX ST N	1138	0.103	41,200.00	1,648.00
WELLINGTON ST	SUSSEX ST N	ALBERT ST N	1139	0.172	68,800.00	2,752.00
WESTWOOD CT	NORTHLIN PK	WEST END	2039	0.128	51,200.00	2,048.00
WHITNEY CT	FOUND AVE	NORTH END	2000	0.125	50,000.00	2,000.00
WILLIAM BOOTH	EGLINGTON ST	NORTH END	2037	0.170	68,000.00	2,720.00
WILLIAM ST N	KENT ST W	PEEL ST	2103	0.142	56,800.00	2,272.00
WILLIAM ST N	PEEL ST	WELLINGTON ST	2104	0.142	56,800.00	2,272.00
WILLIAM ST N	WELLINGTON ST	BOND ST	2105	0.144	57,600.00	2,304.00
WILLIAM ST N	BOND ST	FRANCIS ST	2106	0.142	56,800.00	2,272.00
WILLIAM ST N	FRANCIS ST	COLBORNE ST W	2107	0.092	36,800.00	1,472.00
WILLIAM ST N	COLBORNE ST W	REGENT ST	2108	0.141	56,400.00	2,256.00
WILLIAM ST N	REGENT ST	ELGIN ST	2109	0.141	56,400.00	2,256.00
WILLIAM ST N	ELGIN ST	POTTINGER ST	2110	0.141	56,400.00	2,256.00
WILLIAM ST N	POTTINGER ST	DANIEL CT	2111	0.217	86,800.00	3,472.00
WILLIAM ST N	DANIEL CT	EGLINGTON ST	2113	0.184	73,600.00	2,944.00
WILLIAM ST N	EGLINGTON ST	ORCHARD PK RD	2115	0.260	104,000.00	4,160.00
WILLIAM ST N	ORCHARD PK RD	FOUND AVE	2117	0.169	67,600.00	2,704.00
WILLIAM ST N	FOUND AVE	N TOWN LIMITS	2118	0.255	102,000.00	4,080.00
WILLIAM ST S	KENT ST W	RUSSELL ST W	2025	0.124	49,600.00	1,984.00
WILLIAM ST S	RUSSELL ST W	GLENELG ST W	2026	0.142	56,800.00	2,272.00
WILLIAM ST S	GLENELG ST W	MELBOURNE ST	2027	0.142	56,800.00	2,272.00
WILLIAM ST S	MELBOURNE ST	DURHAM ST W	2028	0.137	54,800.00	2,192.00
WILSON AVE	ANGELINE ST S	PEARSON ST	2029	0.245	98,000.00	3,920.00
WILSON AVE	PEARSON ST	MARY ST W	2031	0.250	100,000.00	4,000.00
WILSON AVE	MARY ST W	N END	2033	0.075	30,000.00	1,200.00
WOLFE ST	DURHAM ST E	GEORGE ST E	3012	0.216	86,400.00	3,456.00
WOLFE ST	GEORGE ST E	DIVISION ST	3014	0.104	41,600.00	1,664.00
WOLFE ST	DIVISION ST	MARY ST E	3015	0.099	39,600.00	1,584.00
YORK ST N	KENT ST W	PEEL ST	2123	0.122	48,800.00	1,952.00
YORK ST S	KENT ST W	RUSSELL ST W	2124	0.122	48,800.00	1,952.00

TOTALS

95.055 38,022,000.00 1,520,880.00

Appendix B

APPLICATION OF RECAPITALIZATION MODEL TO THE CITY OF LINDSAY, ONTARIO

SEWER SYSTEM DATA

REPLACEMENT/DEPRECIATION COSTS (MANHOLES + SEWERS)

AVERAGE UNIT PRICES FOR

Manholes	: \$2500 each
Sewers	
150 mm dia	: \$ 100 per metre
200 mm dia	: \$ 115 per metre
225 mm dia	: \$ 118 per metre
250 mm dia	: \$ 120 per metre
300 mm dia	: \$ 130 per metre
350 mm dia	: \$ 140 per metre
375 mm dia	: \$ 145 per metre
400 mm dia	: \$ 160 per metre
450 mm dia	: \$ 170 per metre
500 mm dia	: \$ 178 per metre
525 mm dia	: \$ 181 per metre
600 mm dia	: \$ 242 per metre
675 mm dia	: \$ 302 per metre
750 mm dia	: \$ 361 per metre

Also enclosed is a hardcopy of the existing data structure and a floppy containing the following files:

SEWERS.DAT : Containing the original, unmodified system data in a text file

SEWERS.DEF : Containing the system database file

SEWERS.FRM : Containing the report format for the database file

README.DOC : Contains the current text, being read.

Re: Structure of "SEWERS.DEF" file

The sewer system data for the City of Lindsay is stored in the dBase III file, named as "SEWERS.DEF". The file consists of 15 fields, each containing 1054 records.

The structure of the database is as shown below:

Field No.	Field Name	Type	Width	Decimal
1	FROMMH	Char	7	-
2	TOMH	Char	7	-
3	NUMOFMH	Num	6	-
4	MHREPVAL	Num	6	-
5	MHDEPVAL	Num	6	2
6	PIPETYPE	Num	2	-
7	DIAMETER	Num	5	-
8	LENGTH	Num	6	2
9	PIPEREPVAL	Num	6	2
10	PIPEDEPVAL	Num	6	2
11	TOTREPVAL	Num	8	2
12	TOTDEPVAL	Num	8	2
13	UP-MH-1	Char	7	-
14	UP-MH-2	Char	7	-
15	UP-MH-3	Char	7	-

MHREPVAL	=	NUMOFMH * (\$2500 per manhole)
MHDEPVAL	=	MHREPVAL / Design life = MHREPVAL / 50 yrs
PIPEREPVAL	=	LENGTH * (Replacement cost per metre length)
PIPEDEPVAL	=	PIPEREPVAL / Design life = PIPEREPVAL / 50 yrs
TOTREPVAL	=	PIPEREPVAL + MHREPVAL
TOTDEPVAL	=	PIPEDEPVAL + MHDEPVAL

CITY OF LINDSAY
SEWER SYSTEM DATA

FROM MANHOLE	TO MANHOLE	# OF DES	REPAIR (MIL \$)	DEP. VAL (MIL \$)	DIAMETER (mm)	LENGTH (feet)	REP. VAL (Dps \$)	DEP. VAL (Dps \$)	FEF. VAL Total \$	DEP. VAL Total \$
HF	HE	1	2500	50.00	200	118.00	13,570.00	271.40	16,070.00	321.40
HH	HG	1	2500	50.00	200	121.60	13,984.00	279.68	16,484.00	329.68
HG	HE	1	2500	50.00	200	119.20	13,708.00	274.16	16,208.00	324.16
HE	HD	1	2500	50.00	300	115.00	14,950.00	299.00	17,450.00	349.00
HD	HC	1	2500	50.00	300	116.50	15,145.00	302.90	17,645.00	352.90
HC	HB	1	2500	50.00	300	84.70	11,011.00	220.22	13,511.00	270.22
HB	GY	1	2500	50.00	300	77.90	10,127.00	202.54	12,627.00	252.54
HA	GZ	1	2500	50.00	200	91.40	10,511.00	210.22	13,011.00	260.22
GZ	GY	1	2500	50.00	200	67.40	7,751.00	155.02	10,251.00	205.02
GY	QX	1	2500	50.00	300	62.20	8,086.00	161.72	10,586.00	211.72
GV	GT	1	2500	50.00	200	101.80	11,707.00	234.14	14,207.00	284.14
GU	GT	1	2500	50.00	200	71.90	8,268.50	165.37	10,768.50	215.37
GT	GS	1	2500	50.00	200	105.40	12,121.00	242.42	14,621.00	292.42
GS	GR	1	2500	50.00	200	117.00	13,455.00	269.10	15,955.00	319.10
GP	GR	1	2500	50.00	200	125.00	14,375.00	287.50	16,875.00	337.50
GQ	GR	1	2500	50.00	200	61.00	7,015.00	140.30	9,515.00	190.30
GR	GW	1	2500	50.00	200	98.80	11,362.00	227.24	13,862.00	277.24
GW	GX	1	2500	50.00	200	12.20	1,403.00	28.06	3,903.00	78.06
GX	PUMP	1	2500	50.00	300	12.50	1,625.00	32.50	4,125.00	82.50
O	DG	1	2500	50.00	200	124.50	14,318.00	286.36	16,818.00	336.36
DG	DF	1	2500	50.00	200	44.80	5,152.00	103.04	7,652.00	153.04
DC	DB	1	2500	50.00	200	48.30	5,554.50	111.09	8,054.50	161.09
MMZ	DB	1	2500	50.00	200	93.00	10,695.00	213.90	13,195.00	263.90
DB	DA	1	2500	50.00	200	39.40	4,531.00	90.62	7,031.00	140.62
DA	CZ	1	2500	50.00	200	57.80	6,647.00	132.94	9,147.00	182.94
KKZ	KKY	1	2500	50.00	200	29.70	3,415.50	68.31	5,915.50	118.31
KIX	KKY	1	2500	50.00	200	18.70	2,150.50	43.01	4,650.50	93.01
KKY	CY	1	2500	50.00	200	40.70	4,680.50	93.61	7,180.50	143.61
CY	CZ	1	2500	50.00	200	63.00	7,245.00	144.90	9,745.00	194.90
CZ	CX	1	2500	50.00	200	80.30	9,234.50	184.69	11,734.50	234.69
CW	CX	1	2500	50.00	200	69.50	7,992.50	159.85	10,492.50	209.85
CX	DE	1	2500	50.00	200	77.00	8,855.00	177.10	11,355.00	227.10
DE	DD	1	2500	50.00	200	79.70	9,165.50	183.31	11,665.50	233.31
DD	DF	1	2500	50.00	200	121.30	13,950.00	279.00	16,450.00	329.00
DF	DH	1	2500	50.00	250	61.40	7,368.00	147.36	9,868.00	197.36
DJ	DI	1	2500	50.00	225	86.30	10,183.00	203.66	12,683.00	253.66
DI	DH	1	2500	50.00	225	86.00	10,148.00	202.96	12,648.00	252.96
DN	DM	1	2500	50.00	225	72.40	8,543.20	170.86	11,043.20	220.86
DM	DL	1	2500	50.00	225	70.60	8,330.80	166.62	10,830.80	216.62
DL	OK	1	2500	50.00	225	99.00	11,682.00	233.64	14,182.00	283.64
OK	DH	1	2500	50.00	225	102.10	12,048.00	240.96	14,548.00	290.96
DH	LLY	1	2500	50.00	300	68.10	8,853.00	177.06	11,353.00	227.06

CITY OF LINDSAY
SEWER SYSTEM DATA

FROM MANHOLE	TO MANHOLE	# OF PIPS	REP. VAL. (PIPS)	DEP. VAL. (PIPS)	DIAMETER (in)	LENGTH (feet)	REP. VAL. (PIPS)	DEP. VAL. (PIPS)	REP. VAL. Total	DEP. VAL. Total
LLW	LLX	1	2500	50.00	200	82.00	9,430.00	188.60	11,930.00	238.60
LLX	LLY	1	2500	50.00	200	91.70	10,546.00	210.92	13,046.00	260.92
MMC	MMB	1	2500	50.00	200	58.00	6,670.00	133.40	9,170.00	183.40
MMB	MMA	1	2500	50.00	200	74.60	8,579.00	171.58	11,079.00	221.58
MMA	LLZ	1	2500	50.00	200	102.70	11,810.00	236.20	14,310.00	286.20
LLZ	LLY	1	2500	50.00	200	102.00	11,730.00	234.60	14,230.00	284.60
LLY	DV	1	2500	50.00	225	126.40	14,915.00	298.30	17,415.00	348.30
DV	DW	1	2500	50.00	225	61.30	7,233.40	144.67	9,733.40	194.67
GGG	GGF	1	2500	50.00	200	63.90	7,348.50	146.97	9,848.50	196.97
GGF	GGE	1	2500	50.00	200	91.10	10,476.00	209.52	12,976.00	259.52
GGE	GGD	1	2500	50.00	200	90.90	10,454.00	209.08	12,954.00	259.08
GGD	EA	1	2500	50.00	200	81.20	9,338.00	186.76	11,838.00	236.76
EA	DZ	1	2500	50.00	200	39.30	4,519.50	90.39	7,019.50	140.39
DZ	DY	1	2500	50.00	200	89.20	10,258.00	205.16	12,758.00	255.16
DY	DX	1	2500	50.00	200	99.50	11,442.00	228.84	13,942.00	278.84
DX	DW	1	2500	50.00	300	104.40	13,572.00	271.44	16,072.00	321.44
DW	EN	1	2500	50.00	300	122.70	15,951.00	318.02	18,451.00	369.02
EN	EO	1	2500	50.00	300	102.70	13,351.00	267.02	15,851.00	317.02
OOH	OOG	1	2500	50.00	200	106.20	12,213.00	244.26	14,713.00	294.26
OOG	OOF	1	2500	50.00	200	89.90	10,338.00	206.76	12,838.00	256.76
OOF	OOE	1	2500	50.00	200	91.20	10,488.00	209.76	12,988.00	259.76
OOE	OOD	1	2500	50.00	250	68.90	8,268.00	165.36	10,768.00	215.36
OOD	OOC	1	2500	50.00	250	74.80	8,976.00	179.52	11,476.00	229.52
OOC	OOB	1	2500	50.00	375	82.70	11,992.00	239.84	14,492.00	289.84
OOB	IIZ	1	2500	50.00	375	83.20	12,064.00	241.28	14,564.00	291.28
JJE	JJD	1	2500	50.00	200	56.80	6,532.00	130.64	9,032.00	180.64
JJD	JJC	1	2500	50.00	200	42.00	4,830.00	96.60	7,330.00	146.60
JJC	JJB	1	2500	50.00	200	94.20	10,833.00	216.66	13,333.00	266.66
JJB	OOY	1	2500	50.00	200	20.40	2,346.00	46.92	4,846.00	96.92
OOZ	OOY	1	2500	50.00	200	74.50	8,567.50	171.35	11,067.50	221.35
OOY	JJA	1	2500	50.00	200	70.10	8,061.50	161.23	10,561.50	211.23
JJA	IIZ	1	2500	50.00	200	95.10	10,936.00	218.72	13,436.00	268.72
IIZ	IİY	1	2500	50.00	400	66.30	10,608.00	212.16	13,108.00	262.16
IİY	IIX	1	2500	50.00	400	78.00	12,480.00	249.60	14,980.00	299.60
IIX	IIW	1	2500	50.00	400	52.30	8,368.00	167.36	10,868.00	217.36
IIW	IIV	1	2500	50.00	400	39.00	6,240.00	124.80	8,740.00	174.80
IIV	IIU	1	2500	50.00	400	35.00	5,600.00	112.00	8,100.00	162.00
IIU	EI	1	2500	50.00	400	18.70	2,992.00	59.84	5,492.00	109.84
EN	EL	1	2500	50.00	200	63.00	7,245.00	144.90	9,745.00	194.90
EL	EK	1	2500	50.00	200	82.00	9,430.00	188.60	11,930.00	238.60
EK	EJ	1	2500	50.00	200	83.20	9,568.00	191.36	12,068.00	241.36
EJ	EI	1	2500	50.00	200	164.50	18,918.00	378.36	21,418.00	428.36

