Municipality of East Hants

Infrastructure Capacity Study
Final Report

October 1998

98-5106-01-01

Submitted by

Porter Dillon Limited
in Association with
Cox Downie and
W. H. Gates Utilities Ltd.

DILLON
CONSULTING

October 6, 1998

MUNICIPALITY OF EAST HANTS
2361 Highway No. 2
Municipal Building
Milford, Nova Scotia
BOH 2HO

ATTENTION: Mr. Ed Gillis, P.Eng.
Director of Operations

Infrastructure Capacity Study - Final Report

Please find enclosed four (4) copies of the Final Report on the Municipality of East Hants Infrastructure Capacity Study. This report documents Study Area boundaries, serviced population projections, regional wastewater system analyses, regional water system analyses, conceptual infrastructure improvements, capital cost estimates, financial analyses and implementation plans. It should be noted that the infrastructure improvements are presented for planning purposes and that configuration of the improvements must be confirmed during detailed design.

Yours truly,

PORTER DILLON LIMITED

Richard Stephenson, P.Eng.
Project Manager and Water Resources Specialist

RS:keb
cc G. Isenor, P.Eng.
Technical Review Partner
Our File: 98-5106-01-01

L:\PROJECTS\FINAL\985106\TEXT\CAPACITY.RPT

Porter Dillon Limited

Table of Contents

Page
No.

Acronyms i
Abbreviations i
Executive Summary I

Part A - Background and Demographics

1.0 INTRODUCTION A-1
1.1 Study Objectives A-1
1.2 Structure of Study A-2
1.3 Service Area Boundaries A-3
1.3.1 Area 1 - Enfield Service Subarea A-3
1.3.2 Area 2 - Elmsdale Service Subarea A-6
1.3.3 Area 3 - Clayton Developments Service Subarea A-6
1.3.4 Area 4 - Maplewood/Lantz Service Subarea A-6
1.3.5 Area 5 - Willowcrest/Ridgefield Service Subarea A-6
1.4 Study Output A-7
1.5 Other Related Studies A-8
1.5.1 Long Term Development Management Plan/Suitability Analysis . . A-8
1.5.2 Floodplain Mapping A-9
1.5.3 Water Supply Capacity/Storage Needs Analysis A-9
1.5.4 Master Drainage Plan - Corridor Section of MEH A-10
1.5.5 Route 214 Transportation Study A-10
1.6 Dwelling Units A-10

2.0 SERVICED POPULATION A-12
2.1 Approach A-12
2.2 Existing Serviced Population A-14
2.3 Intermediate Term Population Projection (2023) A-15
2.4 Ultimate Serviced Population Projection A-17
2.5 Long Term Population Projections A-18
2.6 Five Year Population Projections A-18
2.7 Pace of Development A-19

Table of Contents

(Continued)

Page No.

Part B - Regional Wastewater System Analysis

1.0 INTRODUCTION B-1
1.1 Background B-1

2.0 WASTEWATER FLOW PROJECTIONS B-3
2.1 Existing Wastewater Flows B-3
2.2 Future Wastewater Flow Projections B-5

3.0 DESCRIPTION OF EXISTING WASTEWATER COLLECTION AND TREATMENT SYSTEM B-8
3.1 Sewage Treatment Plant B-8
3.2 Pumping Stations and Forcemains B-9
3.3 Gravity Collection System B-10

4.0 CAPACITY OF EXISTING WASTEWATER SYSTEM B-11
4.1 Assessment Methodology and Assumptions B-11
4.1.1 Sewage Treatment Capacity B-11
4.1.2 Pumping Station Capacity B-12
4.1.3 Gravity Sewer Capacity B-13
4.2 Capacity of Existing Wastewater System B-14
4.2.1 Sewage Treatment Plant B-14
4.2.2 Pumping Stations and Forcemains B-15
4.2.3 Gravity Collection System B-19

5.0 INFRASTRUCTURE PLAN B-22
5.1 Time Horizons B-22
5.2 Short Term Recommendations (1999-2000) B-23
5.3 Intermediate Term Recommendations B-24
5.3.1 Wastewater Treatment B-24
5.3.2 Pumping Stations and Forcemains B-24
5.3.3 Gravity Collection System B-25
5.4 Long Term Recommendations B-26

Table of Contents

(Continued)

		Page No.
6.0	FINANCIAL PLAN	B-28
6.1	Capital Cost Estimates	B-28
	6.1.1 Short Term Upgrades	B-28
	6.1.2 Intermediate Term Upgrades	B-28
7.0	IMPLEMENTATION PLAN	B-31
7.1	Short Term	B-31
7.2	Intermediate Term	B-31

Part C - Regional ~~Waste~~water System Analysis

1.0	INTRODUCTION	C-1
1.1	Background	C-1
1.2	Scope of Work	C-1
1.3	Units	C-2
2.0	SERVICE BOUNDARIES AND DEMAND PROJECTIONS	C-3
2.1	Existing Water Serviceable Boundaries	C-3
2.2	Population and Demand Projections	C-4
3.0	EXISTING WATER SUPPLY AND DISTRIBUTION SYSTEM	C-6
3.1	Raw Water Supply	C-7
3.2	Low Lift Pumps and Supply Line	C-7
3.3	Water Treatment Plant Capacity	C-8
3.4	High Lift Pumps and Clearwell	C-9
3.5	Transmission Main Capacity	C-9
3.6	Storage Reservoir Capacity	C-10
4.0	DESIGN ASSUMPTIONS	C-12
4.1	Hydraulic Design Standard	C-12
4.2	Servicing Restrictions	C-13
4.3	Fire Flow Requirements	C-14

Table of Contents
(Continued)

Page No.

4.4 Storage Requirements C-14
4.5 Transmission Main Requirements C-18

5.0 HYDRAULIC ANALYSIS C-19
5.1 Hydraulic Network Model C-19
5.2 Required Hydraulic Improvements C-21
5.2.1 Reservoir Storage C-21
5.2.2 Primary Transmission Main C-22
5.2.3 Clearwell Capacity C-26
5.2.4 Pumping System Improvements C-26
5.2.5 Raw Water Source Limitations and Water Treatment Plant Capacity C-28

6.0 INFRASTRUCTURE AND IMPLEMENTATION PLAN C-30
6.1 Infrastructure Timeline C-30
6.1.1 Year 1999 Improvements - Average Day Demand 320 USGPM C-30
6.1.2 Year 2009 Improvements - Average Day Demand of 550 USGPM C-32
6.1.3 Year 2013 Improvements - Average Day Demand of 615 USGPM C-32
6.1.4 Year 2018 Improvements - Average Day Demand of 700 USGPM C-33
6.1.5 Year 2024 Improvements - Average Day Demand of 850 USGPM C-33

7.0 CAPITAL COST ESTIMATES C-35

Table of Contents
(Continued)

Page No.

Part D - Financial Analysis

1.0 INTRODUCTION D-1
1.1 Background D-1
1.2 Scope of Study D-3
1.3 Approach to Financial Analysis D-3

2.0 EXISTING MUNICIPAL POLICIES AND PROCEDURES D-6
3.0 CAPITAL COST ESTIMATES D-8
3.1 Wastewater System D-8
3.2 Water System D-10

4.0 CAPITAL COST RECOVERY ALTERNATIVES D-12
4.1 Uniform Capital Cost Recovery Charges D-12
4.1.1 Water Servicing Scenario 1 - Twenty Year Plan D-13
4.1.2 Water Servicing Scenario 2 - Longer Term Plan D-13
4.2 Capital Cost Contribution for Water Infrastructure D-14
4.3 Wastewater Capital Cost Recovery Charges D-17
4.3.1 Recommendation D-18

5.0 RESULTS OF CAPITAL COST RECOVERY ANALYSIS D-19
5.1 Wastewater Capital Cost Recovery Charges D-19
5.2 Water System Capital Cost Recovery Charges D-20
5.2.1 Scenario 1 - Twenty Year Plan D-20
5.2.2 Scenario 2 - Longer Term Plan D-22
5.2.3 Recommended Water Capital Cost Charge D-23
5.3 Stormwater Management Costs D-24
5.4 Road Paving Costs D-25
5.5 Policy Recommendations Summary D-26

Table of Contents
(Continued)

Page
No.

List of Maps (in Pouch)

Map 1 Regional Sanitary System Existing Conditions and 25 Year Upgrades
Map 2 Conceptual Water System Configuration - Long Term

Appendices

Appendix B-1 Detailed Capital Cost Estimates for Wastewater System Improvements

Appendix C-1 Detailed Capital Cost Estimates for Water System Improvements

Appendix D-1 Development of Capital Cost Contributions in New and Existing Developments Serviced by the Municipality of East Hants

Appendix D-2 Detailed Calculations for Capital Cost Contributions for Water System

Appendix D-3 Detailed Calculations for Capital Cost Contributions for Water System

List of Figures

		Page No.
Figure 1-1	Study Organization	A-4
Figure 1-2	Service Area Boundaries	A-5
Figure 5-1	East Hants Water Distribution System Conceptual Layout	C-20
Figure 5-2	Ridgefield/Willowcrest Storage Reservoir #1 Schematic	C-23
Figure 5-3	Willowcrest Storage Reservoir #2 Schematic	C-24
Figure 5-4	Business Park Storage Reservoir Schematic	C-25
Figure 6-1	Infrastructure Timeline	C-31

List of Tables

		Page No.
Table 2-1	Design Population Densities	A-14
Table 2-2	Current Estimated and Potential Population, East Hants Study Area	A-15
Table 2-3	Future Population Estimate, East Hants Study Area, 2023	A-16
Table 2-4	Future Potential (Ultimate) Population, East Hants Study Area	A-17
Table 2-5	Incremental Serviced Population Estimate, East Hants Study Area 1998 to 2023	A-18
Table 2-1	Calculated Existing Average and Peak Flow for each Service Area	B-4
Table 2-2	Calculated Average and Peak Flow Projections for each Service Area	B-6
Table 4-1	Existing Pumping Station Capacity	B-16
Table 4-2	Existing Gravity Collection System Capacity	B-20
Table 6-1	Capital Cost Estimates - Regional Wastewater System	B-30
Table 2-1	Future Maximum Day Water Demand Projections (1998 - 2023)	C-5
Table 4-1	Estimated Fire Flow Requirements	C-15
Table 4-2	Storage Reservoir Requirements	C-17
Table 5-1	Total Volume of Stand Pipe Reservoir Storage for 25 Year Horizon	C-22
Table 3-1	Capital Cost Estimates - Regional Wastewater System	D-9
Table 3-2	Capital Cost Estimates - Regional Water System	D-11
Table 5-2	Summary of Water System Charges - Scenario 1 - Twenty Year Plan	D-21
Table 5-3	Summary of Water System Charges - Scenario 2 - Longer Term Plan	D-23

Acronyms

MEH	-	Municipality of East Hants
HRWC	-	Halifax Regional Water Commission
HRM	-	Halifax Regional Municipality
WSD	-	Water Service District
HCM	-	(Former) Halifax County Municipality
HGL	-	Hydraulic Grade Line
USEPA	-	United Stated Environmental Protection Agency
NSUARB	-	Nova Scotia Utility and Review Board
NSDOE	-	Nova Scotia Department of the Environment
AMSL	-	Above Mean Seal Level (Geodetic)
IAO	-	Insurers Advisory Organization
CCC	-	Chlorine Contact Chamber
WTP	-	Water Treatment Plant

Abbreviations

ac	-	Acres
km	-	Kilometres
mi	-	Miles
igcd	-	Imperial Gallons Per Capita Per Day
MGD	-	Million U.S. Gallons Per Day
MIGD	-	Million Imperial Gallons Per Day
MLD	-	Mega Litres Per Day
ppa	-	Persons Per Acre
hp	-	Horsepower
USgpm	-	U.S. Gallons Per Minute
IGPM	-	Imperial Gallons Per Minute
USGD	-	U.S. Gallons Per Day
PS#1	-	Sanitary Sewage Pumping Station Number 1
USGCD	-	U.S. Gallons per Capita per Day
Musgal	-	Million U.S. Gallons
I/I	-	Infiltration and Inflow

Executive Summary

The Executive Summary highlights the major findings associated with the Municipality of East Hants Infrastructure Capacity Study. The statements are arranged in point form consistent with report parts and sections.