CITY OF LINDSAY
SEWER SYSTEM DATA

FROM MANHOLE	TO MANHOLE	# OF DES	REP. VAL. (MILE)	DEP. VAL. (MILE)	DIAMETER (mm)	LENGTH FOOT	REP. VAL. (DOLLAR)	DEP. VAL. (DOLLAR)	REP. VAL. TOTAL \$	DEP. VAL. TOTAL \$
EI	EH	1	2500	50.00	300	109.50	14,235.00	284.70	16,735.00	334.70
EB	EC	1	2500	50.00	200	85.10	9,786.50	195.73	12,286.50	245.73
EC	ED	1	2500	50.00	200	29.50	3,392.50	67.85	5,892.50	117.85
ED	EE	1	2500	50.00	200	111.30	12,800.00	256.00	15,300.00	306.00
EE	EF	1	2500	50.00	200	90.70	10,430.00	208.60	12,930.00	258.60
EF	EG	1	2500	50.00	200	91.10	10,476.00	209.52	12,976.00	259.52
EG	EH	1	2500	50.00	200	82.30	9,464.50	189.29	11,964.50	239.29
EH	EO	1	2500	50.00	300	126.10	16,393.00	327.86	18,893.00	377.86
EO	EP	1	2500	50.00	300	42.80	5,564.00	111.28	8,064.00	161.28
EP	EQ	1	2500	50.00	300	27.60	3,588.00	71.76	6,088.00	121.76
EQ	ER	1	2500	50.00	300	90.00	11,700.00	234.00	14,200.00	284.00
ER	KKF	1	2500	50.00	400	14.50	2,320.00	46.40	4,820.00	96.40
KKF	KKG	1	2500	50.00	400	67.10	10,736.00	214.72	13,236.00	264.72
KKG	KKH	1	2500	50.00	400	11.20	1,792.00	35.84	4,292.00	85.84
KKH	PUMP	1	2500	50.00	0	2.60	0.00	0.00	2,500.00	50.00
JS	JR	1	2500	50.00	225	88.20	10,408.00	208.16	12,908.00	258.16
JR	JP	1	2500	50.00	225	66.80	7,882.40	157.65	10,382.40	207.65
QM	JQ	1	2500	50.00	225	80.80	9,534.40	190.69	12,034.40	240.69
JQ	JP	1	2500	50.00	225	122.80	14,490.00	289.80	16,990.00	339.80
JP	JO	1	2500	50.00	225	90.20	10,644.00	212.88	13,144.00	262.88
JO	JM	1	2500	50.00	225	161.20	19,022.00	380.44	21,522.00	430.44
JN	JM	1	2500	50.00	225	172.20	20,320.00	406.40	22,820.00	456.40
JM	JL	1	2500	50.00	225	73.80	8,708.40	174.17	11,208.40	224.17
JL	JE	1	2500	50.00	225	67.10	7,917.80	158.36	10,417.80	208.36
JI	JH	1	2500	50.00	225	109.10	12,874.00	257.48	15,374.00	307.48
JH	JF	1	2500	50.00	225	120.70	14,243.00	284.86	16,743.00	334.86
JG	JF	1	2500	50.00	200	152.10	17,492.00	349.84	19,992.00	399.84
JF	JE	1	2500	50.00	225	120.70	14,243.00	284.86	16,743.00	334.86
JK	JJ	1	2500	50.00	225	81.80	9,652.40	193.05	12,152.40	243.05
JJ	JE	1	2500	50.00	225	85.20	10,054.00	201.08	12,554.00	251.08
JE	JD	1	2500	50.00	225	73.80	8,708.40	174.17	11,208.40	224.17
JD	IO	1	2500	50.00	225	67.10	7,917.80	158.36	10,417.80	208.36
IS	IQ	1	2500	50.00	200	98.10	11,282.00	225.64	13,782.00	275.64
IR	IQ	1	2500	50.00	200	82.30	9,464.50	189.29	11,964.50	239.29
IQ	IP	1	2500	50.00	200	67.70	7,785.50	155.71	10,285.50	205.71
IP	IO	1	2500	50.00	225	53.60	6,324.80	126.50	8,824.80	176.50
JC	JB	1	2500	50.00	225	85.80	10,124.00	202.48	12,624.00	252.48
JB	JA	1	2500	50.00	225	85.80	10,124.00	202.48	12,624.00	252.48
JA	IZ	1	2500	50.00	225	68.30	8,059.40	161.19	10,559.40	211.19
IZ	IX	1	2500	50.00	225	69.50	8,201.00	164.02	10,701.00	214.02
IY	JJO	1	2500	50.00	225	82.00	9,676.00	193.52	12,176.00	243.52
JJO	IX	1	2500	50.00	225	91.40	10,785.00	215.70	13,285.00	265.70

CITY OF LINDSAY
SEWER SYSTEM DATA

FROM MANHOLE	TO MANHOLE	# OF PIS	REP. VAL. (MILE)	DEP. VAL. (MILE)	DIAMETER (IN)	LENGTH (FEET)	REP. VAL. (DOLLAR)	DEP. VAL. (DOLLAR)	REP. VAL. TOTAL	DEP. VAL. TOTAL
IX	IW	1	2500	50.00	225	73.10	8,625.80	172.52	11,125.80	222.52
IW	IJ	1	2500	50.00	225	68.90	8,130.20	162.60	10,630.20	212.60
IV	IIM	1	2500	50.00	225	70.90	8,366.20	167.32	10,866.20	217.32
IIM	IU	1	2500	50.00	225	69.50	8,201.00	164.02	10,701.00	214.02
IU	IT	1	2500	50.00	225	111.90	13,204.00	264.08	15,704.00	314.08
IT	IO	1	2500	50.00	225	119.90	14,148.00	282.96	16,648.00	332.96
IO	ID	1	2500	50.00	225	140.80	16,614.00	332.28	19,114.00	382.28
IG	IF	1	2500	50.00	225	88.10	10,396.00	207.92	12,896.00	257.92
IH	IF	1	2500	50.00	200	107.60	12,374.00	247.48	14,874.00	297.48
IF	IE	1	2500	50.00	225	120.40	14,207.00	284.14	16,707.00	334.14
IE	ID	1	2500	50.00	225	120.10	14,172.00	283.44	16,672.00	333.44
IM	IL	1	2500	50.00	225	64.30	7,587.40	151.75	10,087.40	201.75
IL	IJ	1	2500	50.00	225	78.20	9,227.60	184.55	11,727.60	234.55
IN	IJ	1	2500	50.00	225	113.40	13,381.00	267.62	15,881.00	317.62
IK	IJ	1	2500	50.00	225	120.90	14,266.00	285.32	16,766.00	335.32
IJ	II	1	2500	50.00	225	78.60	9,274.80	185.50	11,774.80	235.50
II	ID	1	2500	50.00	225	113.10	13,346.00	266.92	15,846.00	316.92
ID	IA	1	2500	50.00	300	139.30	18,109.00	382.18	20,609.00	412.18
IC	IB	1	2500	50.00	225	81.10	9,569.80	191.40	12,069.80	241.40
IB	IA	1	2500	50.00	225	97.50	11,505.00	230.10	14,035.00	280.10
IA	HZ	1	2500	50.00	300	17.50	2,275.00	45.50	4,775.00	95.50
HZ	HY	1	2500	50.00	300	36.50	4,745.00	94.90	7,245.00	144.90
HY	HX	1	2500	50.00	400	69.50	11,120.00	222.40	13,620.00	272.40
HX	STA	1	2500	50.00	450	23.10	3,927.00	78.54	6,427.00	128.54
PUMP	XZ	1	2500	50.00	300	75.00	9,750.00	195.00	12,250.00	245.00
XZ	XY	1	2500	50.00	300	124.50	16,185.00	323.70	18,685.00	373.70
XY	XX	1	2500	50.00	300	94.20	12,246.00	244.92	14,746.00	294.92
XX	XW	1	2500	50.00	300	94.30	12,259.00	245.18	14,759.00	295.18
XW	XT	1	2500	50.00	300	10.20	1,326.00	26.52	3,826.00	76.52
XV	XU	1	2500	50.00	200	100.90	11,604.00	232.08	14,104.00	282.08
XU	XT	1	2500	50.00	200	101.50	11,672.00	233.44	14,172.00	283.44
XT	XS	1	2500	50.00	200	102.60	11,799.00	235.98	14,299.00	285.98
XL	XM	1	2500	50.00	250	74.50	8,940.00	178.80	11,440.00	228.80
XM	XN	1	2500	50.00	250	77.00	9,240.00	184.80	11,740.00	234.80
XI	XJ	1	2500	50.00	200	58.30	6,704.50	134.09	9,204.50	184.09
XJ	XK	1	2500	50.00	200	67.10	7,716.50	154.33	10,216.50	204.33
XK	XN	1	2500	50.00	200	17.70	2,035.50	40.71	4,535.50	90.71
XN	XO	1	2500	50.00	250	91.00	10,920.00	218.40	13,420.00	268.40
XO	XP	1	2500	50.00	250	91.70	11,004.00	220.08	13,504.00	270.08
XP	XQ	1	2500	50.00	250	92.20	11,064.00	221.28	13,564.00	271.28
XQ	YR	1	2500	50.00	250	91.10	10,932.00	218.64	13,432.00	268.64
XR	XS	1	2500	50.00	250	93.10	11,172.00	223.44	13,672.00	273.44

CITY OF LINDSAY
SEWER SYSTEM DATA

FROM MANHOLE	TO MANHOLE	# OF (FEET)	REP. VAL. (DIPS)	DEP. VAL. (DIPS)	DIAMETER (mm)	LENGTH (FEET)	REP. VAL. (DIPS)	DEP. VAL. (DIPS)	REP. VAL. TOTAL \$	DEP. VAL. TOTAL \$
XS	YA	1	2500	50.00	250	13.60	1,632.00	32.64	4,132.00	82.64
YA	YB	1	2500	50.00	250	90.00	10,800.00	216.00	13,300.00	266.00
YB	YC	1	2500	50.00	250	93.10	11,172.00	223.44	13,672.00	273.44
YC	YD	1	2500	50.00	250	90.40	10,848.00	216.96	13,348.00	266.96
YD	YE	1	2500	50.00	250	90.40	10,848.00	216.96	13,348.00	266.96
YE	YF	1	2500	50.00	250	91.70	11,004.00	220.08	13,504.00	270.08
YF	YG	1	2500	50.00	250	89.70	10,764.00	215.28	13,264.00	265.28
YG	YH	1	2500	50.00	250	90.00	10,800.00	216.00	13,300.00	266.00
YH	YI	1	2500	50.00	250	89.30	10,716.00	214.32	13,216.00	264.32
YI	YJ	1	2500	50.00	250	97.90	11,748.00	234.96	14,248.00	284.96
YJ	YK	1	2500	50.00	250	97.20	11,664.00	233.28	14,164.00	283.28
YK	YL	1	2500	50.00	250	93.60	11,232.00	224.64	13,732.00	274.64
YL	YM	1	2500	50.00	300	92.30	11,999.00	239.98	14,499.00	289.98
YM	YN	1	2500	50.00	300	91.00	11,830.00	236.60	14,330.00	286.60
YN	YO	1	2500	50.00	300	92.00	11,960.00	239.20	14,460.00	289.20
YO	YP	1	2500	50.00	300	91.80	11,934.00	238.68	14,434.00	288.68
YP	IIA	1	2500	50.00	300	62.00	8,060.00	161.20	10,560.00	211.20
HHL	HHM	1	2500	50.00	200	92.10	10,592.00	211.84	13,092.00	261.84
HHM	HHN	1	2500	50.00	200	91.10	10,476.00	209.52	12,976.00	259.52
HHN	HHO	1	2500	50.00	200	54.60	6,279.00	125.58	8,779.00	175.58
HHO	HHP	1	2500	50.00	200	46.20	5,313.00	106.26	7,813.00	156.26
HHP	HHQ	1	2500	50.00	200	46.00	5,290.00	105.80	7,790.00	155.80
HHT	HHS	1	2500	50.00	200	48.80	5,612.00	112.24	8,112.00	162.24
HHS	HHR	1	2500	50.00	200	106.70	12,270.00	245.40	14,770.00	295.40
HHR	HHQ	1	2500	50.00	200	106.70	12,270.00	245.40	14,770.00	295.40
HHQ	HHX	1	2500	50.00	200	49.80	5,727.00	114.54	8,227.00	164.54
HHU	HHV	1	2500	50.00	200	120.40	13,846.00	276.92	16,346.00	326.92
HHV	HHW	1	2500	50.00	200	76.20	8,763.00	175.26	11,263.00	225.26
HHW	HHX	1	2500	50.00	200	76.20	8,763.00	175.26	11,263.00	225.26
HHX	HHY	1	2500	50.00	200	91.70	10,546.00	210.92	13,046.00	260.92
HHY	HHZ	1	2500	50.00	200	94.30	10,844.00	216.88	13,344.00	266.88
HHZ	IIA	1	2500	50.00	200	40.50	4,657.50	93.15	7,157.50	143.15
IIA	YQ	1	2500	50.00	300	25.50	3,315.00	66.30	5,815.00	116.30
YQ	YR	1	2500	50.00	300	90.40	11,752.00	235.04	14,252.00	285.04
YR	YS	1	2500	50.00	300	91.60	11,908.00	238.16	14,408.00	288.16
YS	YT	1	2500	50.00	300	91.50	11,895.00	237.90	14,395.00	287.90
YT	YU	1	2500	50.00	300	93.20	12,116.00	242.32	14,616.00	292.32
YU	YV	1	2500	50.00	300	89.00	11,570.00	231.40	14,070.00	281.40
HHK	HHJ	1	2500	50.00	200	67.40	7,751.00	155.02	10,251.00	205.02
HHJ	HHI	1	2500	50.00	200	66.10	7,601.50	152.03	10,101.50	202.03
HHI	YW	1	2500	50.00	200	101.80	11,707.00	234.14	14,207.00	284.14
HHH	YY	1	2500	50.00	200	115.20	13,248.00	264.96	15,748.00	314.96

CITY OF LINDSAY
SEWER SYSTEM DATA

FROM MANHOLE	TO MANHOLE	# OF SEG	REP. VAL (MILE)	DEP. VAL (MILE)	DIAMETER (mm)	LENGTH (feet)	REP. VAL (DOLLAR)	DEP. VAL (DOLLAR)	REP. VAL TOTAL \$	DEP. VAL TOTAL \$
YY	YX	1	2500	50.00	200	78.30	9,004.50	180.09	11,504.50	230.09
ZK	ZJ	1	2500	50.00	200	24.70	2,840.50	56.81	5,340.50	106.81
ZJ	ZH	1	2500	50.00	200	21.90	2,518.50	50.37	5,018.50	100.37
ZI	ZH	1	2500	50.00	200	76.80	8,832.00	176.64	11,332.00	226.64
ZH	ZG	1	2500	50.00	200	59.70	6,865.50	137.31	9,365.50	187.31
ZG	ZF	1	2500	50.00	200	40.20	4,623.00	92.46	7,123.00	142.46
ZF	ZE	1	2500	50.00	200	16.10	1,851.50	37.03	4,351.50	87.03
ZN	ZM	1	2500	50.00	200	53.30	6,129.50	122.59	8,629.50	172.59
ZM	ZL	1	2500	50.00	200	28.30	3,254.50	65.09	5,754.50	115.09
ZL	ZE	1	2500	50.00	200	87.20	10,028.00	200.56	12,528.00	250.56
ZE	GGJ	1	2500	50.00	200	74.40	8,556.00	171.12	11,056.00	221.12
GGJ	GGK	1	2500	50.00	200	75.30	8,659.50	173.19	11,159.50	223.19
ZD	ZC	1	2500	50.00	200	88.70	10,200.00	204.00	12,700.00	254.00
ZC	GGK	1	2500	50.00	200	99.40	11,431.00	228.62	13,931.00	278.62
GGK	ZB	1	2500	50.00	200	33.50	3,852.50	77.05	6,352.50	127.05
ZB	ZA	1	2500	50.00	200	36.00	4,140.00	82.80	6,640.00	132.80
ZA	YZ	1	2500	50.00	200	91.40	10,511.00	210.22	13,011.00	260.22
YZ	YX	1	2500	50.00	200	101.20	11,638.00	232.76	14,136.00	282.76
YX	YW	1	2500	50.00	200	126.50	14,548.00	290.96	17,048.00	340.96
YW	YV	1	2500	50.00	200	19.80	2,277.00	45.54	4,777.00	95.54
YV	ZO	1	2500	50.00	200	93.90	10,798.00	215.96	13,298.00	265.96
ZQ	ZP	1	2500	50.00	200	81.80	9,407.00	188.14	11,907.00	238.14
ZP	ZC	1	2500	50.00	300	4.70	611.00	12.22	3,111.00	62.22
AAI	AAH	1	2500	50.00	200	104.20	11,983.00	239.66	14,483.00	289.66
AAH	AAD	1	2500	50.00	200	53.30	6,129.50	122.59	8,629.50	172.59
AAG	AAF	1	2500	50.00	200	46.30	5,324.50	106.49	7,824.50	156.49
AAF	AAE	1	2500	50.00	200	45.70	5,255.50	105.11	7,755.50	155.11
AAE	AAD	1	2500	50.00	200	47.70	5,485.50	109.71	7,985.50	159.71
AAD	ZO	1	2500	50.00	200	93.90	10,798.00	215.96	13,298.00	265.96
ZO	ZR	1	2500	50.00	300	92.00	11,860.00	239.20	14,460.00	289.20
AAO	AAM	1	2500	50.00	200	83.50	9,602.50	192.05	12,102.50	242.05
AAN	AAM	1	2500	50.00	200	91.70	10,546.00	210.92	13,046.00	260.92
AAM	AAL	1	2500	50.00	200	63.70	7,325.50	146.51	9,825.50	196.51
AAL	AAK	1	2500	50.00	200	100.60	11,569.00	231.38	14,069.00	281.38
AAK	AAJ	1	2500	50.00	200	31.40	3,611.00	72.22	6,111.00	122.22
AAJ	ZR	1	2500	50.00	200	140.20	16,123.00	322.46	18,523.00	372.46
ZR	ZS	1	2500	50.00	300	90.50	11,765.00	235.30	14,265.00	285.30
ZX	ZW	1	2500	50.00	200	60.70	6,980.50	139.61	9,480.50	189.61
ZW	ZT	1	2500	50.00	200	62.50	7,187.50	143.75	9,687.50	193.75
ZV	ZU	1	2500	50.00	200	68.90	7,923.50	158.47	10,423.50	208.47
ZU	ZT	1	2500	50.00	200	87.90	10,108.00	202.16	12,608.00	252.16
ZT	ZS	1	2500	50.00	200	10.10	1,161.50	23.23	3,661.50	73.23

CITY OF LINDSAY
SEWER SYSTEM DATA

FROM MANHOLE	TO MANHOLE	PCP DEG	REP. VAL. (DOLL.)	DEP. VAL. (DOLL.)	DIAMETER (IN)	LENGTH FEET	REP. VAL. (DOLL.)	DEP. VAL. (DOLL.)	REP. VAL. TOTAL	DEP. VAL. TOTAL
AAC	AAB	1	2500	50.00	200	91.20	10,488.00	209.76	12,988.00	259.76
AAB	ZZ	1	2500	50.00	200	43.70	5,025.50	100.51	7,525.50	150.51
AAA	ZZ	1	2500	50.00	200	38.40	4,416.00	88.32	6,916.00	138.32
ZZ	ZY	1	2500	50.00	200	58.00	6,670.00	133.40	9,170.00	183.40
ZY	ZS	1	2500	50.00	200	36.60	4,209.00	84.18	6,709.00	134.18
ZS	AAP	1	2500	50.00	300	91.70	11,921.00	238.42	14,421.00	288.42
AAP	AAQ	1	2500	50.00	300	89.60	11,648.00	232.96	14,148.00	282.96
AAQ	AAR	1	2500	50.00	300	54.90	7,137.00	142.74	9,637.00	192.74
HHG	HHF	1	2500	50.00	200	120.70	13,880.00	277.60	16,380.00	327.60
KKI	HHD	1	2500	50.00	200	49.00	5,535.00	112.70	8,135.00	162.70
HHD	HHE	1	2500	50.00	200	64.30	7,394.50	147.89	9,894.50	197.89
HHE	HHF	1	2500	50.00	200	80.50	9,257.50	185.15	11,757.50	235.15
HHF	AAV	1	2500	50.00	200	67.40	7,751.00	155.02	10,251.00	205.02
AAV	AAX	1	2500	50.00	200	37.20	4,278.00	85.56	6,778.00	135.56
AAX	AAW	1	2500	50.00	200	54.60	6,279.00	125.58	8,779.00	175.58
AAW	AAU	1	2500	50.00	200	70.90	8,153.50	163.07	10,653.50	213.07
AAU	AAU	1	2500	50.00	200	71.30	8,199.50	163.99	10,699.50	213.99
AAU	AAT	1	2500	50.00	200	99.40	11,431.00	228.62	13,931.00	278.62
BBE	BBD	1	2500	50.00	200	72.90	8,383.50	167.67	10,883.50	217.67
BBD	BBC	1	2500	50.00	200	84.10	9,671.50	193.43	12,171.50	243.43
BBC	BBB	1	2500	50.00	200	81.80	9,407.00	188.14	11,907.00	238.14
BBG	BBF	1	2500	50.00	200	63.20	7,268.00	145.36	9,768.00	195.36
BBF	BBB	1	2500	50.00	200	62.20	7,153.00	143.06	9,653.00	193.06
BBB	BBA	1	2500	50.00	200	2.70	4,910.50	98.21	7,410.50	148.21
BBA	AAZ	1	2500	50.00	200	82.60	9,499.00	189.98	11,999.00	239.98
AAZ	AAT	1	2500	50.00	200	61.00	7,015.00	140.30	9,515.00	190.30
AAT	AAS	1	2500	50.00	250	36.30	4,356.00	87.12	6,856.00	137.12
AAS	AAR	1	2500	50.00	250	56.80	6,816.00	136.32	9,316.00	186.32
AAR	BBH	1	2500	50.00	350	91.60	12,824.00	256.48	15,324.00	306.48
BBH	GGI	1	2500	50.00	350	91.70	12,838.00	256.76	15,338.00	306.76
GGI	BBI	1	2500	50.00	350	26.60	3,724.00	74.48	6,224.00	124.48
CCQ	CCP	1	2500	50.00	200	54.40	6,256.00	125.12	8,756.00	175.12
CCP	CCO	1	2500	50.00	200	78.90	9,073.50	181.47	11,573.50	231.47
CCO	CCN	1	2500	50.00	200	79.90	9,188.50	183.77	11,688.50	233.77
CCN	CCL	1	2500	50.00	200	79.90	9,188.50	183.77	11,688.50	233.77
CCM	CCL	1	2500	50.00	200	30.00	3,450.00	69.00	5,950.00	119.00
CCL	CCK	1	2500	50.00	200	87.50	10,062.00	201.24	12,562.00	251.24
CCK	CCJ	1	2500	50.00	200	80.50	9,257.50	185.15	11,757.50	235.15
CCJ	BBI	1	2500	50.00	200	48.80	5,612.00	112.24	8,112.00	162.24
BBI	IID	1	2500	50.00	350	65.50	9,170.00	183.40	11,670.00	233.40
IID	BBJ	1	2500	50.00	350	36.30	5,082.00	101.64	7,582.00	151.64
CCI	CCH	1	2500	50.00	200	83.20	9,568.00	191.36	12,068.00	241.36

CITY OF LINDSAY
SEWER SYSTEM DATA

FROM MANHOLE	TO MANHOLE	# OF (FEET)	REP. VAL. (MILE)	DEP. VAL. (MILE)	DIAMETER (mm)	LENGTH (FEET)	REP. VAL. (DOLLARS)	DEP. VAL. (DOLLARS)	REP. VAL. (MILE)	DEP. VAL. (MILE)
LLA	CCH	1	2500	50.00	200	43.00	4,945.00	98.90	7,445.00	148.90
CCH	BBJ	1	2500	50.00	200	48.70	5,600.50	112.01	8,100.50	162.01
NNM	NNN	1	2500	50.00	200	62.10	7,141.50	142.83	9,641.50	192.83
NNN	NNO	1	2500	50.00	200	60.30	6,934.50	138.69	9,434.50	188.69
NNO	NNP	1	2500	50.00	200	74.70	8,590.50	171.81	11,090.50	221.81
NNP	NNQ	1	2500	50.00	200	52.20	6,003.00	120.06	8,503.00	170.06
NNQ	JJS	1	2500	50.00	200	91.00	10,465.00	209.30	12,965.00	259.30
JJQ	JJR	1	2500	50.00	200	99.40	11,431.00	228.62	13,931.00	278.62
JJR	JJS	1	2500	50.00	200	30.80	3,542.00	70.84	6,042.00	120.84
JJS	CCE	1	2500	50.00	200	49.70	5,715.50	114.31	8,215.50	164.31
AAL	CCG	1	2500	50.00	200	65.80	7,567.00	151.34	10,067.00	201.34
CCG	CCF	1	2500	50.00	200	107.10	12,316.00	246.32	14,816.00	296.32
CCF	CCE	1	2500	50.00	200	75.90	8,728.50	174.57	11,228.50	224.57
CCE	CCA	1	2500	50.00	350	100.60	14,084.00	281.68	16,584.00	331.68
CCD	CCC	1	2500	50.00	200	83.80	9,637.00	192.74	12,137.00	242.74
CCC	CCB	1	2500	50.00	200	77.40	8,901.00	178.02	11,401.00	228.02
CCB	CCA	1	2500	50.00	200	76.00	8,740.00	174.80	11,240.00	224.80
CCA	BBZ	1	2500	50.00	200	32.30	3,714.50	74.29	6,214.50	124.29
BBZ	BBY	1	2500	50.00	200	56.50	6,497.50	129.95	8,997.50	179.95
BBY	BBX	1	2500	50.00	200	45.70	5,255.50	105.11	7,755.50	155.11
BBX	BBP	1	2500	50.00	200	85.60	9,844.00	196.88	12,344.00	246.88
BBW	BBV	1	2500	50.00	200	123.60	14,214.00	284.28	16,714.00	334.28
BBV	BBU	1	2500	50.00	200	25.80	2,967.00	59.34	5,467.00	109.34
BBU	BBQ	1	2500	50.00	200	57.80	6,647.00	132.94	9,147.00	182.94
BBT	BBS	1	2500	50.00	200	88.90	10,224.00	204.48	12,724.00	254.48
BBS	BBR	1	2500	50.00	200	29.70	3,415.50	68.31	5,915.50	118.31
BBR	BBQ	1	2500	50.00	200	16.00	1,840.00	36.80	4,340.00	86.80
BBQ	BBP	1	2500	50.00	200	102.90	11,834.00	236.68	14,334.00	286.68
BBP	BBK	1	2500	50.00	200	125.30	14,410.00	288.20	16,910.00	338.20
BBN	BBM	1	2500	50.00	200	73.20	8,418.00	168.36	10,918.00	218.36
BBM	BBL	1	2500	50.00	200	107.10	12,316.00	246.32	14,816.00	296.32
BBL	BBK	1	2500	50.00	200	103.50	11,902.00	238.04	14,402.00	288.04
BBK	BBJ	1	2500	50.00	200	53.00	6,095.00	121.90	8,595.00	171.90
BBJ	CCR	1	2500	50.00	200	55.20	6,348.00	126.96	8,848.00	176.96
CCR	CCS	1	2500	50.00	350	85.30	11,942.00	238.84	14,442.00	288.84
CCS	CCT	1	2500	50.00	350	91.40	12,796.00	255.92	15,296.00	305.92
CCT	CCU	1	2500	50.00	350	92.50	12,950.00	259.00	15,450.00	309.00
CCU	CCY	1	2500	50.00	400	91.10	14,576.00	291.52	17,076.00	341.52
CCY	DDA	1	2500	50.00	400	91.70	14,672.00	293.44	17,172.00	343.44
DDA	DDB	1	2500	50.00	400	62.50	10,000.00	200.00	12,500.00	250.00
GGV	GGU	1	2500	50.00	200	106.10	12,202.00	244.04	14,702.00	294.04
GGU	GGT	1	2500	50.00	200	139.60	16,054.00	321.08	18,554.00	371.08

CITY OF LINDSAY
SEWER SYSTEM DATA

FROM MANHOLE	TO MANHOLE	NO. OF ACS	REPAIR MILE S	DEF. VAL MILE S	DIAMETER (IN)	LENGTH FEET	REP. VAL (DOSE)	DEF. VAL (DOSE)	REP. VAL TOTAL S	DEF. VAL TOTAL S
MMS	MMT	1	2500	50.00	200	41.50	4,772.50	95.45	7,272.50	145.45
MMR	MMT	1	2500	50.00	200	86.90	9,993.50	199.87	12,493.50	249.87
MMT	IIG	1	2500	50.00	200	56.10	8,451.50	129.03	8,951.50	179.03
IIG	GGT	1	2500	50.00	200	72.10	8,291.50	165.83	10,791.50	215.83
GGT	GGG	1	2500	50.00	200	86.90	9,993.50	199.87	12,493.50	249.87
GGG	GGR	1	2500	50.00	200	78.80	9,039.00	180.78	11,539.00	230.78
GGR	ODB	1	2500	50.00	200	60.40	6,946.00	138.92	9,446.00	188.92
ODB	DDC	1	2500	50.00	375	59.10	8,569.50	171.39	11,069.50	221.39
DDC	DDD	1	2500	50.00	375	56.10	8,134.50	162.69	10,634.50	212.69
DDD	DDE	1	2500	50.00	375	95.00	13,775.00	275.50	16,275.00	325.50
DDE	IIE	1	2500	50.00	400	90.90	14,544.00	290.88	17,044.00	340.88
IIE	DDF	1	2500	50.00	400	36.70	5,872.00	117.44	8,372.00	167.44
DDF	IIF	1	2500	50.00	500	112.50	20,025.00	400.50	22,525.00	450.50
IIF	EEP	1	2500	50.00	500	106.70	18,993.00	379.86	21,493.00	429.86
EEP	EEQ	1	2500	50.00	500	106.70	18,993.00	379.86	21,493.00	429.86
EEQ	PUMF	1	2500	50.00	500	48.20	8,579.60	171.59	11,079.60	221.59
DDM	DDJ	1	2500	50.00	200	45.90	5,278.50	105.57	7,778.50	155.57
DDL	DDK	1	2500	50.00	200	30.50	3,507.50	70.15	6,007.50	120.15
DDK	DDJ	1	2500	50.00	200	68.00	7,820.00	156.40	10,320.00	206.40
DDJ	DDI	1	2500	50.00	200	93.90	10,798.00	215.96	13,298.00	265.96
DDG	DDH	1	2500	50.00	200	59.70	6,865.50	137.31	9,365.50	187.31
DDH	DDI	1	2500	50.00	200	72.20	8,303.00	166.06	10,803.00	216.06
DDI	DDN	1	2500	50.00	200	76.00	8,740.00	174.80	11,240.00	224.80
DDP	DDO	1	2500	50.00	200	93.30	10,730.00	214.60	13,230.00	264.60
DDO	DDN	1	2500	50.00	200	90.80	10,442.00	208.84	12,942.00	258.84
DDN	DDQ	1	2500	50.00	200	61.60	7,084.00	141.68	9,584.00	191.68
DDS	DDR	1	2500	50.00	200	52.30	6,014.50	120.29	8,514.50	170.29
DDR	DDQ	1	2500	50.00	200	51.70	5,945.50	118.91	8,445.50	168.91
DDQ	DDT	1	2500	50.00	200	71.60	8,234.00	164.68	10,734.00	214.68
DDT	DDU	1	2500	50.00	200	70.40	8,096.00	161.92	10,596.00	211.92
DDU	DDV	1	2500	50.00	200	68.60	7,889.00	157.78	10,389.00	207.78
DDV	DDW	1	2500	50.00	200	50.70	5,830.50	116.61	8,330.50	166.61
DDX	DDW	1	2500	50.00	200	83.40	9,591.00	191.82	12,091.00	241.82
DDW	DDY	1	2500	50.00	200	100.90	11,604.00	232.08	14,104.00	282.08
EEC	EEB	1	2500	50.00	200	73.00	8,395.00	167.90	10,895.00	217.90
EEB	EEA	1	2500	50.00	200	92.00	10,580.00	211.60	13,080.00	261.60
EEA	DDZ	1	2500	50.00	200	92.00	10,580.00	211.60	13,080.00	261.60
DDZ	DDY	1	2500	50.00	200	29.70	3,415.50	68.31	5,915.50	118.31
NND	NNC	1	2500	50.00	200	91.00	10,465.00	209.30	12,965.00	259.30
NNC	NNB	1	2500	50.00	200	93.40	10,741.00	214.82	13,241.00	264.82
LLD	NNB	1	2500	50.00	200	56.60	6,509.00	130.18	9,009.00	180.18
NNB	LLC	1	2500	50.00	450	35.70	6,069.00	121.38	8,569.00	171.38