Part A - Background and Demographics

Introduction

1. The Municipality of East Hants has recognized a need within the Corridor Section to have "an accurate assessment of the real direct costs of development and to ensure that sufficient charges are levied by the Municipality on developers on a per lot basis to recover real costs to the Municipality in servicing lots with sewer and water, storm drainage structures and the completion of the development by the eventual paving of abutting roads".

2. The Infrastructure Capacity Study Report was structured in four parts; Part A - Background and Demographics; Part B - Regional Wastewater System Report; Part C - Regional Water System Report and Part D - Regional Financial Analysis. In addition there is sanitary and water supply trunk infrastructure base mapping which includes study and boundaries, existing trunk water and wastewater infrastructure and recommendations for future improvements.

3. The results of other related studies conducted as part of the ongoing planning review have been considered as part of this study.

Serviced Population

1. Existing serviced population was based on 1996 Census of Canada counts in the Census '96 Electronic Database for Nova Scotia adjusted based on dwelling unit allocation presented in the Highway 214 Transportation Study (Streetwise 1998). The existing serviced population is 4,914 person living on 1,638 lots with an additional 177 serviced but unoccupied lots raising the existing potential serviced population to 5,445 persons on 1,815 serviced lots.

2. The future, 25 year, population estimate (2023) within the Corridor Section is 14,426 persons living in 4,306 dwelling units.

3. While the ultimate future population estimate for all developable area within the Corridor Section is 35,866 persons living on 8,891 lots located on 1,987 acres is theoretically possible in the long term, it is not expected that the community will see such a level of development in the foreseeable future. An intermediate long term population projection of 25,000 persons has been prepared upon which the buried piping infrastructure will be designed.

4. The capital cost recovery financial analysis presented in Part D - Regional Financial Analysis has been based on a 25 year pace of development of 75 serviced lots per year. It is expected that the actual pace of development will be revisited on a regular basis to determine whether the revenue stream is consistent with the capital debt servicing charges incurred to that date and that the capital cost recovery charges may be adjusted accordingly.

Part B - Regional Wastewater

Introduction

1. The Regional Wastewater System analysis, provides a summary of existing and future wastewater flow projections, a description of the existing wastewater collection and treatment system, a discussion of the capacity of the existing system, an infrastructure plan recommending short term, intermediate term and long term improvements to the wastewater system, capital cost estimates and an implementation plan.

Wastewater Flow Projections

1. The existing wastewater flows were assessed using three different accepted methods which enabled evaluation of all trunk wastewater collection and treatment systems.

2. Existing average day wastewater flows for the service area estimated at 490,050 U.S. gallons per day (USGPD) and peak wet weather flows are estimated at 3,297,810 USGPD.

3. Future wastewater flow projections were based on future population projections (2023 and ultimate) presented in Part A and on per capita unit wastewater flows of 378 U.S. gallons per person, per day, and on infiltration and inflow rates of 1,200 U.S.gal/acre/day.

4. Total future (2023) average day wastewater flows are estimated to be 1,298,340 U.S.GPD and total future (2023) maximum day flows are estimated to be 7,541,028 U.S.GPD. These flow projections were used to evaluate the capacity of the existing and future wastewater collection and treatment infrastructure.

Capacity of Existing Wastewater Collection and Treatment System

1. The basic wastewater treatment facility, an aerated lagoon system constructed in 1989/90, has the capacity to provide adequate treatment, based on the current treatment requirements of 20 mg/L of biochemical oxygen demand (BOD) and suspended solids (SS), for the 25-year flow projections. The treatment plant will, however, require upgrading to the aeration system in approximately 10 years and the adequacy of the chlorine disinfection system and the dechlorination system should be reviewed at that time.

2. In general, the capacity of the majority of the twenty-two sanitary pumping stations are adequate to accommodate the 25-year flow projections.

3. Specific sanitary pumping stations and forcemains requiring upgrade in the short and intermediate term include PS4, PS15, PS18 and PS20.

4. The gravity sanitary collection system has been evaluated using 5 year increments of development to the year 2023. The entire gravity collection system has been found to be capable of handling the calculated peak flows for existing conditions. The five year projections (2003) call for upgrades to PS18 and PS20 complete with new forcemains.

5. The first set of gravity system upgrades will be required once the 15 year flow projections are realized and assuming PS18 and PS20 are upgraded in the immediate future, no short term gravity system upgrades are required.

Infrastructure Plan

1. Three distinct groups of improvements have been identified consistent with the following time horizons.

   - ***Short Term (1999-2000)*** which are designed to address existing deficiencies and are considered necessary at this time.

   - ***Intermediate Term (2001-2023)***, which are required as development proceeds to address capacity limitations in the sanitary collection and treatment system over the next 25 years.

   - ***Long Term (beyond 2023)***, which are required when serviced population and associated development exceed the 25 year projections. While not strictly required under the terms of this study, certain long term improvements have been identified so that the Municipality can begin to consider their implications and to plan to address them in the future.

Financial Plan and Implementation Plan

1. Table 1 provides a summary of the recommended short and intermediate term improvements complete with capital costs in the year they are expected to be required.

Table 1 Wastewater Infrastructure Requirements and Capital Cost Estimates

Year Required	Infrastructure Element	Code[1]	Total Capital Cost[1] 1998 Dollars[2]	Total Capital Cost[1] Actual Inflated[3]
1999		$ 337,000	$ 337,000	
2003	• Replace PS18 and PS20 • Forcemain PS18 and PS20 • Emergency Power PS17		$ 1,535,000	$ 1,779,000
2008	• Upgrade PS15 • Upgrade STP Aeration • Emergency Power PS7		$ 357,000	$ 480,000
2013	• Upgrade Gravity Mains • Emergency Power PS8 • Emergency Power PS9	Links Y and Z	$ 572,000	$ 891,000
2018	• Upgrade Gravity Mains • Emergency Power PS10 • Emergency Power PS13	Link U	$ 364,000	$ 657,000
2023	• Upgrade Gravity Mains • Emergency Power PS14	Links I and AG	$ 222,000	$ 465,000
	Totals		$ 3,387,000	$ 4,609,000

Notes:

1. Refer to Drawing No. 1.
2. Costs include a 10% allowance for engineering, a 15% allowance for contingency and the fraction of the HST payable by the Municipality (3/7 of 15%).
3. Cost includes a 3% per year inflation factor; a 10% allowance for engineering and a 15% contingency and the fraction of the HST payable by the Municipality 3/7 of 15%).

The estimated capital cost for all wastewater system improvements amounts to approximately $3,387,000 (in 1998 dollars) including engineering and contingency. Capital costs are also presented in inflated future dollars (at time of construction) based on a 3% per year inflation factor and amount to $4,609,000 in future dollars.

2. Detailed capital cost estimates for recommended wastewater system improvements are presented as an appendix to the Regional Wastewater System Analysis Report.

Part C - Regional Water System Analysis

Introduction

1. The water system analysis identifies water infrastructure requirements to remediate deficiencies in the existing water supply, treatment, storage and transmission system and to provide adequate capacity for intermediate and long term growth.

Service Boundaries and Demand Projections

1. Lands within the Regional Water Serviceable Boundary are designated as potentially serviceable from the existing water supply, treatment and distribution system. Servicing areas outside the present boundaries without making provision for additional raw water supply and treatment capacity will result in reduced serviceability of lands within the presently defined serviceable boundary.

2. Future maximum day water demand projections to the year 2023 have been identified based on population projections prepared in Part A. The future (2023) maximum day water demand for the study area is 1,396 USGPM or approximately 1.7 million imperial gallons per day (MIGD).

Existing Water Supply and Distribution System

1. The existing water supply and distribution system includes the following elements:

   - Raw water supply from the Shubenacadie River south of Enfield immediately upstream of the Highway No. 102 bridges;

   - Low lift pumping from the raw water supply well;

   - Primary water treatment capacity of up to 500 igpm (600 USGPM) located at Enfield and a backup water treatment plant for emergency services with a capacity of 200 igpm (240 USGPM).

   - Treated water clearwell storage capacity at the Enfield Water Treatment Plant of approximately 280,000 IGAL.

   - High lift pumping at an average throttled rate of approximately 400 igpm (480 USGPM). The nominal unthrottled capacity of the high lift pumps is 700 USGPM at 247 feet total dynamic head (TDH).

- Transmission of treated water along the corridor utilizing a single linear transmission main (12"/10"/8") located primarily in Highway No. 2 from the Enfield treatment plant to the Milford/Lantz boundary. Two segments of a new 16" diameter water transmission main have recently been constructed in the Park Road and in Highway No. 214.

- Water distribution piping throughout developed areas of the Study Area are summarized on the conceptual water system plan located in the pouch.

- Elevated reservoir storage in two steel standpipes at Enfield and Lantz.

Design Assumptions and Hydraulic Analysis

1. Hydraulic and planning assumptions for hydraulic design standards, servicing restrictions, fire flow requirements, storage requirements and transmission main design are presented as the basis for hydraulic analysis.

2. A revised hydraulic network model operating in the Epanet environment was applied to evaluate existing and future water transmission and distribution system configurated within the study area.

3. Required future short and intermediate (to 2023) hydraulic improvements include 960,000 imperial gallons of additional reservoir storage, a new 16" diameter primary water transmission main extending from the Enfield water treatment plant to the vicinity of the Willowcrest Subdivision in Lantz, improved low lift, high lift and booster pump station capacity and an increase in the treatment plant capacity to accommodate the Municipality's full water rights from the Shubenacadie River at Enfield.

4. Long term (beyond 2023) water system improvements include identification of expanded raw water supply capacity, development of additional treatment plant capacity and construction of a new water transmission main from the source and new treatment plant location to the existing water transmission system. The most likely source of additional raw water is Grand Lake.

Infrastructure Plan and Financial Plan

1. Table 2 provides a summary of recommended water system improvements and capital cost estimates for the design and construction of those improvements.

Table 2 Water Infrastructure Requirements and Capital Cost Estimates

Year Required	Infrastructure Element	Code on Map 2	Total Capital Cost[1]	
			1998 Dollars	Actual Inflated Dollars
1999	• 0.37 MIG Water Reservoir (North Lantz) • Lantz Water Booster Pumping Station • Transmission Mains	A C B, D, E, G, F	$ 5,633,000	$ 5,802,000
2009	• Upgrade Enfield Water Treatment Plant	H	$ 1,252,000	$ 1,733,000
2013	• 0.96 MIG Water Reservoir (Business Park) • Water Transmission Main	I J	$ 1,397,000	$ 2,176,000
2018	• Build New Water Treatment Plant @ Grand Lake • Build Grand Lane Transmission Main	N O	$ 7,169,000	$ 12,948,000
2024	• 0.46 MIG Water Reservoir (North Lantz) • Upgrade and Construct Water Transmission Main	K L, M	$ 3,074,000	$ 6,629,000
	Totals		$ 18,530,000	$ 29,288,000

Notes:
1. Total Capital Cost includes a 3% per year inflation factor, a 10% allowance for detailed engineering design and a 15% contingency.