CITY OF LINDSAY
SEWER SYSTEM DATA

FROM MANHOLE	TO MANHOLE	# OF (FEET)	REP. VAL. (DOLL.)	DEP. VAL. (DOLL.)	DIAMETER (INCH)	LENGTH (FEET)	REP. VAL. (DOLL.)	DEP. VAL. (DOLL.)	REP. VAL. TOTAL	DEP. VAL. TOTAL
LLC	LLB	1	2500	50.00	450	86.30	14,671.00	293.42	17,171.00	343.42
LLB	EEG	1	2500	50.00	450	82.70	14,059.00	281.18	16,559.00	331.18
EEF	EEG	1	2500	50.00	200	41.00	4,715.00	94.30	7,215.00	144.30
EEE	EED	1	2500	50.00	200	25.30	2,909.50	58.19	5,409.50	108.19
DDY	EED	1	2500	50.00	200	16.60	1,909.00	38.18	4,409.00	88.18
EED	EEG	1	2500	50.00	200	9.20	1,058.00	21.16	3,558.00	71.16
EEG	EEH	1	2500	50.00	525	87.00	15,747.00	314.94	18,247.00	364.94
OOO	OOO	1	2500	50.00	250	79.60	9,552.00	191.04	12,052.00	241.04
OOO	OOO	1	2500	50.00	250	108.70	13,044.00	260.88	15,544.00	310.88
OOO	OOP	1	2500	50.00	250	52.20	8,264.00	125.28	8,764.00	175.28
OOP	OOO	1	2500	50.00	250	48.80	5,856.00	117.12	8,356.00	167.12
OOO	OOV	1	2500	50.00	250	79.60	9,552.00	191.04	12,052.00	241.04
OOV	OOV	1	2500	50.00	250	70.60	8,472.00	169.44	10,972.00	219.44
OOV	EEH	1	2500	50.00	250	86.30	10,356.00	207.12	12,856.00	257.12
EEH	EEI	1	2500	50.00	525	30.80	5,574.80	111.50	8,074.80	161.50
OOX	EEI	1	2500	50.00	250	50.00	6,000.00	120.00	8,500.00	170.00
EEI	EEJ	1	2500	50.00	525	29.00	5,249.00	104.98	7,749.00	154.98
EEJ	EEK	1	2500	50.00	525	65.50	11,856.00	237.12	14,356.00	287.12
EEK	EEL	1	2500	50.00	525	66.70	12,073.00	241.46	14,573.00	291.46
EEM	EEL	1	2500	50.00	250	38.70	4,644.00	92.88	7,144.00	142.88
OOO	OOO	1	2500	50.00	250	45.60	5,472.00	109.44	7,972.00	159.44
OOO	OOT	1	2500	50.00	250	67.80	8,136.00	162.72	10,636.00	212.72
OOT	OOU	1	2500	50.00	250	77.60	9,312.00	186.24	11,812.00	236.24
OOU	EEL	1	2500	50.00	250	76.20	9,144.00	182.88	11,644.00	232.88
EEL	EEN	1	2500	50.00	525	8.90	1,610.90	32.22	4,110.90	82.22
EEN	EEO	1	2500	50.00	525	71.70	12,978.00	259.56	15,478.00	309.56
EEO	JJK	1	2500	50.00	525	86.50	15,656.00	313.12	18,156.00	363.12
JJK	JJL	1	2500	50.00	525	99.10	17,937.00	358.74	20,437.00	408.74
JJL	JJM	1	2500	50.00	525	99.10	17,937.00	358.74	20,437.00	408.74
JJM	PUMP	1	2500	50.00	525	11.30	2,045.30	40.91	4,545.30	90.91
FFZ	A	1	2500	50.00	250	80.50	9,660.00	193.20	12,160.00	243.20
A	B	1	2500	50.00	250	106.50	12,780.00	255.60	15,280.00	305.60
G	F	1	2500	50.00	250	91.70	11,004.00	220.08	13,504.00	270.08
F	E	1	2500	50.00	250	106.80	12,816.00	256.32	15,316.00	306.32
E	D	1	2500	50.00	250	91.70	11,004.00	220.08	13,504.00	270.08
D	C	1	2500	50.00	250	102.20	12,264.00	245.28	14,764.00	295.28
C	B	1	2500	50.00	250	125.70	15,084.00	301.68	17,584.00	351.68
B	H	1	2500	50.00	250	107.30	12,876.00	257.52	15,376.00	307.52
H	I	1	2500	50.00	250	97.80	11,736.00	234.72	14,236.00	284.72
I	MMY	1	2500	50.00	250	37.20	4,464.00	89.28	6,964.00	139.28
MMY	J	1	2500	50.00	250	53.40	6,408.00	128.16	8,908.00	178.16
J	LLP	1	2500	50.00	250	106.90	12,828.00	256.56	15,328.00	306.56

CITY OF LINDSAY
SEWER SYSTEM DATA

FROM MANHOLE	TO MANHOLE	# OF DES	REP. VAL. (DPS)	DEP. VAL. (DPS)	DIAMETER (mm)	LENGTH (feet)	REP. VAL. (DPS)	DEP. VAL. (DPS)	REP. VAL. Total	DEP. VAL. Total
S	R	1	2500	50.00	375	66.70	9,671.50	193.43	12,171.50	243.43
R	Q	1	2500	50.00	375	70.80	10,266.00	205.32	12,766.00	255.32
Q	P	1	2500	50.00	375	102.10	14,804.00	296.08	17,304.00	346.08
P	LLN	1	2500	50.00	375	101.80	14,761.00	295.22	17,261.00	345.22
O	N	1	2500	50.00	225	97.70	11,529.00	230.58	14,029.00	280.58
N	LLN	1	2500	50.00	225	98.30	11,599.00	231.88	14,099.00	281.98
LLN	LLO	1	2500	50.00	375	102.60	14,877.00	297.54	17,377.00	347.54
LLO	LLP	1	2500	50.00	375	106.20	15,399.00	307.98	17,899.00	357.98
MMH	MMJ	1	2500	50.00	200	71.90	8,268.50	165.37	10,768.50	215.37
Y	MMJ	1	2500	50.00	200	65.90	7,578.50	151.57	10,078.50	201.57
MMJ	MMK	1	2500	50.00	200	72.80	8,372.00	167.44	10,872.00	217.44
MMK	MML	1	2500	50.00	200	69.70	8,015.50	160.31	10,515.50	210.31
V	U	1	2500	50.00	200	89.60	10,304.00	206.08	12,804.00	256.08
U	MML	1	2500	50.00	200	94.40	10,856.00	217.12	13,356.00	267.12
MML	LLP	1	2500	50.00	200	96.40	11,086.00	221.72	13,586.00	271.72
LLP	LLQ	1	2500	50.00	375	100.90	14,630.00	292.60	17,130.00	342.60
LLQ	LLR	1	2500	50.00	375	100.60	14,587.00	291.74	17,087.00	341.74
AV	AU	1	2500	50.00	200	58.10	6,681.50	133.63	9,181.50	183.63
AU	AT	1	2500	50.00	200	24.80	2,852.00	57.04	5,352.00	107.04
AT	AS	1	2500	50.00	200	45.60	5,244.00	104.88	7,744.00	154.88
AS	AR	1	2500	50.00	225	12.50	1,475.00	29.50	3,975.00	79.50
AR	AO	1	2500	50.00	225	92.90	10,962.00	219.24	13,462.00	269.24
AQ	AP	1	2500	50.00	200	76.00	8,740.00	174.80	11,240.00	224.80
AP	AO	1	2500	50.00	200	75.70	8,705.50	174.11	11,205.50	224.11
AO	LLR	1	2500	50.00	250	85.60	10,272.00	205.44	12,772.00	255.44
IIT	JJH	1	2500	50.00	200	87.50	10,062.00	201.24	12,562.00	251.24
JJH	LLR	1	2500	50.00	200	10.80	1,242.00	24.84	3,742.00	74.84
LLR	LLS	1	2500	50.00	375	91.80	13,311.00	266.22	15,811.00	316.22
LLS	AD	1	2500	50.00	375	66.50	9,642.50	192.85	12,142.50	242.85
AD	LLT	1	2500	50.00	525	44.80	8,108.80	162.18	10,608.80	212.18
CN	CM	1	2500	50.00	225	81.90	9,684.20	193.28	12,164.20	243.28
CM	KKA	1	2500	50.00	225	64.10	7,563.80	151.28	10,063.80	201.28
KKA	LLT	1	2500	50.00	225	62.40	7,363.20	147.26	9,863.20	197.26
LLT	LLU	1	2500	50.00	450	100.80	17,136.00	342.72	19,636.00	392.72
LLU	LLV	1	2500	50.00	450	100.50	17,085.00	341.70	19,585.00	391.70
LLV	AI	1	2500	50.00	450	78.80	13,396.00	267.92	15,896.00	317.92
JJW	CP	1	2500	50.00	200	90.00	10,350.00	207.00	12,850.00	257.00
CO	CP	1	2500	50.00	225	140.90	16,626.00	332.52	19,126.00	382.52
CR	CQ	1	2500	50.00	250	76.50	9,180.00	183.60	11,680.00	233.60
CQ	JJX	1	2500	50.00	250	85.60	10,272.00	205.44	12,772.00	255.44
JJX	CP	1	2500	50.00	250	80.90	9,708.00	194.16	12,208.00	244.16
CP	JJV	1	2500	50.00	250	66.90	8,028.00	160.56	10,528.00	210.56

CITY OF LINDSAY
SEWER SYSTEM DATA

FROM MANHOLE	TO MANHOLE	P.C. (IN)	REP. VAL. (IN)	DEP. VAL. (IN)	DIAMETER (IN)	LENGTH (FEET)	REP. VAL. (IN)	DEP. VAL. (IN)	REP. VAL. (IN)	DEP. VAL. (IN)
JJV	CS	1	2500	50.00	250	70.30	8,436.00	168.72	10,936.00	218.72
CL	CS	1	2500	50.00	225	65.30	7,705.40	154.11	10,205.40	204.11
CS	CT	1	2500	50.00	250	30.00	3,600.00	72.00	6,100.00	122.00
CT	CU	1	2500	50.00	225	86.70	10,231.00	204.62	12,731.00	254.62
CU	KKB	1	2500	50.00	225	76.70	9,050.60	181.01	11,550.60	231.01
KKB	CV	1	2500	50.00	225	76.50	9,027.00	180.54	11,527.00	230.54
CV	AK	1	2500	50.00	225	122.20	14,420.00	288.40	16,920.00	338.40
AK	AI	1	2500	50.00	375	77.40	11,223.00	224.46	13,723.00	274.46
AI	AL	1	2500	50.00	450	34.30	5,831.00	116.62	8,331.00	166.62
BE	BC	1	2500	50.00	225	73.80	8,708.40	174.17	11,208.40	224.17
BD	BC	1	2500	50.00	200	55.20	6,348.00	126.96	8,848.00	176.96
BC	BB	1	2500	50.00	225	61.50	7,257.00	145.14	9,757.00	195.14
BB	BA	1	2500	50.00	225	107.00	12,626.00	252.52	15,126.00	302.52
BA	AZ	1	2500	50.00	225	93.30	11,009.00	220.18	13,509.00	270.18
BF	AZ	1	2500	50.00	375	102.70	14,892.00	297.84	17,392.00	347.84
AZ	AY	1	2500	50.00	375	131.60	19,082.00	381.64	21,582.00	431.64
LLT	AY	1	2500	50.00	300	87.10	11,323.00	226.46	13,823.00	276.46
AY	BG	1	2500	50.00	375	100.50	14,572.00	291.44	17,072.00	341.44
BI	NNA	1	2500	50.00	225	87.50	10,325.00	206.50	12,825.00	256.50
NNA	BH	1	2500	50.00	225	72.30	8,531.40	170.63	11,031.40	220.63
BH	BG	1	2500	50.00	225	47.70	5,628.60	112.57	8,128.60	162.57
BG	BJ	1	2500	50.00	300	102.10	13,273.00	265.46	15,773.00	315.46
BJ	BK	1	2500	50.00	300	64.00	8,320.00	166.40	10,820.00	216.40
BK	JJU	1	2500	50.00	300	62.60	8,138.00	162.76	10,638.00	212.76
MMG	BN	1	2500	50.00	200	86.60	9,959.00	199.18	12,459.00	249.18
BN	JJG	1	2500	50.00	225	18.60	2,194.80	43.90	4,694.80	93.90
JJG	BO	1	2500	50.00	225	185.10	21,842.00	436.84	24,342.00	486.84
BO	BP	1	2500	50.00	225	171.10	20,190.00	403.80	22,690.00	453.80
BP	BQ	1	2500	50.00	225	201.60	23,789.00	475.78	26,289.00	525.78
BY	JJY	1	2500	50.00	225	29.00	3,422.00	68.44	5,922.00	118.44
JJZ	JJY	1	2500	50.00	200	33.60	3,864.00	77.28	6,364.00	127.28
JJY	BX	1	2500	50.00	225	74.40	8,778.20	175.58	11,278.20	225.58
BZ	BX	1	2500	50.00	225	120.60	14,231.00	284.62	16,731.00	334.62
BX	BW	1	2500	50.00	200	64.80	7,452.00	149.04	9,952.00	199.04
BW	BQ	1	2500	50.00	225	64.60	7,622.80	152.46	10,122.80	202.46
BV	BT	1	2500	50.00	225	180.00	21,240.00	424.80	23,740.00	474.80
BU	BT	1	2500	50.00	225	111.70	13,181.00	263.62	15,681.00	313.62
BT	BS	1	2500	50.00	225	202.50	23,895.00	477.90	26,395.00	527.90
BS	BR	1	2500	50.00	225	197.90	23,352.00	467.04	25,852.00	517.04
BR	BQ	1	2500	50.00	225	66.80	7,882.40	157.65	10,382.40	207.65
BQ	CA	1	2500	50.00	225	102.40	12,083.00	241.66	14,583.00	291.66
CD	CB	1	2500	50.00	150	51.30	5,130.00	102.60	7,630.00	152.60

CITY OF LINDSAY
SEWER SYSTEM DATA

FROM MANHOLE	TO MANHOLE	# OF CDS	REP. VAL. (DIPS)	DER. VAL. (DIPS)	DIAMETER (mm)	LENGTH (FEET)	REP. VAL. (DIPS)	DER. VAL. (DIPS)	REP. VAL. TOTAL \$	DER. VAL. TOTAL \$
CC	CB	1	2500	50.00	225	56.40	6,655.20	133.10	9,155.20	183.10
CB	CA	1	2500	50.00	225	75.40	8,697.20	177.94	11,397.20	227.94
CA	JJT	1	2500	50.00	250	120.00	14,400.00	288.00	16,900.00	338.00
JJT	CE	1	2500	50.00	250	71.00	8,520.00	170.40	11,020.00	220.40
CE	CF	1	2500	50.00	250	95.60	11,472.00	229.44	13,972.00	279.44
CF	JJU	1	2500	50.00	250	96.10	11,532.00	230.64	14,032.00	280.64
JJU	AL	1	2500	50.00	375	9.90	1,435.50	28.71	3,935.50	78.71
AL	BL	1	2500	50.00	600	96.50	23,353.00	467.06	25,853.00	517.06
CA	CG	1	2500	50.00	225	91.70	10,821.00	216.42	13,321.00	266.42
CG	CH	1	2500	50.00	375	28.70	4,161.50	83.23	6,661.50	133.23
CH	CI	1	2500	50.00	375	31.70	4,596.50	91.93	7,096.50	141.93
CI	CJ	1	2500	50.00	375	106.70	15,472.00	309.44	17,972.00	359.44
CJ	CK	1	2500	50.00	375	112.20	16,269.00	325.38	18,769.00	375.38
CK	BL	1	2500	50.00	375	78.60	11,397.00	227.64	13,897.00	277.94
BL	PUMP	1	2500	50.00	0	0.00	0.00	0.00	2,500.00	50.00
EEZ	E	1	2500	50.00	2	5.00	0.00	0.00	2,500.00	50.00
EEY	EEX	1	2500	50.00	250	85.40	10,248.00	204.86	12,748.00	254.86
EEX	EEW	1	2500	50.00	250	121.20	14,544.00	290.88	17,044.00	340.88
EEW	EEV	1	2500	50.00	250	91.50	10,980.00	219.60	13,480.00	269.60
EEV	EEU	1	2500	50.00	250	91.80	11,016.00	220.32	13,516.00	270.32
EEU	EET	1	2500	50.00	525	11.30	2,045.30	40.91	4,545.30	90.91
FFA	EET	1	2500	50.00	525	7.90	1,429.90	28.60	3,929.90	78.60
EET	FFB	1	2500	50.00	525	76.40	13,828.00	276.56	16,328.00	326.56
FFB	EES	1	2500	50.00	525	77.90	14,100.00	282.00	16,600.00	332.00
EER	EES	1	2500	50.00	200	122.30	14,064.00	281.28	16,564.00	331.28
EES	FFC	1	2500	50.00	600	97.50	23,595.00	471.90	26,095.00	521.90
FFC	FFD	1	2500	50.00	600	84.00	20,328.00	406.56	22,828.00	456.56
FFD	FFE	1	2500	50.00	600	108.50	26,257.00	525.14	28,757.00	575.14
FFE	FFF	1	2500	50.00	600	108.30	26,209.00	524.18	28,709.00	574.18
FFF	FFG	1	2500	50.00	600	106.50	25,773.00	515.46	28,273.00	565.46
FFG	FFH	1	2500	50.00	600	106.70	25,821.00	516.42	28,321.00	566.42
FFH	FFI	1	2500	50.00	600	108.60	26,281.00	525.62	28,781.00	575.62
FFI	FFJ	1	2500	50.00	600	92.00	22,264.00	445.28	24,764.00	495.28
FFJ	FFK	1	2500	50.00	675	106.60	32,193.00	643.86	34,693.00	693.86
FFK	FFL	1	2500	50.00	675	111.50	33,673.00	673.46	36,173.00	723.46
FFL	FFM	1	2500	50.00	750	118.30	35,727.00	714.54	38,227.00	764.54
FFM	FFN	1	2500	50.00	750	127.70	46,100.00	922.00	48,600.00	972.00
FFN	FFO	1	2500	50.00	750	124.80	45,053.00	901.06	47,553.00	951.06
FFO	FFP	1	2500	50.00	750	129.20	46,641.00	932.82	49,141.00	982.82
FFP	FFQ	1	2500	50.00	750	127.50	46,028.00	920.56	48,528.00	970.56
FFQ	FFR	1	2500	50.00	750	125.20	45,197.00	903.94	47,697.00	953.94
FFR	FFS	1	2500	50.00	750	70.40	25,414.00	508.28	27,914.00	558.28

CITY OF LINDSAY
SEWER SYSTEM DATA

FROM MANHOLE	TO MANHOLE	# OF (PCS)	REF. VAL. (MPS)	DEF. VAL. (MPS)	DIAMETER (mm)	LENGTH METER	REF. VAL. (MPS)	DEF. VAL. (MPS)	REF. VAL. TWD 3	DEF. VAL. TWD 3
FFS	FFU	1	2500	50.00	450	70.10	25,306.00	506.12	27,806.00	556.12
FFT	FFU	1	2500	50.00	750	12.40	2,108.00	42.16	4,608.00	92.16
FFU	FFV	1	2500	50.00	750	96.20	34,728.00	694.56	37,228.00	744.56
FFV	FFW	1	2500	50.00	225	96.00	34,656.00	693.12	37,156.00	743.12
GO	GN	1	2500	50.00	225	96.30	11,363.00	227.26	13,863.00	277.26
GN	GL	1	2500	50.00	225	103.80	12,248.00	244.86	14,748.00	294.86
GL	GK	1	2500	50.00	225	102.20	12,060.00	241.20	14,560.00	291.20
GK	GI	1	2500	50.00	200	105.80	12,484.00	249.68	14,984.00	299.68
GJ	GI	1	2500	50.00	200	96.30	11,074.00	221.48	13,574.00	271.48
GI	GD	1	2500	50.00	200	98.80	11,362.00	227.24	13,862.00	277.24
GE	GD	1	2500	50.00	200	115.80	13,317.00	266.34	15,817.00	316.34
GD	GC	1	2500	50.00	225	41.10	4,726.50	94.53	7,226.50	144.53
GH	GG	1	2500	50.00	225	60.10	7,091.80	141.84	9,591.80	191.84
GG	GF	1	2500	50.00	225	107.40	12,673.00	253.46	15,173.00	303.46
GF	GC	1	2500	50.00	200	110.40	12,696.00	253.92	15,196.00	303.92
GC	GB	1	2500	50.00	300	52.60	10,738.00	214.76	13,238.00	264.76
GB	FZ	1	2500	50.00	300	5.20	676.00	13.52	3,176.00	63.52
GA	FV	1	2500	50.00	200	64.80	7,463.50	149.27	9,963.50	199.27
FV	FZ	1	2500	50.00	200	57.30	6,589.50	131.79	9,089.50	181.79
FZ	FW	1	2500	50.00	300	153.80	19,994.00	399.88	22,494.00	449.88
FY	FW	1	2500	50.00	200	101.20	11,638.00	232.76	14,138.00	282.76
FX	FW	1	2500	50.00	200	114.00	13,110.00	262.20	15,610.00	312.20
FW	FT	1	2500	50.00	300	119.20	15,496.00	309.92	17,996.00	359.92
FU	FT	1	2500	50.00	225	82.90	9,782.20	195.64	12,282.20	245.64
FT	FR	1	2500	50.00	300	139.80	18,174.00	363.48	20,674.00	413.48
FS	FR	1	2500	50.00	200	93.00	10,695.00	213.90	13,195.00	263.90
FR	FQ	1	2500	50.00	300	140.80	18,304.00	366.08	20,804.00	416.08
FQ	FO	1	2500	50.00	300	135.80	17,654.00	353.08	20,154.00	403.08
FP	FO	1	2500	50.00	225	101.20	11,942.00	238.84	14,442.00	288.84
FO	FN	1	2500	50.00	375	58.40	8,468.00	169.36	10,968.00	219.36
FF	FE	1	2500	50.00	200	75.60	8,694.00	173.88	11,194.00	223.88
FE	FD	1	2500	50.00	200	75.30	8,659.50	173.19	11,159.50	223.19
FL	FC	1	2500	50.00	200	16.20	1,863.00	37.26	4,363.00	87.26
FC	FA	1	2500	50.00	200	48.50	5,577.50	111.55	8,077.50	161.55
FB	FA	1	2500	50.00	200	84.70	9,740.50	194.81	12,240.50	244.81
FA	EY	1	2500	50.00	200	140.40	16,146.00	322.92	18,646.00	372.92
EZ	EY	1	2500	50.00	225	84.70	9,994.60	199.89	12,494.60	249.89
EY	EX	1	2500	50.00	300	21.90	2,847.00	56.94	5,347.00	106.94
EX	EW	1	2500	50.00	300	79.90	10,387.00	207.74	12,887.00	257.74
EW	EV	1	2500	50.00	300	77.40	10,062.00	201.24	12,562.00	251.24
FG	FH	1	2500	50.00	200	68.30	7,854.50	157.09	10,354.50	207.09
FH	FI	1	2500	50.00	200	140.50	16,158.00	323.16	18,658.00	373.16

CITY OF LINDSAY
SEWER SYSTEM DATA

FROM MANHOLE	TO MANHOLE	SIZE (IN)	REP. VAL. (DOLL.)	DEP. VAL. (DOLL.)	DIAMETER (MM)	LENGTH (FEET)	REP. VAL. (DOLL.)	DEP. VAL. (DOLL.)	REP. VAL. TOTAL \$	DEP. VAL. TOTAL \$
FJ	FI	1	2500	50.00	200	86.00	8,890.00	197.80	12,390.00	247.80
FI	IIR	1	2500	50.00	225	70.40	8,307.20	166.14	10,807.20	216.14
IIR	FK	1	2500	50.00	225	69.60	8,212.80	164.26	10,712.80	214.26
FL	FK	1	2500	50.00	225	81.70	9,640.60	192.81	12,140.60	242.81
FK	EV	1	2500	50.00	225	121.90	14,384.00	287.68	16,884.00	337.68
EV	EU	1	2500	50.00	300	23.80	3,094.00	61.88	5,594.00	111.88
EU	FM	1	2500	50.00	300	47.50	6,175.00	123.50	8,675.00	173.50
GGC	FM	1	2500	50.00	225	24.10	2,843.80	56.88	5,343.80	106.88
FM	FN	1	2500	50.00	375	70.30	10,194.00	203.88	12,694.00	253.88
FN	HT	1	2500	50.00	450	116.40	19,788.00	395.76	22,288.00	445.76
HT	HU	1	2500	50.00	450	114.30	19,431.00	388.62	21,931.00	438.62
HU	HV	1	2500	50.00	450	123.10	20,927.00	418.54	23,427.00	468.54
HI	HJ	1	2500	50.00	200	65.80	7,567.00	151.34	10,067.00	201.34
HJ	HK	1	2500	50.00	200	77.00	8,855.00	177.10	11,355.00	227.10
HK	HL	1	2500	50.00	200	67.70	7,785.50	155.71	10,285.50	205.71
HM	HL	1	2500	50.00	225	59.70	7,044.60	140.89	9,544.60	190.89
HL	HN	1	2500	50.00	225	133.80	15,788.00	315.76	18,288.00	365.76
HN	HO	1	2500	50.00	225	117.00	13,806.00	276.12	16,306.00	326.12
IIP	HP	1	2500	50.00	225	34.90	4,118.20	82.36	6,613.20	132.36
HP	HO	1	2500	50.00	225	42.10	4,967.80	99.36	7,467.80	149.36
HO	HQ	1	2500	50.00	225	120.10	14,172.00	283.44	16,672.00	333.44
IIO	HQ	1	2500	50.00	225	76.20	8,991.60	179.83	11,491.60	229.83
HQ	HS	1	2500	50.00	225	61.00	7,198.00	143.96	9,698.00	193.96
HS	HV	1	2500	50.00	225	4.60	542.80	10.86	3,042.80	60.86
HV	HW	1	2500	50.00	450	34.70	5,899.00	117.98	8,399.00	167.98
HW	PUMP	1	2500	50.00	450	8.50	1,445.00	28.90	3,945.00	78.90
KKJ	KKK	1	2500	50.00	150	38.10	3,810.00	76.20	6,310.00	126.20
KKK	PUMP	1	2500	50.00	150	27.10	2,710.00	54.20	5,210.00	104.20
XH	XF	1	2500	50.00	200	36.90	4,243.50	84.87	6,743.50	134.87
OOA	XF	1	2500	50.00	200	58.20	6,693.00	133.86	9,193.00	183.86
XF	XE	1	2500	50.00	200	102.40	11,776.00	235.52	14,276.00	285.52
XE	XC	1	2500	50.00	200	104.40	12,006.00	240.12	14,506.00	290.12
XD	XC	1	2500	50.00	200	45.10	5,186.50	103.73	7,686.50	153.73
XC	XB	1	2500	50.00	200	62.80	7,222.00	144.44	9,722.00	194.44
XB	XA	1	2500	50.00	200	26.20	3,013.00	60.26	5,513.00	110.26
XA	WZ	1	2500	50.00	250	34.70	4,164.00	83.28	6,664.00	133.28
WZ	WY	1	2500	50.00	250	101.20	12,144.00	242.88	14,644.00	292.88
WY	WV	1	2500	50.00	250	43.90	5,268.00	105.36	7,768.00	155.36
WX	WW	1	2500	50.00	200	70.40	8,096.00	161.92	10,596.00	211.92
WW	WV	1	2500	50.00	200	68.60	7,889.00	157.78	10,389.00	207.78
WV	WU	1	2500	50.00	250	61.60	7,392.00	147.84	9,892.00	197.84
WU	WS	1	2500	50.00	250	104.40	12,528.00	250.56	15,028.00	300.56