2. Each improvement is related to a code which refers to Map 2 - Conceptual Water System Configuration - Long Term located in the pouch at the end of this report.

3. The total cost of improving the East Hants water system over the next 25 years is approximately $29.3 million in the actual inflated future dollars or $18.5 million in 1998 dollars. The detailed capital cost estimates are presented in Appendix C.

Part D - Financial Analysis

Introduction

1. The financial analysis includes the approach to financial analysis, a brief review of relevant existing municipal planning policies and procedures, a summary of capital cost estimates, a review of capital cost recovery alternatives, identification of the preferred capital cost recovery model, calculation of applicable capital cost recovery charges for water and wastewater trunk infrastructure and a summary of the proposed implementation plan.

2. Two basic principles, which have been identified as relevant to the financing of new trunk services for development, are "user pay" and "revenue/cost neutrality". The principle of "revenue/cost neutrality" simply states that the Municipality, the Utility and the existing

residents are not prepared to assume all of the costs and risks of future capital expenditures to service new developments except on the "user pay" basis.

3. The prototype capital cost recovery mechanism in the Province is a set of procedures established and ratified in favour of the Halifax Regional Water Commission known as the "Gates Formula" for appropriating capital costs with respect to trunk water system improvements in Bedford South.

Existing Municipal Policies and Procedures

1. Existing municipal policies, bylaws and procedures which relate to the development and execution of a capital cost recovery strategy include:

   - Trunk Sewer Tax Bylaw No. 155
   - Regional Water Utility Schedule of Rules and Regulations
   - Subdivision Bylaw
   - Municipal Services General Specification
   - Sewer Bylaw No. 139
   - Policy Regarding Extension of Services within the Serviceable Area

Capital Cost Estimates

1. Capital cost estimates for future (to Year 2023) wastewater and water system improvements have been presented above.

Capital Cost Recovery Alternatives

1. Two time dependent scenarios or plans have been considered for financing capital improvements for the water system:

   - *Water Servicing Scenario 1 - Twenty Year Plan* which addresses short term (1999) and intermediate term improvements (to 2018) requirements for water supply, treatment, transmission and storage.

   - *Water Servicing Scenario 2 - Long Term Plan* which represents the stream of capital expenditures and revenues required to provide for development from the present to beyond the 20 year horizon including the significant capital expenditures in Year 2018 associated with construction of a new water treatment plant and transmission main at Grand Lake.

2. A proposed capital cost recovery formula presented here, which is based on a method (Gates Formula) approved by the Nova Scotia Utility and Review Board (NSUARB), is intended to enable the Water Utility to remain cost neutral in the construction of trunk water infrastructure required to service new developments (See Appendix D-1 for detailed presentation of proposed formula).

Results of Capital Cost Recovery Analysis

1. The new wastewater system infrastructure improvements proposed for the next 25 years ($3,387,000 in 1998 dollars) should be funded by a capital cost recovery charge similar in appearance to the existing sewer tax charge of $3,000 per lot which is adequate to cover future requirements. The existing sewer tax should be retained at its current level to fund future wastewater system improvements to the year 2023.

2. The new short and intermediate term water system improvements (2018) proposed as Scenario 1 - 20 year plan for the next 20 years ($9,711,000 in future inflated dollars) will require a capital cost recovery charge of $3,012 per lot or $13,514 per acre.

3. The new short, intermediate and longer term water system improvements (beyond 2018) proposed as Scenario 2 - Longer Term Plan ($29,288,000 in future inflated dollars) will require a capital cost recovery charge of $5,840 per lot or $26, 134 per acre.

4. The capital costs associated with future stormwater management infrastructure improvements identified in the Master Drainage Plan (Porter Dillon 1997) are specific to particular watershed and therefore no area wide capital cost estimates for stormwater management infrastructure are presented here. The developer will be required to negotiate the requirements for new stormwater management infrastructure on a case by case basis.

5. Typical paving cots for residential roads within the Corridor Section of the Municipality is estimated to be $2,000 to $2,500 per R1 or R2 lot or $1,000 to $1,250 per semi-detached dwelling unit. Assuming an average development density of 4.5 lots per acre, the cost of road paving is estimated at $9,000 to $11,250 per acre.

Policy Recommendations

Wastewater System

1. The Municipality should adopt and periodically update a comprehensive wastewater general specification which is consistent with NSDOE Guidelines and with specifications currently in effect throughout the Halifax Regional Municipality. It should be the policy of MEH to update their general specification on a regular basis. To make it consistent with that of

Halifax Regional Municipality where possible, so that the development community in the region can work to one standard.

2. The Municipality currently has a policy which requires that all lands approved for development within the Serviceable Area be serviced by the regional wastewater system. It is recommended that the use of on-site sanitary systems be discouraged in all future residential developments within the Serviceable Area so that the Municipality can ensure that a fair proportion of the cost of trunk wastewater infrastructure will be recovered from new development.

3. The Municipality should consider adoption of a policy requiring that wastewater management within individual sewersheds be based on gravity collection and transmission sewer mains and that the use of sanitary pumping stations be minimized wherever possible.

Water System

1. Water supply design criteria consistent with those in effect within the Halifax Regional Municipality and Halifax Regional Water Commission should be adopted so that the Municipality is presenting similar regulatory requirements to the development community across the region.

2. Evaluate long term potential for expanding raw water supply beyond the existing water rights permit to accommodate long term growth. Potential additional supply may be available from the Shubenacadie River, Grand Lake or from groundwater sources.

3. Consider a policy to limit water service to the existing water service district boundary thereby reducing the potential for costly urban sprawl.

4. Establish a capital cost recovery mechanism to recover the capital costs associated with extending services to new development from the new homeowners or developers so that the burden does not fall on the existing customer base.

5. Institute a policy to encourage or require developers to integrate the water distribution piping in new developments with that in adjacent developments to improve interconnections and promote hydraulic cross flow thereby increasing fireflow capacity within the overall system.

Capital Cost Recovery

1. The new wastewater system improvements proposed for the next 25 years should be funded by a capital cost recovery charge of $3,000 per lot similar in appearance to the existing

sewer tax charge which will be adequate to cover future sanitary system requirements. To this end, the existing sewer tax of $3,000 per lot should be retained to fund future wastewater system improvements.

2. The new water system improvements to 2018 as proposed in Scenario 1 - 20 year plan should be funded by a water system capital cost recovery charge of $3,012 per lot of $13,514 per acre.

3. The Municipality should initiate discussions with the Nova Scotia Utility and Review Board (NSUARB) with the goal of acquiring permission for the Water Utility to collect a water system capital cost recovery charge.

4. The Municipality should establish a policy on stormwater management to recover capital costs associated with improvements to the regional stormwater management infrastructure required by new development. The capital costs of these improvements should be recovered directly from those developments which benefit from them.

Part A
Background and Demographics

Table of Contents
Part A - Background and Demographics

Page No.

1.0 INTRODUCTION A-1
1.1 Study Objectives A-1
1.2 Structure of Study A-2
1.3 Service Area Boundaries A-3
1.3.1 Area 1 - Enfield Service Subarea A-3
1.3.2 Area 2 - Elmsdale Service Subarea A-6
1.3.3 Area 3 - Clayton Developments Service Subarea A-6
1.3.4 Area 4 - Maplewood/Lantz Service Subarea A-6
1.3.5 Area 5 - Willowcrest/Ridgefield Service Subarea A-6
1.4 Study Output A-7
1.5 Other Related Studies A-8
1.5.1 Long Term Development Management Plan/Suitability Analysis . . A-8
1.5.2 Floodplain Mapping A-9
1.5.3 Water Supply Capacity/Storage Needs Analysis A-9
1.5.4 Master Drainage Plan - Corridor Section of MEH A-10
1.5.5 Route 214 Transportation Study A-10
1.6 Dwelling Units A-10

2.0 SERVICED POPULATION A-12
2.1 Approach A-12
2.2 Existing Serviced Population A-14
2.3 Intermediate Term Population Projection (2023) A-15
2.4 Ultimate Serviced Population Projection A-17
2.5 Long Term Population Projections A-18
2.6 Five Year Population Projections A-18
2.7 Pace of Development A-19

List of Figures

Page No.

Figure 1-1 Study Organization A-4
Figure 1-2 Service Area Boundaries A-5

List of Tables

		Page No.
Table 2-1	Design Population Densities	A-14
Table 2-2	Current Estimated and Potential Population, East Hants Study Area	A-15
Table 2-3	Future Population Estimate, East Hants Study Area, 2023	A-16
Table 2-4	Future Potential (Ultimate) Population, East Hants Study Area	A-17
Table 2-5	Incremental Serviced Population Estimate, East Hants Study Area 1998 to 2023	A-18

1.0 INTRODUCTION

Over the past two decades, the Municipality of East Hants, and specifically the Corridor Section, has been one of the fastest growing residential communities in Nova Scotia. As with several other growing municipalities, East Hants has recognized the need to ensure that future development must be "cost neutral" in terms of its long term financial impact on the existing community. In order that the Municipality exercise control over the direction of development, it has commissioned this Infrastructure Capacity Study to assess the real direct costs of future development on the trunk sanitary and water supply systems, and to provide the basis for a serviceable area development policy in relation to financial planning, and the implementation of development proposals.

1.1 Study Objectives

The principal objective of this Infrastructure Capacity Study has been to define in detail the anticipated cost of current and future trunk infrastructure needs with specific emphasis on sewer, and water infrastructure and to provide the basis for a serviceable area development policy in relation to financial planning and the implementation of development proposals. As stated in the Terms of Reference, the Municipality has recognized their need to have

> "an accurate assessment of the real direct costs of development and ensure that sufficient charges are levied by the Municipality on developers on a per lot basis to recover real costs to the Municipality in servicing lots with sewer and water, storm drainage structures and the completion of the development by the eventual paving of abutting roads".

The main focus of this Infrastructure Capacity Study has been wastewater and water systems, however, reference has also been made to the capital costs associated with upgrading of Regional Drainage Infrastructure and to the cost of paving public roadways within the various developments.

1.2 Structure of Study

To achieve the stated objectives, the following major work tasks identified in the proposal have been completed under three principal activities:

ACTIVITY 1 - REGIONAL WASTEWATER SYSTEM ANALYSIS

1.1 Review Background Information and Collect Field Data
1.2 Establish Servicing Boundary Alternatives and Sanitary Sewershed Mapping
1.3 Develop Population Projections and Sanitary Loading
1.4 Review and Evaluate Existing Sanitary Sewer and Treatment Facilities
1.5 Identify Ultimate Servicing Concept
1.6 Develop Capital Costs and Implementation Schedule
1.7 Reporting

ACTIVITY 2 - REGIONAL WATER SYSTEM ANALYSIS

2.1 Review Background Information and Design Criteria
2.2 Upgrade Existing Preliminary Computer Model
2.3 Develop Demand Projections
2.4 Establish and Model Alternative Servicing Scenarios
2.5 Identify Preferred Servicing Scenarios
2.6 Develop Capital Cost and Implementation Schedule
2.7 Reporting

ACTIVITY 3 - FINANCIAL AND ECONOMIC ANALYSIS

3.1 Review Municipal Planning Polices and Procedures
3.2 Identify Life Cycle Capital & Operating Costs
3.3 Identify and Review Alternative Cost Recovery Schemes
3.4 Assess Impacts of Cost Recovery Schemes on Attractiveness of East Hants for Development
3.5 Identify Potential Fiscal Capacity Constraints
3.6 Recommend Capital and Operating Cost Recovery Schemes
3.7 Prepare an Implementation Plan
3.8 Reporting

Figure 1-1 provides a graphical representation of the overall approach to the preparation of Infrastructure Capacity Study. The regional wastewater system analysis and the regional water system analysis have been conducted in parallel during the initial phase of the study and the results of these activities have been compiled and integrated into the financial analysis which in turn has been fed into the policy recommendations component of the study.