CITY OF LINDSAY
SEWER SYSTEM DATA

FROM MANHOLE	TO MANHOLE	# OF (FEET)	REP. VAL. (\$1,000)	DER. VAL. (\$1,000)	DIAMETER (mm)	LENGTH (feet)	REP. VAL. (\$1,000)	DER. VAL. (\$1,000)	REP. VAL. Total \$	DER. VAL. Total \$
VD	WR	1	2500	50.00	250	36.00	4,320.00	86.40	6,820.00	136.40
WR	WS	1	2500	50.00	250	47.40	5,688.00	113.76	8,188.00	163.76
WS	WT	1	2500	50.00	250	88.50	10,620.00	212.40	13,120.00	262.40
WT	PUMP	1	2500	50.00	250	32.30	3,876.00	77.52	6,376.00	127.52
SN	SM	1	2500	50.00	225	112.00	13,216.00	264.32	15,716.00	314.32
SM	SL	1	2500	50.00	225	126.00	14,868.00	297.36	17,368.00	347.36
SL	SK	1	2500	50.00	225	124.50	14,691.00	293.82	17,191.00	343.82
SK	SJ	1	2500	50.00	225	69.20	8,165.60	163.31	10,655.60	213.31
SJ	SI	1	2500	50.00	300	9.10	1,183.00	23.66	3,683.00	73.66
SI	SH	1	2500	50.00	300	89.00	11,570.00	231.40	14,070.00	281.40
SH	SG	1	2500	50.00	300	87.50	11,375.00	227.50	13,875.00	277.50
SG	SF	1	2500	50.00	300	70.50	9,165.00	183.30	11,665.00	233.30
NNL	NNK	1	2500	50.00	200	72.40	8,326.00	166.52	10,826.00	216.52
NNK	NNI	1	2500	50.00	200	68.10	7,831.50	156.63	10,331.50	206.63
NNJ	NNI	1	2500	50.00	200	43.20	4,968.00	99.36	7,468.00	149.36
NNI	NNG	1	2500	50.00	200	87.00	10,005.00	200.10	12,505.00	250.10
OOK	OOJ	1	2500	50.00	200	83.00	9,545.00	190.90	12,045.00	240.90
OOJ	OOI	1	2500	50.00	200	62.00	7,130.00	142.60	9,630.00	192.60
OOI	NNH	1	2500	50.00	200	62.00	7,130.00	142.60	9,630.00	192.60
NNH	NNG	1	2500	50.00	200	65.20	7,498.00	149.96	9,998.00	199.96
NNG	NNF	1	2500	50.00	200	48.90	5,623.50	112.47	8,123.50	162.47
NNF	NNE	1	2500	50.00	200	85.50	9,832.50	196.65	12,332.50	246.65
NNE	KKW	1	2500	50.00	200	29.10	3,346.50	66.93	5,846.50	116.93
KKW	SV	1	2500	50.00	200	42.20	4,853.00	97.06	7,353.00	147.06
SV	SS	1	2500	50.00	200	82.90	9,533.50	190.67	12,033.50	240.67
PPP	PPQ	1	2500	50.00	200	62.60	7,199.00	143.98	9,699.00	193.98
PPQ	PPM	1	2500	50.00	200	93.00	10,695.00	213.90	13,195.00	263.90
PPN	PPM	1	2500	50.00	200	24.60	2,829.00	56.58	5,329.00	106.58
PPM	PPR	1	2500	50.00	200	85.30	9,809.50	196.19	12,309.50	246.19
PPG	PPH	1	2500	50.00	200	51.50	5,922.50	118.45	8,422.50	168.45
PPH	PPI	1	2500	50.00	200	21.00	2,415.00	48.30	4,915.00	98.30
PPI	PPJ	1	2500	50.00	200	84.50	9,717.50	194.35	12,217.50	244.35
PPJ	PPK	1	2500	50.00	200	43.90	5,048.50	100.97	7,548.50	150.97
PPK	PPL	1	2500	50.00	200	47.40	5,451.00	109.02	7,951.00	159.02
PPL	OOM	1	2500	50.00	200	100.80	11,592.00	231.84	14,092.00	281.84
PPG	PPF	1	2500	50.00	200	20.50	2,357.50	47.15	4,857.50	97.15
PPF	PPE	1	2500	50.00	200	78.50	9,027.50	180.55	11,527.50	230.55
PPE	PPD	1	2500	50.00	200	79.50	9,142.50	182.85	11,642.50	232.85
PPD	PPB	1	2500	50.00	200	91.90	10,568.00	211.36	13,068.00	261.36
PPC	PPB	1	2500	50.00	200	32.80	3,772.00	75.44	6,272.00	125.44
PPB	OOM	1	2500	50.00	200	45.20	5,198.00	103.96	7,698.00	153.96
OOM	OOL	1	2500	50.00	200	62.90	7,233.50	144.67	9,733.50	194.67

CITY OF LINDSAY
SEWER SYSTEM DATA

FROM MANHOLE	TO MANHOLE	NO. (FEET)	REP. VAL. (DOLLARS)	DEP. VAL. (DOLLARS)	DIAMETER (INCH)	LENGTH (FEET)	REP. VAL. (DOLLARS)	DEP. VAL. (DOLLARS)	REP. VAL. TOTAL \$	DEP. VAL. TOTAL \$
OOL	KKV	1	2500	50.00	200	61.00	7,015.00	140.30	9,515.00	190.30
KKV	KKU	1	2500	50.00	200	46.90	5,393.50	107.87	7,893.50	157.87
KKU	KKT	1	2500	50.00	200	44.50	5,117.50	102.35	7,617.50	152.35
KKT	KKS	1	2500	50.00	200	51.80	5,957.00	119.14	8,457.00	169.14
KKS	KKR	1	2500	50.00	200	48.00	5,612.00	112.24	8,112.00	162.24
KKR	KKQ	1	2500	50.00	200	48.00	5,612.00	112.24	8,112.00	162.24
KKQ	SS	1	2500	50.00	200	12.80	1,472.00	29.44	3,972.00	79.44
SS	ST	1	2500	50.00	200	89.60	10,304.00	206.08	12,804.00	256.08
ST	SS	1	2500	50.00	200	91.40	10,511.00	210.22	13,011.00	260.22
SS	SR	1	2500	50.00	200	71.30	8,199.50	163.99	10,699.50	213.99
SR	SQ	1	2500	50.00	200	68.30	7,854.50	157.09	10,354.50	207.09
SQ	SP	1	2500	50.00	200	68.60	7,889.00	157.78	10,389.00	207.78
SP	SO	1	2500	50.00	200	68.00	7,820.00	156.40	10,320.00	206.40
SO	SF	1	2500	50.00	200	54.00	6,210.00	124.20	8,710.00	174.20
SF	SE	1	2500	50.00	300	104.90	13,637.00	272.74	16,137.00	322.74
SE	SD	1	2500	50.00	300	9.40	1,222.00	24.44	3,722.00	74.44
SD	SC	1	2500	50.00	300	103.60	13,468.00	269.36	15,968.00	319.36
SC	JJJ	1	2500	50.00	400	55.50	8,880.00	177.60	11,380.00	227.60
JJJ	JJI	1	2500	50.00	400	91.40	14,624.00	292.48	17,124.00	342.48
JJI	SA	1	2500	50.00	400	91.40	14,624.00	292.48	17,124.00	342.48
SA	RZ	1	2500	50.00	400	90.20	14,432.00	288.64	16,932.00	338.64
RZ	MI	1	2500	50.00	400	68.00	10,880.00	217.60	13,380.00	267.60
MI	OZ	1	2500	50.00	400	11.00	1,760.00	35.20	4,260.00	85.20
HHC	HHB	1	2500	50.00	200	84.70	9,740.50	194.81	12,240.50	244.81
HHB	HHA	1	2500	50.00	200	80.50	9,257.50	185.15	11,757.50	235.15
HHA	RX	1	2500	50.00	200	80.50	9,257.50	185.15	11,757.50	235.15
RY	MMI	1	2500	50.00	200	55.50	6,382.50	127.65	8,882.50	177.65
MMI	RX	1	2500	50.00	200	14.30	1,644.50	32.89	4,144.50	82.89
RX	RP	1	2500	50.00	200	56.70	6,520.50	130.41	9,020.50	180.41
RW	RV	1	2500	50.00	200	98.30	11,304.00	226.08	13,804.00	276.08
RV	RU	1	2500	50.00	200	90.70	10,430.00	208.60	12,930.00	258.60
RU	RT	1	2500	50.00	200	91.40	10,511.00	210.22	13,011.00	260.22
RT	RQ	1	2500	50.00	200	9.40	1,081.00	21.62	3,581.00	71.62
RS	RR	1	2500	50.00	200	67.70	7,785.50	155.71	10,285.50	205.71
RR	ROW	1	2500	50.00	200	84.10	9,671.50	193.43	12,171.50	243.43
RO	RP	1	2500	50.00	200	52.70	6,060.50	121.21	8,560.50	171.21
RP	RO	1	2500	50.00	200	94.60	10,879.00	217.58	13,379.00	267.58
RO	RN	1	2500	50.00	200	90.20	10,373.00	207.46	12,873.00	257.46
RN	RD	1	2500	50.00	200	88.40	10,166.00	203.32	12,666.00	253.32
RL	RK	1	2500	50.00	200	90.50	10,408.00	208.16	12,908.00	258.16
RK	RJ	1	2500	50.00	200	57.60	6,624.00	132.48	9,124.00	182.48
RJ	RI	1	2500	50.00	200	91.80	10,557.00	211.14	13,057.00	261.14

CITY OF LINDSAY
SEWER SYSTEM DATA

FROM MANHOLE	TO MANHOLE	# OF (REQ)	REP. VAL (DOLL.)	DEP. VAL (DOLL.)	DIAMETER (IN)	LENGTH (FEET)	REP. VAL (DOLL.)	DEP. VAL (DOLL.)	REP. VAL TOTAL \$	DEP. VAL TOTAL \$
RM	RI	1	2500	50.00	225	131.70	15,541.00	310.82	18,041.00	360.82
RI	RD	1	2500	50.00	225	133.50	15,753.00	315.06	18,253.00	365.06
RG	RF	1	2500	50.00	200	39.10	4,496.50	89.93	6,996.50	139.93
RF	RE	1	2500	50.00	200	10.30	1,184.50	23.69	3,684.50	73.69
RH	RE	1	2500	50.00	225	48.80	5,758.40	115.17	8,258.40	165.17
RE	ED	1	2500	50.00	225	72.50	8,555.00	171.10	11,055.00	221.10
RD	RA	1	2500	50.00	225	135.50	15,989.00	319.78	18,489.00	369.78
RC	RB	1	2500	50.00	200	45.70	5,255.50	105.11	7,755.50	155.11
RB	RA	1	2500	50.00	225	69.50	8,201.00	164.02	10,701.00	214.02
RA	QZ	1	2500	50.00	225	134.70	15,895.00	317.90	18,395.00	367.90
QZ	QW	1	2500	50.00	400	29.60	4,736.00	94.72	7,236.00	144.72
QW	QX	1	2500	50.00	400	91.90	14,704.00	294.08	17,204.00	344.08
QX	LL	1	2500	50.00	450	93.90	15,963.00	319.26	18,463.00	369.26
LL	QY	1	2500	50.00	450	60.50	10,285.00	205.70	12,785.00	255.70
QY	QJ	1	2500	50.00	450	65.80	11,186.00	223.72	13,686.00	273.72
QK	QJ	1	2500	50.00	200	48.50	5,577.50	111.55	8,077.50	161.55
QV	QU	1	2500	50.00	225	61.00	7,198.00	143.96	9,698.00	193.96
QU	QT	1	2500	50.00	225	64.30	7,587.40	151.75	10,087.40	201.75
QT	QS	1	2500	50.00	225	101.80	12,012.00	240.24	14,512.00	290.24
QW	QS	1	2500	50.00	225	70.10	8,271.80	165.44	10,771.80	215.44
QS	QM	1	2500	50.00	225	53.00	6,254.00	125.08	8,754.00	175.08
QR	QQ	1	2500	50.00	225	44.20	5,215.60	104.31	7,715.60	154.31
QQ	QP	1	2500	50.00	225	68.90	8,130.20	162.60	10,630.20	212.60
QP	QO	1	2500	50.00	225	69.50	8,201.00	164.02	10,701.00	214.02
QO	QN	1	2500	50.00	225	68.30	8,059.40	161.19	10,559.40	211.19
QN	QM	1	2500	50.00	225	62.80	7,410.40	148.21	9,910.40	198.21
QM	QL	1	2500	50.00	200	94.50	10,868.00	217.36	13,368.00	267.36
QL	QJ	1	2500	50.00	200	97.40	11,201.00	224.02	13,701.00	274.02
PK	QJ	1	2500	50.00	225	48.50	5,723.00	114.46	8,223.00	164.46
QJ	QI	1	2500	50.00	450	71.30	12,121.00	242.42	14,621.00	292.42
QI	PF	1	2500	50.00	450	70.70	12,019.00	240.38	14,519.00	290.38
PZ	QA	1	2500	50.00	200	54.30	6,244.50	124.89	8,744.50	174.89
QB	QA	1	2500	50.00	200	102.10	11,742.00	234.84	14,242.00	284.84
GA	PY	1	2500	50.00	200	10.70	1,230.50	24.61	3,730.50	74.61
PPB	PY	1	2500	50.00	200	42.00	4,830.00	96.60	7,330.00	146.60
PY	PX	1	2500	50.00	200	121.00	13,915.00	278.30	16,415.00	328.30
PX	PW	1	2500	50.00	200	106.50	12,248.00	244.96	14,748.00	294.96
PW	PU	1	2500	50.00	200	47.20	5,428.00	108.56	7,928.00	158.56
PV	PU	1	2500	50.00	225	70.70	8,342.60	166.85	10,842.60	216.85
PU	PT	1	2500	50.00	225	9.50	1,121.00	22.42	3,621.00	72.42
PT	MME	1	2500	50.00	250	39.30	4,716.00	94.32	7,216.00	144.32
MME	PS	1	2500	50.00	250	82.30	9,876.00	197.52	12,376.00	247.52

CITY OF LINDSAY
SEWER SYSTEM DATA

FROM MANHOLE	TO MANHOLE	FOF (FEET)	REP. VAL. (DIPS)	DEF. VAL. (DIPS)	DIAMETER (IN)	LENGTH (FEET)	REP. VAL. (DIPS)	DEF. VAL. (DIPS)	REP. VAL. TOTAL \$	DEF. VAL. TOTAL \$
LLG	QH	1	2500	50.00	200	11.00	1,265.00	25.30	3,765.00	75.30
QH	QG	1	2500	50.00	200	56.10	6,451.50	129.03	8,951.50	179.03
QG	QF	1	2500	50.00	225	25.60	3,020.80	60.42	5,520.80	110.42
QF	QE	1	2500	50.00	225	38.40	4,531.20	90.52	7,031.20	140.62
QE	QD	1	2500	50.00	225	35.70	4,212.60	84.25	6,712.60	134.25
QD	QC	1	2500	50.00	225	61.00	7,198.00	143.96	9,698.00	193.96
QC	PS	1	2500	50.00	225	65.50	7,729.00	154.58	10,229.00	204.58
PS	PR	1	2500	50.00	225	25.90	3,056.20	61.12	5,556.20	111.12
PR	PQ	1	2500	50.00	200	105.50	12,132.00	242.64	14,632.00	292.64
PQ	PP	1	2500	50.00	200	41.80	4,807.00	96.14	7,307.00	146.14
PP	PO	1	2500	50.00	200	48.80	5,612.00	112.24	8,112.00	162.24
PO	PH	1	2500	50.00	200	61.10	9,326.50	186.53	11,826.50	236.53
PN	PM	1	2500	50.00	225	67.70	7,988.60	159.77	10,488.60	209.77
PM	PPC	1	2500	50.00	225	100.00	11,800.00	236.00	14,300.00	286.00
PL	PK	1	2500	50.00	225	24.40	2,879.20	57.58	5,379.20	107.58
PK	PPC	1	2500	50.00	225	29.30	3,457.40	69.15	5,957.40	119.15
PPC	PH	1	2500	50.00	225	77.40	9,133.20	182.66	11,633.20	232.66
PI	PH	1	2500	50.00	225	54.30	6,407.40	128.15	8,907.40	178.15
PH	PG	1	2500	50.00	200	85.60	9,844.00	196.88	12,344.00	246.88
PG	PF	1	2500	50.00	250	107.30	12,876.00	257.52	15,376.00	307.52
PF	GGZ	1	2500	50.00	500	67.70	12,051.00	241.02	14,551.00	291.02
GGZ	PB	1	2500	50.00	500	73.80	13,136.00	262.72	15,636.00	312.72
PE	PD	1	2500	50.00	225	90.80	10,714.00	214.28	13,214.00	264.28
PD	PC	1	2500	50.00	200	92.30	10,614.00	212.28	13,114.00	262.28
PC	PB	1	2500	50.00	200	99.80	11,477.00	229.54	13,977.00	279.54
PB	PA	1	2500	50.00	500	120.10	21,378.00	427.56	23,878.00	477.56
PA	OD	1	2500	50.00	500	24.40	1,343.20	86.86	6,843.20	136.86
OZ	OY	1	2500	50.00	200	60.70	6,980.50	139.61	9,480.50	189.61
OY	OW	1	2500	50.00	200	13.10	1,506.50	30.13	4,006.50	80.13
OX	OW	1	2500	50.00	200	76.50	8,797.50	175.95	11,297.50	225.95
OW	OV	1	2500	50.00	225	52.60	6,206.80	124.14	8,706.80	174.14
OV	OT	1	2500	50.00	225	19.80	2,336.40	46.73	4,836.40	96.73
OT	OO	1	2500	50.00	225	64.00	7,552.00	151.04	10,052.00	201.04
MMX	OS	1	2500	50.00	200	40.60	4,669.00	93.38	7,169.00	143.38
OS	OR	1	2500	50.00	200	10.30	1,184.50	23.69	3,684.50	73.69
OR	OQ	1	2500	50.00	200	24.20	2,783.00	55.66	5,283.00	105.66
MMQ	OQ	1	2500	50.00	225	72.20	8,519.60	170.39	11,019.60	220.39
OQ	OO	1	2500	50.00	200	9.90	1,138.50	22.77	3,638.50	72.77
OO	ON	1	2500	50.00	200	74.40	8,556.00	171.12	11,056.00	221.12
ON	OI	1	2500	50.00	200	63.60	7,314.00	146.28	9,814.00	196.28
OK	OJ	1	2500	50.00	225	131.70	15,541.00	310.82	18,041.00	360.82
OL	OJ	1	2500	50.00	225	121.00	14,278.00	285.56	16,778.00	335.56

CITY OF LINDSAY
SEWER SYSTEM DATA

FROM MANHOLE	TO MANHOLE	# OF (HFO)	REP. VAL. (HFLS)	DEP. VAL. (HFLS)	DIAMETER (INCH)	LENGTH FOOT	REP. VAL. (DPSL)	DEP. VAL. (DPSL)	REP. VAL. TOTAL	DEP. VAL. TOTAL
OJ	OI	1	2500	50.00	200	120.40	13,846.00	276.92	16,346.00	326.92
OI	OH	1	2500	50.00	200	111.30	12,800.00	256.00	15,300.00	306.00
OH	OG	1	2500	50.00	200	106.10	12,202.00	244.04	14,702.00	294.04
OG	OF	1	2500	50.00	200	61.00	7,015.00	140.30	9,515.00	190.30
OF	OE	1	2500	50.00	200	83.70	9,625.50	192.51	12,125.50	242.51
OE	OD	1	2500	50.00	200	110.00	12,650.00	253.00	15,150.00	303.00
NO	NP	1	2500	50.00	300	100.60	13,078.00	261.56	15,578.00	311.56
NP	NQ	1	2500	50.00	250	71.90	8,628.00	172.56	11,128.00	222.56
NN	NQ	1	2500	50.00	225	65.80	7,764.40	155.29	10,264.40	205.29
NQ	NR	1	2500	50.00	200	7.80	897.00	17.94	3,397.00	67.94
NR	IJJ	1	2500	50.00	200	16.50	1,897.50	37.95	4,397.50	87.95
IJJ	NS	1	2500	50.00	225	167.60	19,777.00	395.54	22,277.00	445.54
NU	NS	1	2500	50.00	225	109.70	12,945.00	258.90	15,445.00	308.90
NS	GGY	1	2500	50.00	200	75.00	8,625.00	172.50	11,125.00	222.50
GGY	OD	1	2500	50.00	200	75.60	8,694.00	173.88	11,194.00	223.88
OD	OC	1	2500	50.00	500	121.60	21,645.00	432.90	24,145.00	482.90
OC	GGX	1	2500	50.00	500	65.80	11,712.00	234.24	14,212.00	284.24
GGX	NY	1	2500	50.00	500	84.10	14,970.00	299.40	17,470.00	349.40
NT	IJK	1	2500	50.00	450	104.20	17,714.00	354.28	20,214.00	404.28
IJK	NV	1	2500	50.00	450	103.80	17,646.00	352.92	20,146.00	402.92
NV	IIL	1	2500	50.00	450	54.60	9,282.00	185.64	11,782.00	235.64
IIL	NX	1	2500	50.00	200	4.50	517.50	10.35	3,017.50	60.35
NW	NX	1	2500	50.00	375	72.80	10,556.00	211.12	13,056.00	261.12
NX	NY	1	2500	50.00	375	40.80	5,916.00	118.32	8,416.00	168.32
NY	OA	1	2500	50.00	500	9.10	1,619.80	32.40	4,119.80	82.40
MMD	PPA	1	2500	50.00	225	40.80	4,814.40	96.29	7,314.40	146.29
PPA	OA	1	2500	50.00	200	3.70	425.50	8.51	2,925.50	58.51
OA	OB	1	2500	50.00	200	14.60	1,679.60	33.58	4,179.00	83.58
OB	MZ	1	2500	50.00	500	119.50	21,271.00	425.42	23,771.00	475.42
IIB	NJ	1	2500	50.00	225	60.00	7,080.00	141.60	9,580.00	191.60
NK	NJ	1	2500	50.00	225	5.90	696.20	13.92	3,196.20	63.92
NJ	NI	1	2500	50.00	225	68.30	8,059.40	161.19	10,559.40	211.19
NI	NH	1	2500	50.00	225	68.30	8,059.40	161.19	10,559.40	211.19
NH	NF	1	2500	50.00	225	137.20	16,190.00	323.80	18,690.00	373.80
NM	NL	1	2500	50.00	225	90.20	10,644.00	212.88	13,144.00	262.88
NL	NF	1	2500	50.00	225	121.30	14,313.00	286.26	16,813.00	336.26
NG	NF	1	2500	50.00	225	107.30	12,661.00	253.22	15,161.00	303.22
NF	NE	1	2500	50.00	225	100.00	11,800.00	236.00	14,300.00	286.00
NE	NC	1	2500	50.00	225	92.50	10,915.00	218.30	13,415.00	268.30
ND	NC	1	2500	50.00	225	121.90	14,384.00	287.68	16,884.00	337.68
NC	NA	1	2500	50.00	225	123.70	14,597.00	291.94	17,097.00	341.94
NB	NA	1	2500	50.00	225	114.60	13,523.00	270.46	16,023.00	320.46

CITY OF LINDSAY
SEWER SYSTEM DATA

FROM MANHOLE	TO MANHOLE	# OF CUT	REP. VAL. (DOLL.)	DEP. VAL. (DOLL.)	DIAMETER (mm)	LENGTH FEET	REP. VAL. (DOLL.)	DEP. VAL. (DOLL.)	REP. VAL. TOTAL	DEP. VAL. TOTAL
NA	MZ	1	2500	50.00	225	10.40	1,227.20	24.54	3,727.20	74.54
MZ	MY	1	2500	50.00	500	90.70	16,145.00	322.90	18,645.00	372.90
MY	MX	1	2500	50.00	500	33.50	5,963.00	119.26	8,463.00	169.26
SB	MH	1	2500	50.00	250	73.20	8,784.00	175.68	11,284.00	225.68
MH	MG	1	2500	50.00	250	91.40	10,968.00	219.36	13,468.00	269.36
MG	ME	1	2500	50.00	250	86.30	10,356.00	207.12	12,856.00	257.12
MF	ME	1	2500	50.00	375	16.90	2,450.50	49.01	4,950.50	99.01
KKE	KKD	1	2500	50.00	150	81.00	8,100.00	162.00	10,600.00	212.00
KKD	KKC	1	2500	50.00	150	132.00	13,200.00	264.00	15,700.00	314.00
KKC	ME	1	2500	50.00	225	16.00	1,888.00	37.76	4,388.00	87.76
ME	MD	1	2500	50.00	375	53.70	7,786.50	155.73	10,286.50	205.73
MD	MC	1	2500	50.00	375	55.20	8,004.00	160.08	10,504.00	210.08
MC	MB	1	2500	50.00	375	41.80	6,061.00	121.22	8,561.00	171.22
MB	MA	1	2500	50.00	375	48.20	6,689.00	139.78	9,489.00	189.78
IIN	MA	1	2500	50.00	200	71.30	8,199.50	163.99	10,699.50	213.99
MA	LZ	1	2500	50.00	375	31.70	4,596.50	91.93	7,096.50	141.93
LZ	LM	1	2500	50.00	375	104.20	15,109.00	302.18	17,609.00	352.18
LY	LX	1	2500	50.00	200	107.00	12,305.00	246.10	14,805.00	296.10
LX	LW	1	2500	50.00	200	111.00	12,765.00	255.30	15,265.00	305.30
LW	LV	1	2500	50.00	200	112.50	14,625.00	292.50	17,125.00	342.50
LV	LU	1	2500	50.00	300	89.00	11,570.00	231.40	14,070.00	281.40
LU	LT	1	2500	50.00	300	50.90	6,617.00	132.34	9,117.00	182.34
LT	LS	1	2500	50.00	300	84.70	11,011.00	220.22	13,511.00	270.22
LS	LR	1	2500	50.00	300	98.20	12,766.00	255.32	15,266.00	305.32
LR	LN	1	2500	50.00	300	7.90	1,027.00	20.54	3,527.00	70.54
LQ	MMN	1	2500	50.00	225	39.60	4,672.80	93.46	7,172.80	143.46
MMN	LP	1	2500	50.00	225	31.10	3,669.80	73.40	6,169.80	123.40
LP	LO	1	2500	50.00	300	71.90	9,347.00	186.94	11,847.00	236.94
LO	LN	1	2500	50.00	300	63.70	8,281.00	165.62	10,781.00	215.62
LN	GGH	1	2500	50.00	375	86.00	12,470.00	249.40	14,970.00	299.40
GGH	LM	1	2500	50.00	375	85.70	12,426.00	248.52	14,926.00	298.52
LM	LK	1	2500	50.00	375	87.20	12,644.00	252.88	15,144.00	302.88
LK	U	1	2500	50.00	375	48.00	6,960.00	139.20	9,460.00	189.20
U	U	1	2500	50.00	225	30.80	3,634.40	72.69	6,134.40	122.69
U	LH	1	2500	50.00	375	135.30	19,618.00	392.36	22,118.00	442.36
LH	LE	1	2500	50.00	375	143.90	20,866.00	417.32	23,366.00	467.32
LG	LF	1	2500	50.00	300	70.70	9,191.00	183.82	11,691.00	233.82
LF	LE	1	2500	50.00	300	54.60	7,098.00	141.96	9,598.00	191.96
LE	LC	1	2500	50.00	375	137.80	19,981.00	399.62	22,481.00	449.62
LD	LC	1	2500	50.00	225	123.30	14,549.00	290.98	17,049.00	340.98
LC	KV	1	2500	50.00	375	145.70	21,126.00	422.52	23,626.00	472.52
KV	KU	1	2500	50.00	225	8.50	1,003.00	20.06	3,503.00	70.06

CITY OF LINDSAY
SEWER SYSTEM DATA

FROM MANHOLE	TO MANHOLE	# OF (FEET)	REP. VAL (MILE \$)	DEP. VAL (MILE \$)	DIAMETER (mm)	LENGTH (FEET)	REP. VAL (DOLLAR)	DEP. VAL (DOLLAR)	REP. VAL TOTAL \$	DEP. VAL TOTAL \$
LB	LA	1	2500	50.00	225	66.50	7,847.00	156.94	10,347.00	206.94
LA	KY	1	2500	50.00	225	140.80	16,614.00	332.28	19,114.00	382.28
KZ	KY	1	2500	50.00	225	68.30	8,059.40	161.19	10,559.40	211.19
KY	KW	1	2500	50.00	225	142.00	16,756.00	335.12	19,256.00	385.12
KX	KW	1	2500	50.00	225	63.60	7,504.80	150.10	10,004.80	200.10
KW	KU	1	2500	50.00	225	145.70	17,193.00	343.86	19,693.00	393.86
KU	KF	1	2500	50.00	525	116.30	21,050.00	421.00	23,550.00	471.00
KT	KR	1	2500	50.00	225	98.70	11,647.00	232.94	14,147.00	282.94
KS	KR	1	2500	50.00	225	102.90	12,142.00	242.84	14,642.00	292.84
KR	KQ	1	2500	50.00	225	79.30	9,357.40	187.15	11,857.40	237.15
KQ	KP	1	2500	50.00	225	60.40	7,127.20	142.54	9,627.20	192.54
KP	KO	1	2500	50.00	225	142.00	16,756.00	335.12	19,256.00	385.12
KO	KN	1	2500	50.00	225	114.60	13,523.00	270.46	16,023.00	320.46
KN	KF	1	2500	50.00	225	34.10	4,023.80	80.48	6,523.80	130.48
KJ	KI	1	2500	50.00	225	69.50	8,201.00	164.02	10,701.00	214.02
KI	KH	1	2500	50.00	225	91.70	10,821.00	216.42	13,321.00	266.42
KH	KG	1	2500	50.00	225	90.40	10,667.00	213.34	13,167.00	263.34
KG	KFI	1	2500	50.00	225	14.30	1,687.40	33.75	4,187.40	83.75
KM	KL	1	2500	50.00	225	76.50	9,027.00	180.54	11,527.00	230.54
KL	KK	1	2500	50.00	225	90.10	10,632.00	212.64	13,132.00	262.64
KK	KF	1	2500	50.00	225	14.30	1,687.40	33.75	4,187.40	83.75
KF	KFI	1	2500	50.00	225	0.00	0.00	0.00	2,500.00	50.00
KFI	GGW	1	2500	50.00	450	72.50	12,325.00	246.50	14,825.00	296.50
GGW	KC	1	2500	50.00	450	74.40	12,648.00	252.96	15,148.00	302.96
KD	KC	1	2500	50.00	225	87.30	10,301.00	206.02	12,801.00	256.02
KE	KC	1	2500	50.00	225	164.30	19,387.00	387.74	21,887.00	437.74
KC	KB	1	2500	50.00	375	67.10	9,729.50	194.59	12,229.50	244.59
KB	KA	1	2500	50.00	400	81.10	12,976.00	259.52	15,476.00	309.52
KA	MX	1	2500	50.00	400	8.10	1,296.00	25.92	3,796.00	75.92
MX	MW	1	2500	50.00	500	64.30	11,445.00	228.90	13,945.00	278.90
MW	ML	1	2500	50.00	500	101.80	18,120.00	362.40	20,620.00	412.40
MV	MU	1	2500	50.00	225	126.20	14,892.00	297.84	17,392.00	347.84
MU	MS	1	2500	50.00	225	154.40	18,219.00	364.38	20,719.00	414.38
MS	MR	1	2500	50.00	225	89.60	10,573.00	211.46	13,073.00	261.46
MR	MP	1	2500	50.00	225	100.90	11,906.00	238.12	14,406.00	288.12
MQ	MP	1	2500	50.00	225	99.40	11,729.00	234.58	14,229.00	284.58
MP	MO	1	2500	50.00	225	125.00	14,750.00	295.00	17,250.00	345.00
MO	MN	1	2500	50.00	225	126.80	14,362.00	299.24	17,462.00	349.24
MN	ML	1	2500	50.00	200	5.50	632.50	12.65	3,132.50	62.65
MM	ML	1	2500	50.00	200	109.70	12,616.00	252.32	15,116.00	302.32
ML	GGO	1	2500	50.00	500	93.90	16,714.00	334.28	19,214.00	384.28
GGO	GGP	1	2500	50.00	500	77.40	13,777.00	275.54	16,277.00	325.54