1.3 Service Area Boundaries

The section of the Municipality of East Hants to which municipal water and sanitary services have been extended is known as the Corridor Section.

The portion of the existing Corridor Section service area considered in this study is bounded on the south and the east by the Shubenacadie River, on the west by Highway No. 102, and on the north by the Lantz/Milford Boundary. The Study Area also includes the East Hants Business Park located west of Highway No. 102 near its junction with Highway No. 214.

For the purposes of technical analysis within the Infrastructure Capacity Study, the Corridor Section has been subdivided into five subareas based on existing sewershed and watershed boundaries. Each of the five service subareas are illustrated on Figure 1-2 and are discussed in the following sections.

1.3.1 Area 1 - Enfield Service Subarea

The Enfield Service Sub-area encompasses that area within the Corridor Section known as Enfield with a minor deviation along the Enfield/Elmsdale boundary to recognize the existing sewershed boundary.

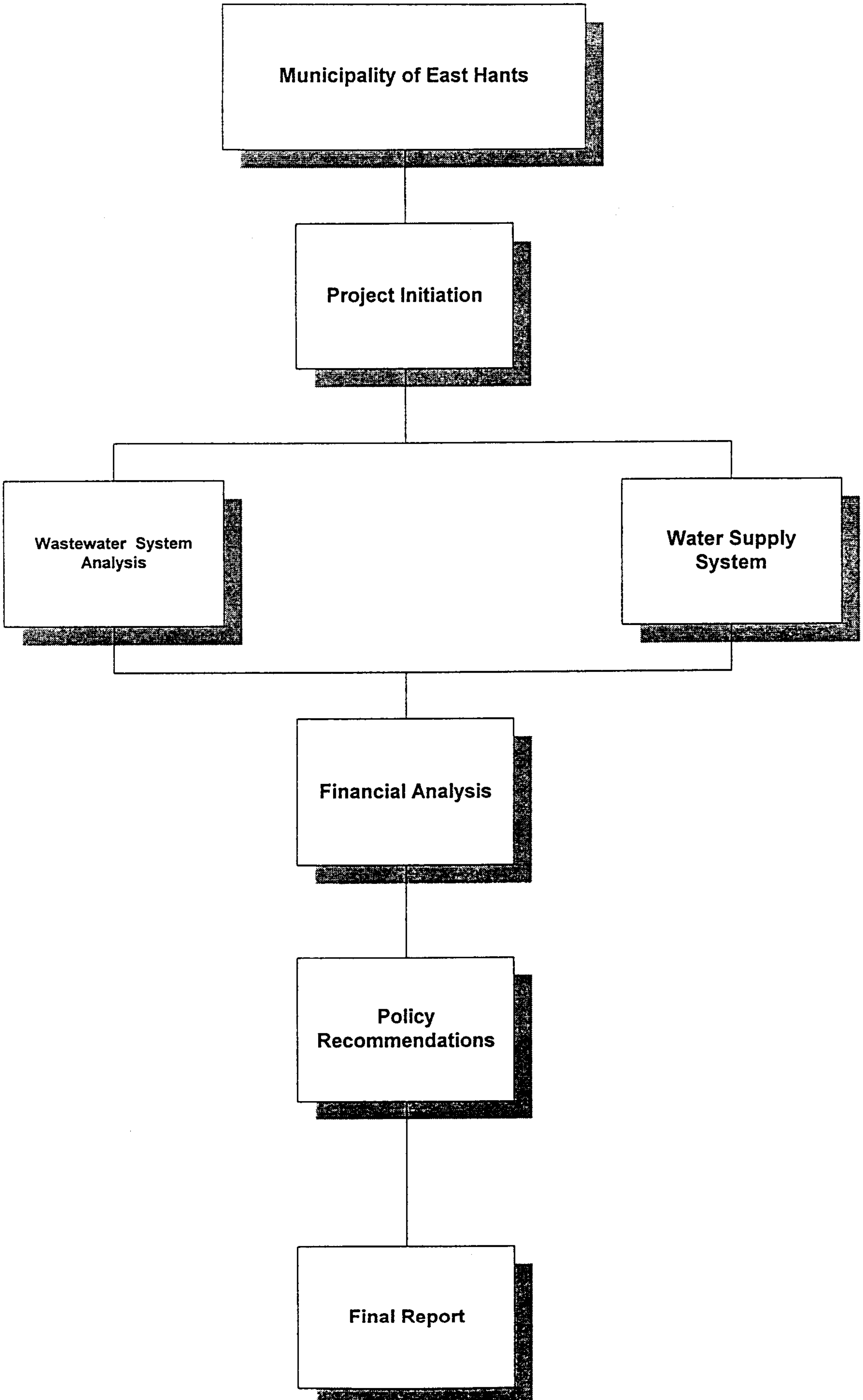
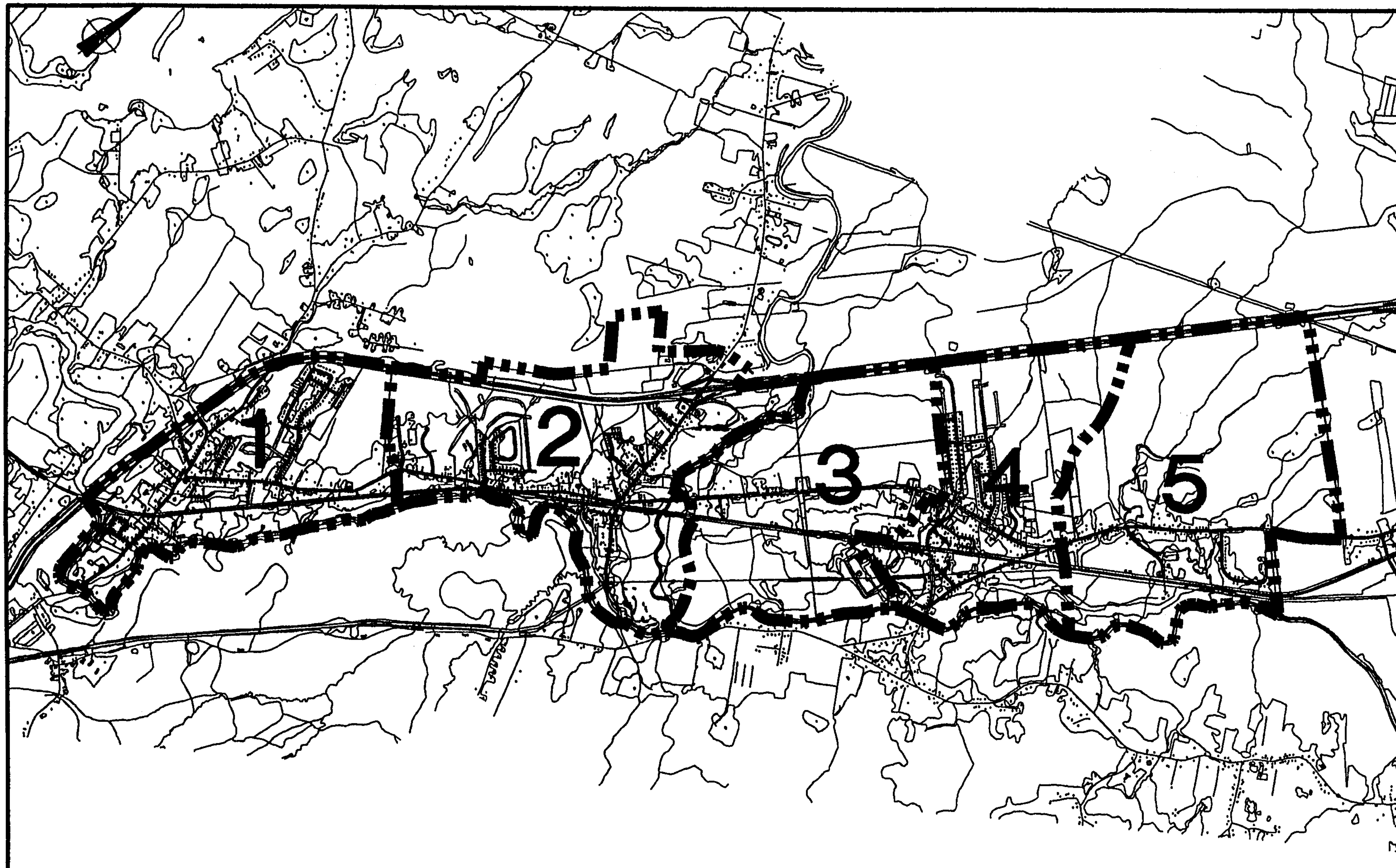


Figure 1-1
Study Organization

G:\CAD\985106\5106F1-2 19980602.1514



Porter Dillon Limited	TITLE SERVICE BOUNDARY	PROJECT No. 98-5106
DATE OCTOBER 1998	PROJECT EAST HANTS INFRASTRUCTURE CAPACITY STUDY	FIGURE No. 1-2

1.3.2 Area 2 - Elmsdale Service Subarea

The Elmsdale Service Subarea encompasses that area within the Corridor Section known as Elmsdale extending from the boundary with Enfield to the Nine Mile River including the Elmwood Subdivision, MacMillan Manor, the East Hants Business Park and the development along Highway No. 214.

1.3.3 Area 3 - Clayton Developments Service Subarea

The Clayton Developments Service Subarea includes that area within the Corridor Section from the Nine Mile River to the south boundary of the existing Maplewood Subdivision. This subarea is generally those lands owned by Clayton Developments for which a conceptual residential development plan currently exists.

1.3.4 Area 4 - Maplewood/Lantz Service Subarea

The Maplewood/Lantz Service Subarea encompasses that area from the north boundary of the Clayton Developments lands to the south boundary of the Barney's Brook watershed with a small deviation to accommodate existing sanitary sewershed boundaries. Generally sewage from Area 4 flows by gravity either to the Pumping Station PS15 or to the existing gravity transmission system in Highway No. 2 and thence to PS17.

1.3.5 Area 5 - Willowcrest/Ridgefield Service Subarea

The Willowcrest/Ridgefield Service Subarea encompasses lands within the Barney's Brook watershed to the Lantz/Milford boundary. Generally Area 5 includes the majority of the proposed Willowcrest subdivision, the Ridgefield Subdivision and other smaller land holdings. Sanitary sewage from Area 5 flows by gravity to PS18 and PS20 from which it is pumped over the watershed divide into the existing gravity transmission system which flows toward PS17 and the sewage treatment plant.

1.4 Study Output

Principal elements of the Infrastructure Capacity Study Report include the following major parts:

- **Sanitary and Water Supply Trunk Infrastructure Base Mapping** including Study Area and Subarea boundaries, existing trunk infrastructure, and recommendations for future improvements. The base mapping comprises two maps: Map 1 - Regional Sanitary System Existing Conditions and 25 Year Upgrades and Map 2 - Conceptual Water System Configuration (year 2023).

- **Serviced Population Projections** (Part A - Background and Demographics) based on existing service population statistics and projected regional growth rates consistent with the growth expectations of the Municipality.