CITY OF LINDSAY
SEWER SYSTEM DATA

FROM MANHOLE	TO MANHOLE	# OF (S)	REP. VAL. (M, \$)	DEP. VAL. (M, \$)	DIAMETER (mm)	LENGTH feet	REP. VAL. (M, \$)	DEP. VAL. (M, \$)	REP. VAL. Total \$	DEP. VAL. Total \$
GQP	GQQ	1	2500	50.00	500	14.60	2,598.80	51.98	5,098.80	101.98
GQQ	GGM	1	2500	50.00	500	139.30	24,795.00	495.90	27,295.00	545.90
GGM	GGL	1	2500	50.00	525	26.20	4,742.20	94.84	7,242.20	144.84
JX	JW	1	2500	50.00	225	75.00	8,850.00	177.00	11,350.00	227.00
JW	JV	1	2500	50.00	225	76.50	9,027.00	180.54	11,527.00	230.54
JY	JV	1	2500	50.00	225	110.30	13,015.00	260.30	15,515.00	310.30
JV	JU	1	2500	50.00	225	140.20	16,544.00	330.88	19,044.00	380.88
KA	JZ	1	2500	50.00	300	96.80	12,584.00	251.68	15,084.00	301.68
MMO	MMP	1	2500	50.00	225	96.30	11,363.00	227.26	13,863.00	277.26
MMP	JZ	1	2500	50.00	250	20.00	2,400.00	48.00	4,900.00	98.00
JZ	JU	1	2500	50.00	375	112.30	16,284.00	325.68	18,784.00	375.68
JU	JT	1	2500	50.00	450	142.70	24,259.00	485.18	26,759.00	535.18
JT	SW	1	2500	50.00	450	79.30	13,481.00	269.62	15,981.00	319.62
SW	SX	1	2500	50.00	450	59.70	10,149.00	202.98	12,649.00	252.98
NNW	NNV	1	2500	50.00	200	76.00	8,740.00	174.80	11,240.00	224.80
NNV	NNU	1	2500	50.00	200	74.00	8,510.00	170.20	11,010.00	220.20
NPU	NNT	1	2500	50.00	200	92.00	10,580.00	211.60	13,080.00	261.60
NNT	NNS	1	2500	50.00	200	86.40	9,936.00	198.72	12,436.00	248.72
NNR	NNS	1	2500	50.00	200	50.80	5,842.00	116.84	8,342.00	166.84
NNS	MMW	1	2500	50.00	200	11.10	1,276.50	25.53	3,776.50	75.53
MMW	MMV	1	2500	50.00	200	46.70	5,370.50	107.41	7,870.50	157.41
MMV	MMU	1	2500	50.00	200	58.10	6,681.50	133.63	9,181.50	183.63
NNZ	NNY	1	2500	50.00	200	46.10	5,301.50	106.03	7,801.50	156.03
NNY	NNX	1	2500	50.00	200	88.60	10,189.00	203.78	12,689.00	253.78
NNX	MMU	1	2500	50.00	200	93.20	10,718.00	214.36	13,218.00	264.36
MMU	UO	1	2500	50.00	200	102.10	11,742.00	234.84	14,242.00	284.84
UO	UN	1	2500	50.00	200	81.40	9,361.00	187.22	11,861.00	237.22
UN	UM	1	2500	50.00	200	80.20	9,223.00	184.46	11,723.00	234.46
UM	UL	1	2500	50.00	200	71.70	8,245.50	164.91	10,745.50	214.91
UL	UK	1	2500	50.00	200	72.70	8,360.50	167.21	10,860.50	217.21
US	UP	1	2500	50.00	225	90.80	10,714.00	214.28	13,214.00	264.28
UR	UQ	1	2500	50.00	200	51.50	5,922.50	118.45	8,422.50	168.45
UQ	UP	1	2500	50.00	200	76.80	8,832.00	176.64	11,332.00	226.64
UP	UK	1	2500	50.00	225	45.70	5,392.60	107.85	7,892.60	157.85
UK	UH	1	2500	50.00	225	64.30	7,587.40	151.75	10,087.40	201.75
UJ	IU	1	2500	50.00	200	127.40	14,651.00	293.02	17,151.00	343.02
UI	UH	1	2500	50.00	200	125.30	14,410.00	288.20	16,910.00	338.20
UH	UF	1	2500	50.00	225	133.20	15,718.00	314.36	18,218.00	364.36
JJP	UG	1	2500	50.00	200	42.70	4,910.50	98.21	7,410.50	148.21
UG	UF	1	2500	50.00	200	86.00	9,890.00	197.80	12,390.00	247.80
UF	UE	1	2500	50.00	225	111.60	13,169.00	263.38	15,669.00	313.38
UW	UV	1	2500	50.00	225	84.10	9,923.80	198.48	12,423.80	248.48

CITY OF LINDSAY
SEWER SYSTEM DATA

FROM MANHOLE	TO MANHOLE	FOF (FEET)	REP. VAL. (MILE \$)	DEP. VAL. (MILE \$)	DIAMETER (mm)	LENGTH (FEET)	REP. VAL. (MILE \$)	DEP. VAL. (MILE \$)	REP. VAL. TOTAL \$	DEP. VAL. TOTAL \$
UV	UU	1	2500	50.00	225	5.80	684.40	13.69	3,184.40	63.69
UY	UU	1	2500	50.00	225	80.50	9,499.00	189.98	11,999.00	239.98
UX	UU	1	2500	50.00	225	130.40	15,387.00	307.74	17,887.00	357.74
UU	UT	1	2500	50.00	225	70.70	8,342.60	166.85	10,842.60	216.85
UT	UE	1	2500	50.00	225	71.60	8,448.80	168.98	10,948.80	218.98
UE	UD	1	2500	50.00	225	27.70	3,268.60	65.37	5,768.60	115.37
UD	UB	1	2500	50.00	225	134.70	15,895.00	317.90	18,395.00	367.90
UC	UB	1	2500	50.00	225	119.50	14,101.00	282.02	16,601.00	332.02
UB	UA	1	2500	50.00	225	190.80	22,514.00	450.28	25,014.00	500.28
UA	TZ	1	2500	50.00	225	143.20	16,898.00	337.96	19,398.00	387.96
TZ	TY	1	2500	50.00	225	34.70	4,094.80	81.89	6,594.60	131.89
TY	TX	1	2500	50.00	225	73.10	8,625.80	172.52	11,125.80	222.52
TX	TW	1	2500	50.00	225	82.90	9,782.20	195.64	12,282.20	245.64
TW	TV	1	2500	50.00	225	123.10	14,526.00	290.52	17,026.00	340.52
VT	VS	1	2500	50.00	200	65.20	7,498.00	149.96	9,998.00	199.96
VS	VR	1	2500	50.00	200	96.30	11,074.00	221.48	13,574.00	271.48
VR	VQ	1	2500	50.00	200	98.70	11,350.00	227.00	13,850.00	277.00
VQ	VP	1	2500	50.00	200	107.30	12,340.00	246.80	14,840.00	296.80
VP	VO	1	2500	50.00	225	90.50	10,679.00	213.58	13,179.00	263.58
VO	VM	1	2500	50.00	225	89.60	10,573.00	211.46	13,073.00	261.46
VN	VM	1	2500	50.00	225	100.90	11,906.00	238.12	14,406.00	288.12
VM	VL	1	2500	50.00	225	149.70	17,665.00	353.30	20,165.00	403.30
VL	VJ	1	2500	50.00	225	126.60	14,939.00	298.78	17,439.00	348.78
VK	VJ	1	2500	50.00	225	90.80	10,714.00	214.28	13,214.00	264.28
VJ	VI	1	2500	50.00	225	78.90	9,310.20	186.20	11,810.20	236.20
VI	VH	1	2500	50.00	225	89.30	10,537.00	210.74	13,037.00	260.74
VH	VF	1	2500	50.00	225	145.40	17,157.00	343.14	19,657.00	393.14
VG	VF	1	2500	50.00	225	88.40	10,431.00	208.62	12,931.00	258.62
VF	VE	1	2500	50.00	225	11.70	1,380.60	27.61	3,880.60	77.61
VE	VC	1	2500	50.00	225	129.30	15,257.00	305.14	17,757.00	355.14
VC	VB	1	2500	50.00	225	129.80	15,316.00	306.32	17,816.00	356.32
VB	VA	1	2500	50.00	225	56.10	6,619.80	132.40	9,119.80	182.40
VA	UZ	1	2500	50.00	225	70.10	8,271.80	165.44	10,771.80	215.44
WK	WI	1	2500	50.00	225	73.50	8,673.00	173.46	11,173.00	223.46
WJ	WI	1	2500	50.00	225	75.00	8,850.00	177.00	11,350.00	227.00
WI	IIH	1	2500	50.00	225	11.40	1,345.20	26.90	3,845.20	76.90
IIH	WH	1	2500	50.00	225	89.00	10,502.00	210.04	13,002.00	260.04
WH	WG	1	2500	50.00	225	91.70	10,821.00	216.42	13,321.00	266.42
WG	WE	1	2500	50.00	225	117.30	13,841.00	276.82	16,341.00	326.82
WF	WE	1	2500	50.00	225	33.90	11,080.00	221.60	13,580.00	271.60
WE	WD	1	2500	50.00	225	162.80	19,210.00	384.20	21,710.00	434.20
WD	WC	1	2500	50.00	225	165.10	19,482.00	389.64	21,982.00	439.64

CITY OF LINDSAY
SEWER SYSTEM DATA

FROM MANHOLE	TO MANHOLE	# OF DEG	REP. VAL (MILE)	DEP. VAL (MILE)	DIAMETER (mm)	LENGTH (FOOT)	REP. VAL (FOOT)	DEP. VAL (FOOT)	REP. VAL TOTAL	DEP. VAL TOTAL
WB	WC	1	2500	50.00	200	73.80	8,487.00	169.74	10,987.00	219.74
WC	VZ	1	2500	50.00	225	139.30	16,437.00	328.74	18,937.00	378.74
WA	VZ	1	2500	50.00	225	65.00	7,670.00	153.40	10,170.00	203.40
VZ	VX	1	2500	50.00	225	180.30	21,275.00	425.50	23,775.00	475.50
WQ	WP	1	2500	50.00	225	60.00	7,080.00	141.60	9,580.00	191.60
WP	WO	1	2500	50.00	225	49.70	5,864.60	117.29	8,364.60	167.29
WO	WN	1	2500	50.00	225	88.80	10,478.00	209.56	12,978.00	259.56
WN	WL	1	2500	50.00	225	86.40	10,185.00	203.80	12,685.00	253.80
WM	WL	1	2500	50.00	300	61.30	7,969.00	159.38	10,469.00	209.38
WL	VX	1	2500	50.00	300	108.50	14,105.00	282.10	16,605.00	332.10
VX	VW	1	2500	50.00	300	124.60	16,198.00	323.96	18,698.00	373.96
VW	VV	1	2500	50.00	300	7.60	988.00	19.76	3,488.00	69.76
VV	VU	1	2500	50.00	300	76.20	9,906.00	198.12	12,406.00	248.12
VU	UZ	1	2500	50.00	300	5.00	650.00	13.00	3,150.00	63.00
UZ	TV	1	2500	50.00	225	70.10	8,271.80	165.44	10,771.80	215.44
VD	TV	1	2500	50.00	250	60.00	7,200.00	144.00	9,700.00	194.00
TV	TU	1	2500	50.00	225	71.30	8,413.40	168.27	10,913.40	218.27
TU	TP	1	2500	50.00	225	70.10	8,271.80	165.44	10,771.80	215.44
TP	SX	1	2500	50.00	225	89.60	10,573.00	211.46	13,073.00	261.46
TJ	TI	1	2500	50.00	225	55.50	6,549.00	130.98	9,049.00	180.98
MT	TI	1	2500	50.00	225	36.90	4,354.20	87.08	6,854.20	137.08
TI	TH	1	2500	50.00	225	25.80	3,044.40	60.89	5,544.40	110.89
TH	TG	1	2500	50.00	225	81.70	9,640.60	192.81	12,140.60	242.81
TG	TF	1	2500	50.00	225	150.60	17,771.00	355.42	20,271.00	405.42
TF	TD	1	2500	50.00	225	61.00	7,198.00	143.96	9,698.00	193.96
TE	TD	1	2500	50.00	225	50.00	5,900.00	118.00	8,400.00	168.00
TN	TM	1	2500	50.00	225	86.90	10,254.00	205.08	12,754.00	255.08
TM	TL	1	2500	50.00	225	93.90	11,080.00	221.60	13,580.00	271.60
TL	TK	1	2500	50.00	225	92.70	10,939.00	218.78	13,439.00	268.78
TO	TK	1	2500	50.00	225	86.60	10,219.00	204.38	12,719.00	254.38
TK	TD	1	2500	50.00	225	93.80	11,068.00	221.36	13,568.00	271.36
TD	TC	1	2500	50.00	225	10.10	1,191.80	23.84	3,691.80	73.84
MMM	TC	1	2500	50.00	225	87.80	10,360.00	207.20	12,860.00	257.20
TC	TB	1	2500	50.00	225	78.00	9,204.00	184.08	11,704.00	234.08
TB	TA	1	2500	50.00	225	43.60	5,144.80	102.90	7,644.80	152.90
TA	SX	1	2500	50.00	225	192.30	22,691.00	453.82	25,191.00	503.82
TT	TS	1	2500	50.00	225	80.50	9,499.00	189.98	11,999.00	239.98
TK	TS	1	2500	50.00	225	11.60	1,368.80	27.38	3,868.80	77.38
TS	TR	1	2500	50.00	225	120.70	14,243.00	284.86	16,743.00	334.86
TR	TQ	1	2500	50.00	225	100.30	11,835.00	236.70	14,335.00	286.70
TQ	TP	1	2500	50.00	225	91.40	10,785.00	215.70	13,285.00	265.70
SX	SY	1	2500	50.00	225	18.20	3,094.00	61.88	5,594.00	111.88

CITY OF LINDSAY
SEWER SYSTEM DATA

FROM MANHOLE	TO MANHOLE	# OF (FEET)	REP. VAL. (\$1,000)	DEP. VAL. (\$1,000)	DIAMETER (INCH)	LENGTH (FEET)	REP. VAL. (\$1,000)	DEP. VAL. (\$1,000)	REP. VAL. (\$1,000)	DEP. VAL. (\$1,000)
SY	GGL	1	2500	50.00	450	3.90	705.90	14.12	3,205.90	64.12
GGL	JJN	1	2500	50.00	525	53.80	9,737.80	194.76	12,237.80	244.76
JJN	SZ	1	2500	50.00	600	88.80	21,490.00	429.80	23,990.00	479.80
SZ	PUMP	1	2500	50.00	250	10.00	1,200.00	24.00	3,700.00	74.00
TOTALS		1054	2635000	52,700.00		80,914.80	10,409,329.80	208,186.68	13,044,329.80	260,886.68

Manhole + Pipes

The sum of Replacement = \$13,044,329.80 13 Million \$

The sum of Depreciation = \$260,886.68 0.26 Million \$

END

3 1 - 0 5 - 9 5

FIN