- **Regional Wastewater System Report** (Part B) outlining existing and projected sanitary flow rates, the capacity of existing trunk sanitary infrastructure including the wastewater treatment plant, pumping stations and forcemains and gravity sewers; recommended short, intermediate and long term infrastructure improvements; and an implementation plan for phasing the improvements.

- **Regional Water System Report** (Part C) outlining the existing and future water supply requirements, the capacity of the existing water supply, treatment, transmission and storage system, design parameters, hydraulic analysis methodology, recommended short, intermediate and long term infrastructure improvements, and an implementation plan for phasing the improvements.

- **Regional Financial Analysis** (Part D) including a review of existing municipal planning policies and procedures, a summary of capital cost expenditures, a review of capital cost recovery alternatives; selection of a preferred capital cost recovery model and an implementation plan incorporating the various infrastructure elements with a capital expenditure cash flow time line.

The study outputs included in this Infrastructure Capacity Study and the companion mapping provide the Municipality of East Hants with the tools to assist to plan and finance capital expenditures for the regional water and wastewater systems and to establish a capital cost recovery process designed to be "revenue cost-neutral" to the municipality and the existing customer base.

The principal of "revenue/cost neutrality" simply states that the Municipality and the Utility are not prepared to assume all of the cost and risks of future capital expenditures to service new developments except on the "user pay" basis.

1.5 Other Related Studies

As part of an ongoing legislated review of its 1991 Planning Documents, which include the Municipal Planning Strategy (MPS), Land Use By-Law (LUB), Generalized Future Land Use Mapping (GFLUM) and the 1986 Subdivision By-Law, the Municipality of East Hants has recently completed the following other related studies. These studies have provided information which has been incorporated into this study.

1.5.1 Long Term Development Management Plan/Suitability Analysis

The Municipality has in the past been required to review and approve proposals for development in the absence of adequate information required to evaluate the impacts of that development on existing neighbouring lands and communities. This situation applied primarily to the development of residential subdivisions. These newly constructed residential subdivisions, although approved separately, eventually have merged together over time to create one larger development or neighbourhood.

To make most effective use of sewer and water infrastructure, roads, open spaces, schools, playgrounds, environmentally sensitive areas, community involvement and other issues relating to development, a residential development should be evaluated in relation to its impact on the entire community. The Planning and Development Department of the Municipality of East Hants has completed a Long Term Development Management Plan/Suitability Analysis that fulfills this goal with a comprehensive plan for the Study Area. This study was initiated at the beginning of July, 1997 and completed in January, 1998 (EDM, 1998).

1.5.2 Floodplain Mapping

The floodplain of most of the Shubenacadie River and the Nine Mile River within the Study Area was mapped as part of a study conducted in 1981 by the Maritime Resource Management Services (MRMS). The following zone classifications were determined as a result of that effort: the "Environmental Hazard Zone" (approximately 1 in 6 years flood frequency); and, the "Environmental Low Flood Risk Zone" (approximately 1 in 100 years flood frequency). These two zones are shown on the existing Land Use By-Law (LUB) maps. The 1981 floodplain study has been reviewed as part of the current Planning Review. A subsequent study to review, revise and complete the Municipality's floodplain mapping was initiated in November, 1997 and completed in early 1998 (CBCL, 1998).

1.5.3 Water Supply Capacity/Storage Needs Analysis

In 1997, the Municipality of East Hants (MEH) was granted permission to expend funding under the Canada/Nova Scotia Infrastructure Works Program for the preparation of a Water Supply Capacity/Storage Needs Analysis aimed at identifying short term infrastructure requirements to remediate deficiencies in the existing water supply and distribution system. Capital works identified in this study (Porter Dillon 1997) and constructed during the winter of 1997/1998 include approximately 1700 metres of 400 mm (16") diameter PVC water transmission main connecting the Elmwood Subdivision to the East Hants Business Park and approximately 220,000 imperial gallons of additional buried clearwell storage immediately adjacent the Enfield Water Treatment Plant. The recommended water system improvements are consistent with long term operational requirements of the system.

1.5.4 Master Drainage Plan - Corridor Section of MEH

In 1997, the Municipality of East Hants (MEH) initiated a study (Porter Dillon, 1998) to prepare a Master Drainage Plan for the Corridor Section. This Master Drainage Plan identified approximately 50 individual subwatersheds incorporated into ten major independent watersheds draining to the Shubenacadie River, estimated peak stormwater runoff rates from the subwatersheds, identified inadequate culverts and other drainage infrastructure and estimated the size and cost of new drainage infrastructure required to accommodate long term peak runoff rates under ultimate development conditions

.

1.5.5 Route 214 Transportation Study

Route 214, which is a two lane highway in Elmsdale beginning at Trunk Highway No. 2 and running in a northwest direction to Trunk Highway No. 14 near the Nine Mile River, represents one of the most significant commercial districts within the Municipality. In anticipation of several new commercial developments expected in the near future, the Municipality commissioned the Route 214 Transportation Study (Streetwise, 1998) to identify expected traffic loading on Route 214 resulting from both commercial development along its length and residential growth within its collection arms and to determine the geometric improvements that would be required to service and efficiently manage this traffic loading. In addition, other objectives included identification of potential locations for future points of access to Route 214, review of interconnections between commercial and potential commercial business and investigation of the impact on pedestrian traffic.

1.6 Dwelling Units

Lands within the Study Area which have been designated Residential are typically zoned R1 and R2. Throughout this study, an individual residential dwelling unit has been referred to as "serviced lot", which is intended to indicate one single occupancy housing unit. For the purposes of this study, an R2 lot includes two serviced lots each intended to accommodate one single occupancy housing unit.

2.0 SERVICED POPULATION

An important consideration in infrastructure design is the population that must be served. For all municipal systems it is important to know both the current and future number of dwellings and residents to be serviced in order to size pipes, plants and related infrastructure. This is a key step in the analytical process given that rehabilitation of inadequate systems or financing of overbuilt systems is normally very expensive.

2.1 Approach

Designers must be particularly careful to avoid undersizing municipal infrastructure, as systems that cannot provide the necessary level of service must be replaced or twinned. Oversizing, on the other hand, will result in upfront over-investment by developers and the municipality. Given, however, that many of the components of water and sewer networks are designed for a 100 year service life, there is reasonable expectation that the community will eventually "grow into" these systems. The additional cost of larger diameter collection and distribution pipes is very modest relative to the cost of upgrading an under-designed system. For these reasons, engineers with the long term picture in mind who are charged with the responsibility of designing municipal infrastructure should be conservative.

It is also important to coordinate estimates with other work that has been done for the Study Area. As discussed above, several studies have been completed recently that are relevant to the development of the Study Area. The CBCL floodplain study has established the area of the floodplain on the banks of the Nine Mile River and Shubenacadie River in which development should be restricted. The *Long Term Development Plan/Suitability Analysis* by EDM outlines development constraints and proposes various restrictions on development to protect the environment, including establishment of buffer zones around minor watercourses and environmentally sensitive areas. The Water Supply Capacity Storage Need Analysis (PDL, 1998) has set certain parameters for estimating the impact of development on infrastructure requirements. Finally, the recent *Route 214 Transportation Study* by Streetwise included detailed dwelling unit and employment projections broken down into zones that fit reasonably well with our population considerations for water and sewer servicing.

On the basis of previously noted studies conducted within the Study Area, consultation with municipal engineering and planning staff, and our own experience with assignments of this type, a number of assumptions were developed for estimating future population. These assumptions take into account the limits on developing certain parts of the Study Area and appropriate bases for sizing infrastructure. Our primary assumptions and the considerations underlying each follow:

- ***No development in the Nine Mile River Floodplain***
  The floodplain of the Nine Mile and Shubenacadie Rivers was defined on the basis of recent floodplain study by CBCL Ltd. The 1:20 year floodplain has been designated as the restricted area and no development will be permitted within this zone.

- ***No development within 15 m. of any other watercourse***
  EDM in their Suitability Analysis has proposed a 30 m buffer on either side of watercourses within the Study Area other than the Nine Mile River. The purpose of this buffer is to ensure separation of development from watercourses and preservation of some or all natural vegetation to allow filtering of stormwater runoff. As of the printing date of this report, this recommendation has not been considered by Council. It is possible that backyards will be permitted in this buffer area, that the recommended buffer will be reduced, or that the measure will not be approved. To facilitate this study, it was decided to assume half (15 m) the recommended watercourse buffer area will remain undeveloped.

- ***Population Densities***
  The Porter Dillon report *Water Supply Capacity/Storage Needs Analysis for the East Hants Regional Water Utility* assumed 3.35 persons per dwelling unit as a basis for estimating water system requirements in the Municipality. Although this figure is slightly greater than the existing household size determined by the most recent Census for the Study Area (3.0 persons per dwelling unit), it was assumed that this higher household density would provide

an appropriate contingency for system design consistent with the future growth potential of young families.

Residential population densities applied throughout this study area based on 3.35 persons per household and 4.1 housing units per acre of developable land for R-1 development and 4.8 housing units per acre of developable land for R-2 development. These housing densities were based on typical lot size and road frontages prevalent within the community and are consistent with industry standards. Table 2-1 provides a summary of population densities assumed for R-1 and R-2 development in this study.

Table 2-1 Design Population Densities

Type of Development	Lots Per Acre	Household[1] Size (Persons)	Design Population Density (Persons Per Acre)
R-1	4.1	3.35	13.8
R-2	4.8	3.35	16.0

Notes:
1. Household size based on typical number of persons per household experienced within the region and consistent with industry standard.

The weighted average number of lots per acre assumed across the study area is 4.5 and the average population density is 15 persons per acre. This weighted average assumes a higher proportion of R-2 lots with semi detached dwelling units which is consistent with recent developments proposed for approval within the Study Area.

2.2 Existing Serviced Population

Current population and dwelling units were determined from 1996 Census of Canada counts. Reference was made to Enumeration Area (EA) counts in the Census '96 GeoRef electronic database for Nova Scotia. As the boundaries of EAs, which are the smallest standard areas for which data are compiled by the Census, do not correspond to our service subareas, some adjustments were made based on dwelling unit allocations in the Highway 214 Transportation

Study (Streetwise, 1998). Dwelling unit counts for each service area were multiplied by 3.0, the current average household size determined from Census data, to determine current serviced population estimates.

Current population and dwelling unit counts by service subarea are summarized in Table 2-2. We estimate that there are 1,638 dwelling units within the Study Area occupied by 4,914 people. There are also 177 existing approved but unoccupied, serviced building lots bringing the total number of occupied and unoccupied service area lots to 1,815. Therefore, the serviced area is considered to have a current potential to increase to 5,445 people or an additional 10.8 per cent above today's serviced population without further lots approved.

Table 2-2 Current Estimated and Potential Population, East Hants Study Area

Service Area	Existing Dwellings	Existing Population	Additional Serviced Lots[1]	Total Serviced Lots	Existing Potential Population
Area 1 - Enfield	500	1,500	0	500	1,500
Area 2 - Elmsdale	486	1,458	80	566	1,698
Area 3 - Clayton	60	180	0	60	180
Area 4 - Maplewood/ Lantz	429	1,287	97	526	1,578
Area 5 - Willow Crest/Ridgefield	163	489	0	163	489
TOTAL	**1,638**	**4,914**	**177**	**1,815**	**5,445**

Notes:
1. Additional serviced but unoccupied lots include both R1 and R2 lots.

2.3 Intermediate Term Population Projection (2023)

Comparison of the estimates of dwelling units for the Study Area based on Census of Canada counts and dwelling unit counts for zones corresponding to the Study Area in the Streetwise

Transportation Study found very little difference. Therefore, the Streetwise estimates for zones corresponding to our service areas have been adopted. As Streetwise projected dwelling units to 2004 and 2016, we have further extrapolated their estimate to 2023, our Horizon year. This ensures that water and sewer infrastructure planning for the Study Area is consistent with traffic planning, which will be similarly affected by future growth. Streetwise dwelling unit projections were multiplied by a future population density of 3.35 persons per household to obtain an anticipated serviced population at the Horizon year.

By 2023, extrapolation of the Streetwise projections based on their annual per cent increases for each service subarea indicates that the Study Area should accommodate 14,426 people in 4,306 dwelling units. This is a 163.6 per cent increase over existing dwelling unit counts and a 194.3 per cent increase in population. As discussed in the following section, this estimate for 2023 is still well short of the overall capacity of the Study Area. By comparison, the 2023 population estimate is similar to the former Town of Bedford (13,618 in 1996) and slightly larger than the Town of Truro (11,938 in 1996). Table 2-3 provides an estimate of future serviced population within the five serviced subareas to the year 2023. The expected annual percentage increase represents the compounded annual growth rate necessary to achieve the projected number of dwelling units estimated for the year 2023.

Table 2-3 Future Population Estimate, East Hants Study Area, 2023

Service Area	Existing Dwelling Units	Expected[1] Annual % Increase	Expected Dwelling Units 2023	Expected Population 2023	Expected Developed Area 2023 (acres)
Area 1 - Enfield	500	1.40	707	2,368	398
Area 2 - Elmsdale	486	2.41	881	2,951	430
Area 3 - Clayton	60	10.82	782	2,620	215
Area 4 - Maplewood/ Lantz	429	2.02	707	2,369	313
Area 5 - Willow Crest/ Ridgefield	163	8.42	1,229	4,118	375
TOTAL	**1,638**	**3.94**	**4,306**	**14,426**	**1,741**

Notes: Expected annual percent increase represents the compounded annual growth rate necessary to achieve the projected number of dwelling units expected for the year 2023.

2.4 Ultimate Serviced Population Projection

The ultimate developable land area within the Study Area was determined by subtracting the floodplain, hazard lands, and water course buffer areas from the total undeveloped acreage in the Study Area. The ultimate development potential of undeveloped land was estimated based on an assumption of 4.1 lots per acre for R-1 (Single Family) zones resulting in an assumed density of 13.8 person per acre. In lands zoned R-2 (Duplex), a density of 16 persons per acre was assumed. The housing mix anticipated within future development assumes that 83 per cent of R-2 areas will be developed with single family homes, while 17 per cent will be developed with semi-detached structures.

Overall, as Table 2-4 shows, we estimate that 1,987 acres of the 4,399 acres (43.2 per cent) comprising the total Study Area can be developed. This developable land can accommodate 8,891 additional units and existing dwellings based on our assumptions. Given an average household of 3.35 persons, these units will accommodate 35,866 people, an increase of 729.9 per cent over the 1998 population. The community at this point would be roughly equivalent to the present day Sackville area. This population seems very unlikely in the current context but is conceivable however given an extended (50 to 100 year) horizon.

Table 2-4 Future Potential (Ultimate) Population, East Hants Study Area

Service Area	Total Area (Acres)	Future Developable Area (Acres)	Existing Lots	Additional Future Lots	Ultimate Future Potential Population
Area 1 - Enfield	760.5	300	500	1,359	6,229
Area 2 - Elmsdale	877.6	242	566	1,086	5,533
Area 3 - Clayton	876.0	407	60	1,845	6,383
Area 4 - Maplewood	761.5	290	526	1,255	5,967
Area 5 - Willow Crest	1,123.4	748	163	3,346	11,755
TOTAL	**4,399**	**1,987**	**1,816**	**8,891**	**35,866**

2.5 Long Term Population Projections

Buried municipal water and wastewater infrastructure, particularly collection and transmission and distribution piping, are typically designed to provide in excess of 100 years of service and therefore are sized to handle a level of development beyond the 25 year (2023) horizon of this study. The ultimate population of 35,866 people calculated above represents the extreme upper bound of potential ultimate population. An intermediate population of 25,000 people was used as the long term population projection for the purposes of major buried infrastructure design. The 25,000 population estimate is near the median between the 25 year population estimation of 14,426 and the ultimate population of 35,866 persons.

2.6 Five Year Population Projections

Preparation of an implementation plan for the construction of water and wastewater infrastructure requires a projection of incremental serviced population growth at regular intervals from now (1998) to the year 2023. Incremental serviced population projections have been prepared at five year intervals assuming a linear growth pattern over the 25 year design horizon.

Five year incremental population estimates for the Study Area are presented in Table 2-5.

Table 2-5 Incremental Serviced Population Estimate, East Hants Study Area 1998 to 2023

Service Area	Projected Serviced Population					
	1998	2003	2008	2013	2018	2023
Area 1-Enfield	1,500	1,816	1,954	2,092	2,230	2,368
Area 2-Elmsdale	1,458	2,107	2,318	2,529	2,740	2,951
Area 3-Clayton	180	685	1,168	1,652	2,136	2,620
Area 4-Maplewood	1,287	1,883	2,005	2,126	2,247	2,369
Area 5 - Willowcrest	489	1,261	1,975	2,689	3,404	4,118
Total	4,914	7,752	9,420	11,088	12,757	14,426

As the population grows over the coming decades, the actual date at which each of these population thresholds are reached can be substituted and the estimates of future population can be adjusted. Accordingly, the specific dates at which individual infrastructure improvements are required are based on total serviced population and not on any particular date.

2.7 Pace of Development

The intermediate term population projections to Year 2023 presented in Section 2.3 imply an increase in serviced lots of approximately 2500 over a 25 year timeframe, for an average rate of 100 lots per year. While this growth rate is consistent with growth projections presented above, recent development rates within the Study Area have fallen short of this figure.

Each year the Municipality must service capital debt incurred for trunk infrastructure out of taxes or capital cost recovery charges levied on new lots being approved. When development falls below that rate necessary to cover debt servicing, the Municipality must find other sources of funding.

At this time, it is not known what impact the initiation of a capital cost recovery charge will have on the pace of development. To avoid an overly optimistic revenue projection, the financial analysis component of this study has been prepared based on a pace of development of 75 lots per year. It is expected that the Capital Cost Recovery Charge developed on the basis of a pace of development of 75 lots per year will be revisited at regular intervals to determine whether the revenue stream is consistent with the Capital Debt Servicing charges incurred to date.

Part B

Regional Wastewater System Analysis

Table of Contents
Part B - Regional Wastewater System Analysis

Page No.

1.0 INTRODUCTION B-1
1.1 Background B-1

2.0 WASTEWATER FLOW PROJECTIONS B-3
2.1 Existing Wastewater Flows B-3
2.2 Future Wastewater Flow Projections B-5

3.0 DESCRIPTION OF EXISTING WASTEWATER COLLECTION AND TREATMENT SYSTEM B-8
3.1 Sewage Treatment Plant B-8
3.2 Pumping Stations and Forcemains B-9
3.3 Gravity Collection System B-10

4.0 CAPACITY OF EXISTING WASTEWATER SYSTEM B-11
4.1 Assessment Methodology and Assumptions B-11
4.1.1 Sewage Treatment Capacity B-11
4.1.2 Pumping Station Capacity B-12
4.1.3 Gravity Sewer Capacity B-13
4.2 Capacity of Existing Wastewater System B-14
4.2.1 Sewage Treatment Plant B-14
4.2.2 Pumping Stations and Forcemains B-15
4.2.3 Gravity Collection System B-19

5.0 INFRASTRUCTURE PLAN B-22
5.1 Time Horizons B-22
5.2 Short Term Recommendations (1999-2000) B-23
5.3 Intermediate Term Recommendations B-24
5.3.1 Wastewater Treatment B-24
5.3.2 Pumping Stations and Forcemains B-24
5.3.3 Gravity Collection System B-25
5.4 Long Term Recommendations B-26

Table of Contents
(Continued)

		Page No.
6.0	FINANCIAL PLAN	B-28
6.1	Capital Cost Estimates	B-28
6.1.1	Short Term Upgrades	B-28
6.1.2	Intermediate Term Upgrades	B-28
7.0	IMPLEMENTATION PLAN	B-31
7.1	Short Term	B-31
7.2	Intermediate Term	B-31

Appendix

Appendix B-1 Detailed Capital Cost Estimates for Wastewater System Improvements

List of Tables

		Page No.
Table 2-1	Calculated Existing Average and Peak Flow for each Service Area	B-4
Table 2-2	Calculated Average and Peak Flow Projections for each Service Area	B-6
Table 4-1	Existing Pumping Station Capacity	B-16
Table 4-2	Existing Gravity Collection System Capacity	B-20
Table 6-1	Capital Cost Estimates - Regional Wastewater System	B-30

1.0 INTRODUCTION

This part of the Infrastructure Capacity Study presents the results of the regional wastewater system analysis. This section of the report, which is intended to stand alone, provides a summary of wastewater flow projections, a description of the existing wastewater collection, and treatment system, a discussion of the capacity of the existing system, an infrastructure plan recommending short term, intermediate term and long term improvements to the wastewater system, capital cost estimates for the recommended improvements, and an implementation plan recommending phased improvements.

1.1 Background

The current configuration of the wastewater collection and treatment system is the result of an amalgamation completed in the early 1990's of three independent systems. The three former separate systems serviced the urbanized sections of the communities of Enfield, Elmsdale and Lantz. Several components of the current wastewater system (i.e., pumping and treatment facilities, gravity piping and forcemains) were upgraded or constructed as part of the amalgamation. As a result, the components which comprise the existing system were not all designed based on the same design flows, serviceable boundaries or time horizons.

A number of the wastewater system components are approaching or have exceeded their design capacity. Further development within the corridor must be planned in conjunction with an analysis of the capacity of the existing trunk wastewater system to handle the additional loads expected under future development.

The current Infrastructure Capacity Study is intended to provide the Municipality with a concept level understanding of the extent and capital costing of the upgrades required to the main trunk wastewater collection components under various loading scenarios representing future development throughout the corridor. The analysis and recommendations for future upgrades have been primarily focused on the capacity of the system rather than on its structural condition. The only components of the trunk wastewater collection, transmission and distribution system which have been evaluated with respect to their physical condition are the sanitary sewage pumping stations (PS) which have been subjected to a visual inspection and a hydraulic capacity pump test. Analysis of the physical condition of the sanitary transmission mains and forcemains is beyond the scope of this study.

2.0 WASTEWATER FLOW PROJECTIONS

This section provides an estimate of existing and future wastewater flows which have been used to evaluate excess capacity within the existing trunk wastewater system and to determine the size and configuration of future infrastructure requirements within the Study Area.

2.1 Existing Wastewater Flows

Existing wastewater flows were assessed using three different methods which enabled evaluation of all trunk wastewater collection and treatment system components.

The most comprehensive evaluation of existing flows was based on estimates of serviced population, developed area and unit rates for domestic sewage flows and allowances for wet weather inflow and infiltration (I/I). This approach allowed calculation of average and peak wastewater flows for tributary areas with boundaries tailored to the particular analysis. For example, flows to each individual pumping station could be calculated by defining its tributary area and estimating the serviced population and service area. Unit sanitary flow rates used for these calculations were:

- Average per capita daily domestic flow rate: 90 US gallons per capita per day (usgpcd)
  Source: Nova Scotia Standards and Guidelines Manual for the Collection, Treatment and Disposal of Sanitary Sewage

- Peak per capita daily domestic flow rate: 378 usgpcd
  Source: Municipality of the District of East Hants - Municipal Services Systems General Specifications dated April 20, 1994

- Peak daily inflow and infiltration rate: 1,200 US gallons per acre per day (usgal/ac/day) based on the area of the developed portion of the sewershed

Source: Municipality of the District of East Hants - Municipal Services Systems General Specifications dated April 20, 1994

The results of these flow calculations showing existing flows for each of the five service subareas, are presented in Table 2-1.

Table 2-1 Calculated Existing Average and Peak Flow for each Service Area

Area	Subarea Name	Estimated Population	Estimated Developed Area (ac)	Calculated Ave. Flow (USGPD)	Calculated Peak Flow (USGPD)
1	Enfield	1,500	352	135,000	989,400
2	Elmsdale	1,698	359	152,820	1,072,644
3	Clayton	180	56	16,200	135,240
4	Maplewood	1,578	129	142,020	751,284
5	Willow Crest	489	137	44,010	349,242
TOTALS		5,445	1,033	490,050	3,297,810

Records of daily readings from the flow meter at the sewage treatment lagoon were reviewed to assess the range of current total flows from the entire serviceable boundary. These data provided the average daily flow and peak flows measured at the outlet of the treatment plant. Since the volume, and therefore the hydraulic retention time, of the lagoons is relatively high, the peak flows measured at the lagoon outlet do not reflect the actual peak flows coming to the plant. That is, the volume of the lagoon will temporarily increase in response to peak flows thereby attenuating or "flattening out" the peaks in the flow by the time it is measured at the lagoon outlet. It is also expected that there may possibly be a number of pumping station overflows during peak flows which would further reduce the peaks measured at the treatment plant. The period of record from June 1, 1997 to December 31, 1997 indicated an average flow at the outlet of the treatment plant of 460,000 USGPD and a peak flow of 1,300,000 USGPD. It should be noted that the calculated average daily flow of 460,000 USGPD (from Table 2-1) corresponds within 6% of the measured average flow of 490,000 USGPD.

Pumping station hour meter records provided by the Municipality along with the instantaneous flow rates measured by Porter Dillon from each pumping station enabled calculation of the average daily flows from the specific areas tributary to each station. Due to the relatively infrequent recording of the hour meter readings from the pumping station, only the average conditions could be evaluated.

For the purposes of this analysis peak wastewater flow rates based on Design Unit Rates as presented in Table 2-1 have been used to evaluate the hydraulic capacity of the existing and future collection system.

2.2 Future Wastewater Flow Projections

Assessment of the capacity of the wastewater collection, required projecting the flows under a number of time horizons including 5, 10, 15, 20 and 25-year horizons as well as the ultimate, or fully developed condition, when all developable lands have been fully developed. Wastewater flow projections were calculated using the estimated serviced population (Part A, Section 2.0) and developed areas for each time horizon, a peak unit domestic flow of 378 U.S. gallons per capita per day (USgpcd) and a peak inflow and infiltration (I/I) rate of 1,200 usgal/ac/day. Peak domestic and I/I rates were obtained from the Municipal Services Systems General Specifications as discussed in Section 2.1.

The results of the flow projection calculations are summarized in Table 2-2. This Table only indicates the accumulated flows for each of the five service areas to provide an indication of the magnitude of flow increases throughout the study area. However, analysis of the gravity collection system involved subdividing the collection system into a number of individual links. Therefore, flows were projected for each sewershed area tributary to a given link. Meanwhile, the tributary area to each pumping station was defined and flows were projected for that area. In several cases, pumping station discharges were also considered as inflows into a downstream section of gravity piping or pumping station.

Table 2-2 Calculated Average and Peak Flow Projections for each Service Area

Area	Name	Estimated Population	Estimated Developed Area (ac)	Calculated Ave. Flow (USGPD)	Calculated Peak Flow (USGPD)
5-year projections					
1	Enfield	1,816	362	163,440	1,120,848
2	Elmsdale	2,107	374	189,630	1,245,246
3	Clayton	685	88	61,650	364,530
4	Maplewood	1,883	278	169,470	1,045,374
5	Willow Crest	1,261	195	113,490	710,658
TOTAL		7,752	1,297	697,680	4,486,656
10-year projections					
1	Enfield	1,954	371	175,860	1,183,812
2	Elmsdale	2,318	388	208,620	1,341,804
3	Clayton	1,168	120	105,120	585,504
4	Maplewood	2,005	287	180,450	1,102,290
5	Willow Crest	1,975	243	177,750	1,038,150
TOTAL		9,420	1,409	847,800	5,251,560
15-year projections					
1	Enfield	2,092	380	188,280	1,246,776
2	Elmsdale	2,529	402	227,610	1,438,362
3	Clayton	1,652	152	148,680	806,856
4	Maplewood	2,126	295	191,340	1,157,628
5	Willow Crest	2,689	290	242,010	1,364,442
TOTAL		11,088	1,519	997,920	6,014,064
20-year projections					
1	Enfield	2,230	389	200,700	1,309,740
2	Elmsdale	2,740	416	246,600	1,534,920
3	Clayton	2,136	184	192,240	1,028,208
4	Maplewood	2,247	304	202,230	1,214,166
5	Willow Crest	3,404	338	306,360	1,692,312
TOTAL		12,757	1,631	1,148,130	6,779,346
25-year projections					
1	Enfield	2,368	398	213,120	1,372,704
2	Elmsdale	2,951	430	265,590	1,631,478
3	Clayton	2,620	215	235,800	1,248,360
4	Maplewood	2,369	312	213,210	1,269,882
5	Willow Crest	4,118	385	370,620	2,018,604
TOTAL		14,426	1,740	1,298,340	7,541,028

A review of the flows shown in Table 2-2 indicate the average wastewater flows are expected to nearly double in the next 15 years. These average and peak wastewater flow projections were used to evaluate the capacity of existing and future wastewater collection and treatment infrastructure.

3.0 DESCRIPTION OF EXISTING WASTEWATER COLLECTION AND TREATMENT SYSTEM

Existing wastewater trunk infrastructure including the pumping stations, forcemains, gravity system and sewage treatment are shown on the drawing (Dwg. No. 1 - Conceptual Wastewater Collection System) attached to this report. Also noted on the drawing are the proposed wastewater system upgrades for the 25-year flow projections (2023).

The following sections present a brief description of the configuration and operation of the Lantz Sewage Treatment Plant, the twenty-two (22) sanitary pumping stations and associated forcemains and the gravity collection and transmission system.

3.1 Sewage Treatment Plant

The serviced portion of the Enfield, Elmsdale, Lantz area is serviced by the Lantz wastewater treatment facility constructed in 1989/90 which consists of an aerated lagoon and chlorine contact chamber to provide adequate retention time for disinfection. Three forcemains convey sewage to the treatment plant site where they are inter-connected to feed the lagoon via one of three inlet locations. The lagoon has a total of three cells with static tube aerators in each of the cells. The first cell has 48 aerators for a total aeration capacity of 720 standard cubic feet per minute (scfm), the second cell has 20 aerators for a total capacity of 300 scfm while the third cell has 10 aerators and an aeration capacity of 150 scfm. Aeration is focused on the first cell since the majority of the biological treatment occurs in that cell. Three blowers (two duty and one stand-by) provide air to the lagoons. Each blower is capable of supplying 585 scfm of air.

The total volume of each of the cells was calculated from the as-built drawings to be: 7.9 million us gallons (Musgal) for Cell 1, 11.3 Musgal for Cell 2 and 18.5 Musgal for Cell 3 for a total volume of 37.7 Musgal. The volume of the chlorine contact chamber (CCC) was calculated to be 68,700 usgal based on a liquid level of 43 ft. Influent sewage to the CCC is chlorinated by the addition of a chlorine gas solution through a submerged diffuser. Effluent from the CCC is dechlorinated using a sulphur dioxide gas solution. The feed rates of both the chlorine gas and the sulphur dioxide are controlled by the flow rate through the CCC as measured by the height of liquid above the V-notch weirs. Dechlorinated effluent is discharged by gravity to the Shubenacadie River.

Sampling conducted by CBCL Ltd. and the Nova Scotia Department of Health from 1990 to 1992 indicated that the lagoons were producing effluent well within the required quality standards of 20 mg/L for Biochemical Oxygen Demand (BOD) and suspended solids (SS). Flows at the lagoon were in the range of 400,000 USGPD during the testing period.

3.2 Pumping Stations and Forcemains

The Enfield-Elmsdale-Lantz wastewater collection system includes 22 pumping stations (PS's). Twenty-one of the pumping stations are Flygt submersible duplex stations with concrete wet wells and floats for pump control. A number of the stations were installed when the three communities were initially serviced in the early 1970's. These original stations were intended to convey the wastewater to the individual treatment facility servicing that particular community. The remaining stations were constructed in 1980's when the three systems were amalgamated to convey all wastewater to the new treatment plant site in Lantz. For identification, the Municipality has numbered the stations from 1 to 20 from Enfield to Lantz. This same numbering system has been maintained throughout this study.

The topography of the serviced area results in a number of situations where double and triple pumping is necessary. For example, PS1 (Enfield) pumps into PS4 which pumps into PS7 which pumps directly to the treatment plant. Four pumping stations in Elmsdale (PS7, PS8, PS9 and PS10) pump to a common forcemain which flows to the treatment plant. PS14 and PS17 each pump directly to the treatment plant for a total of three forcemains entering the treatment plant site.

There is a significant range in pumping capabilities of the sanitary pumping stations from 2 HP pumps in PS20 to 88 HP pumps in PS7.

The length of a particular pumping station forcemain is dictated by the distance from the station to the nearest downstream high spot for gravity flow to continue or the distance to the treatment plant. Lengths of the forcemains range from several hundred feet (PS20) to 15,000 ft (PS7) and diameters range from 3 to 14 inch. Forcemains are typically constructed of PVC.

3.3 Gravity Collection System

Analysis of the gravity collection system completed for this study primarily focused on the main trunk gravity collection system along Route No. 2. The following description highlights the features of the main trunk gravity system.

The gravity collection piping, as with the pumping stations, was originally constructed to convey wastewater to the three independent sewage treatment plants which previously serviced the three communities. Several modifications to the gravity system were completed as part of the amalgamation of the wastewater system to direct flow toward the new plant. The majority of the gravity piping is constructed of concrete, with the a minor amount constructed of PVC. Pipe diameters range from 8 to 21 inches (between MH19 and PS14 along Highway No. 2) and slopes range from 0.2% to 6%. Manholes are typically 42 inch diameter pre-cast concrete.

4.0 CAPACITY OF EXISTING WASTEWATER SYSTEM

This section provides a brief description of the assumptions and the assessment methodology applied to analysis of the capacity of the existing wastewater system, and a summary of the capacity of the existing sewage treatment plant, sanitary pumping stations and forcemains and gravity collection system.

4.1 Assessment Methodology and Assumptions

The basic approach to assessing the capacity of the wastewater infrastructure involved comparing the estimated capacities of the existing components (piping, pumping and treatment) with the specific current and projected peak flows for each of those components. Where deficiencies were observed, replacement infrastructure was identified. This was undertaken with flow projections for the time horizons described in Section 2.2, that is, for 5, 10, 15, 20 and 25-year time horizons.

4.1.1 Sewage Treatment Capacity

The capacity of the sewage treatment plant was established by reviewing correspondence and design information from the original designers CBCL Ltd. The volume of each of the lagoon cells, the volume of the CCC and the capacity of the blowers and aerators were confirmed by reviewing as-built drawings. Volumes of the three lagoon cells were used in conjunction with reaction coefficients and the treatment efficiency equation recommended in Section 6.4.5.2.2 of the Nova Scotia Standards and Guidelines Manual. The volume of the CCC was used with the contact time recommendations of Section 7.3.1.3 of that same reference. These two calculations allowed an assessment of the capacity of the lagoon, in terms of average flow, and the CCC, in terms of the average and peak hourly flows.

4.1.2 Pumping Station Capacity

The principal approach to assessment of the capacity of the sanitary pumping stations was to conduct pump-down tests in the field. These tests involved shutting off the pumps and measuring the rate at which the liquid level rose in the wet well. Multiplying this rate by the plan area of the wet well resulted in the flow rate of wastewater entering the wet well. Pumps were then turned on and the rate at which the liquid level dropped was measured allowing calculation of the drawdown rate. The addition of these two rates, inflow and drawdown, provided the actual pump output capacity of the station. Occasionally, in instances where one pump could not handle the inflow, the second pump was turned on to investigate the improvement in output with the two pumps running simultaneously.

The second source of information on the capacities of the pumping stations were the hour meter records. The run-time of the pumps provided insight into the discharge capability of the pumps relative to current loading conditions. For example, a pumping station with pumps that only operate for an hour a day typically has significant capacity for additional loading whereas a station which typically operates for ten or more hours per day has little or no capacity for additional loading associated with future development.

The third source of information regarding sanitary pumping station capacity was anecdotal reports from the Municipal operations staff. These reports provided important information relative to pumping station reliability, frequency of high level alarms and frequency of overflow or overloading.

For each pumping station, the capacities of the wet well chamber and the forcemain were also evaluated. Capacity of the wet well was used to determine the largest capacity pump which could be accommodated in the wet well while maintaining adequate pump start-stop cycles (i.e., 8 pump start-stops per hour per pump). The forcemain capacity was established by calculating the flow that would result in a velocity of 8 feet per second, which was considered the maximum recommended velocity and therefore the maximum capacity of the forcemain.

Once a pumping station reached its capacity, it was replaced in the analysis by one capable of handling the 25-year projected peak flow for the remainder of the analysis.

4.1.3 Gravity Sewer Capacity

The methodology applied to assess the capacity of the trunk gravity main collection system involved a number of steps. First, the piping system was divided into 33 sections, or links, which grouped together several manhole-to-manhole pipes on the basis of similar diameter, slope and flow. As-built drawings were reviewed to determine the manhole-to-manhole pipe within each link with the least slope. This pipe was then considered the "critical" pipe within the link since it would ultimately limit the overall capacity of the link. Therefore, the capacity of the "critical" pipe, calculated using Manning's equation, was established as the capacity of the entire link. Roughness coefficients (n) used in Mannings equation were 0.013 for concrete and 0.011 for PVC.

Once the capacities of each individual link was established, the peak flows tributary to each link under current and projected conditions were calculated based on the projections described in Section 2.2. This involved making assumptions on the patterns in which future development would occur to assess the future developed areas to calculate future peak I/I values. This evaluation also required consideration of the flow into a particular link from the forcemain of a pumping station. Therefore, the analysis of the gravity collection system was completed in parallel to the analysis of the pumping stations so future pumping station upgrades could be incorporated into the gravity system analysis.

Through discussions with the Municipality, it was agreed that a pipe would be considered at capacity when the pipe was flowing full under peak flow conditions (as per Nova Scotia Standards and Guidelines Manual). Once a pipe was determined to have reached its capacity, it was replaced by a pipe capable of handling the peak flow under ultimate development conditions with the pipe flowing half full (as per the Municipal Specifications).

4.2 Capacity of Existing Wastewater System

This section provides a summary of the results of the wastewater system analysis with respect to the existing capacity of the Lantz Sewage Treatment Plant, the pumping stations and forcemains and the gravity collection system.

4.2.1 Sewage Treatment Plant

As discussed in Section 3.1, the volumes of the three wastewater treatment cells have been calculated to be: 7.9 Musgal for Cell 1, 11.3 Musgal for Cell 2 and 18.5 Musgal for Cell 3 for a total volume of 37.7 Musgal. Using these lagoon-cell volumes and the treatment efficiency calculation recommended in the Nova Scotia Standards and Guidelines Manual and a design BOD concentration of 200 mg/L (which is a typical design value), the treatment capacity of the lagoon was determined to be 1,140,000 USGPD (average daily flow). It should be noted that CBCL Ltd. indicated that, by contrast, the volume of the lagoons is 40.5 Musgal and the capacity of the lagoon is suitable for a total flow of 1,494,000 USGPD (population of 15,000 persons at an average unit flow rate of 100 usgpcd) based on a design BOD concentration of 180 mg/L. It can be concluded from this evaluation that the capacity of lagoons will depend on the future organic strength of the wastewater and is likely to be in the range of 1.1 to 1.5 Musgpd for a serviced population of 14,400 to 15,000 persons).

The above capacity calculations were based strictly on the hydraulic retention time (i.e., volume) of the lagoon cells. The existing aeration system, including the blowers and the static tube aerators, were only designed to provide oxygen to treat the flow from a serviced population of 9,000 persons at a per capita flow of 100 USGPD for a total flow of 900,000 USGPD (based on a design BOD concentration of 180 mg/L). Therefore, once the loading to the lagoon reaches this value, the aeration system will be inadequate to supply sufficient oxygen for the biological reactions and additional aeration will be required. The upgrades to the aeration system have been incorporated into the future infrastructure requirements.

Based on the volume of the CCC, it has a capacity for an average flow of 3,300,000 USGPD and a peak hourly flow of 6,600,000 USGPD using the hydraulic retention times recommended in the Nova Scotia Standards and Guidelines Manual. Therefore, the capacity of the chlorine contact chamber exceeds the capacity of the lagoon and will not require upgrade throughout the 25-year time horizon of this study.

The results of the capacity analysis indicate that the basic treatment facility has the capability to provide adequate treatment, based on the current treatment requirements of 20 mg/L of BOD and SS, for the anticipated 25-year flow projections. The treatment plant will however require an upgrade to the aeration system in approximately ten years. The adequacy of the chlorine disinfection and the sulphur dioxide dechlorination systems should be reviewed at that time.

4.2.2 Pumping Stations and Forcemains

The capacities of the pumps, wet wells and forcemains in each of the major pumping stations were assessed following the procedure described in Section 4.1.2. These measured capacities were then compared with the calculated peak flows under current and projected development conditions. The results of this evaluation are presented in Table 4-1.

The criteria for determining that a pumping station has reached its capacity was not limited to simply comparing its capacity with the calculated current peak flows. Peak flow calculations are typically based on conservative design values which occur infrequently. For example, peak infiltration and inflow (I/I) is calculated on the basis of the total developed area and if a large portion of the developed area slopes away from the sewer, the calculation likely provides an overly conservative I/I estimate. Also, depending on the water usage habits of the residents, the peak domestic flow of 378 USGPD for each resident may never be observed simultaneously with the peak I/I event. Furthermore, the peak flow calculation is intended primarily as the basis for the design of a new system, not for the evaluation of existing systems. Therefore, in addition to the comparison of capacity and projected flows, hour meter records and observations from

Table 4-1 Existing Pumping Station Capacity

Pumping Station	Exist. Peak Flow (uspgd)	5-yr Peak Flow (uspgd)	10-yr Peak Flow (uspgd)	15-yr Peak Flow (uspgd)	20-yr Peak Flow (uspgd)	25-yr Peak Flow (uspgd)	Ult. Peak Flow (uspgd)	Capacity of Pumps	Capacity of Forcemain	Comments
1	43,014	46,794	47,550	48,306	49,062	49,818	187,974	n/a	672,000	Pump recently changed
2	44,820	50,112	52,446	53,580	54,714	55,848	64,296	n/a	n/a	Likely OK - ave. run time=0.2 hrs/d
3	129,174	139,758	143,226	145,872	149,340	151,986	388,968	**105,000**	442,000	Pump recently changed
4	533,826	580,386	596,838	613,290	628,542	642,972	1,235,172	**200,000**	n/a	Reportedly exceeds capacity
5	45,084	49,620	50,754	52,710	53,844	54,978	97,200	n/a	253,000	Likely OK - ave. run time=1 hrs/d
7	456,774	540,018	587,352	633,486	680,820	739,332	1,864,212	1,846,000	4,000,000	
8	550,938	626,112	660,840	695,946	730,674	766,602	1,258,086	734,000	4,000,000	
9	127,788	175,518	201,864	228,210	254,556	279,324	754,488	353,000	4,000,000	
10A	81,624	98,388	109,860	121,710	132,360	144,210	217,956	185,000	n/a	
10	379,716	438,000	473,808	510,114	543,642	578,000	771,000	562,000	1,000,000	
11	121,236	218,004	306,768	396,354	484,740	574,704	307,794	n/a	n/a	
11A	1,500	72,000	144,000	216,000	288,000	360,000	360,000	360,000	1,000,000	
12	47,748	50,772	50,772	50,772	50,772	50,772	223,278	140,000	442,000	
13	92,094	226,026	352,710	479,772	608,412	735,474	1,759,038	1,030,000	1,800,000	
14	181,854	402,384	609,174	817,164	1,027,110	1,234,278	2,839,458	1,825,000	5,600,000	
15	189,012	228,210	250,332	274,032	297,732	321,054	842,190	216,000	1,000,000	
16	27,546	30,192	30,192	30,192	30,192	30,192	142,758	n/a	254,000	
17	761,340	1,060,824	1,121,000	1,182,660	1,242,534	1,295,000	3,367,000	1,388,000	4,000,000	
18	194,000	415,000	612,000	808,000	1,003,000	1,200,000	3,813,000	**80,640**	442,000	
19	9,072	29,898	36,390	42,882	49,374	54,666	82,524	75,000	253,000	
20	145,000	280,000	407,000	532,000	658,000	785,000	2,217,770	**45,000**	253,000	

Note: PS6 is a small station servicing two residential properties east of the CN tracks. Pumps are reported to be adequate but operational problems have been reported. The Municipality has indicated that future improvements are planned to address these deficiencies.

operations staff were factored into the decision for the need to replace or upgrade a particular pumping station.

Pumping stations identified to be at or exceeding their capacity are PS4, PS18 and PS20. PS4 is an important station which conveys wastewater from the Enfield area to PS7 which in turn pumps directly to the treatment plant. PS4 consist of a pair of 5 ft diameter wet wells; one has two pumps while the other has one pump and each station pumps into its own dedicated forcemain. During the pump test, the station exhibited obvious signs of recent overloading resulting in wastewater flowing out of the wet well around the access hatches (there are no overflow pipes). Operations staff have indicated that the I/I problem has been exacerbated by a recent nearby sewer main break which can only be repaired once the groundwater conditions are favourable (late summer). Despite this temporary situation, the station appears to be regularly overloaded and will require upgrading or replacement.

PS18 and PS20 located in Lantz near Barney's Brook are both at or exceeding their capacity. During pump-down testing, conducted during a wet weather period, the liquid level in PS18 continued to rise with both pumps running. Operations staff report that PS18 frequently operates above the high level alarm, indicated by an alarm light mounted on the adjacent power pole. For PS20, although there were no signs of overflow, based on the tributary area and population, hour meter records and limited capacity of the pumps, it has been determined this station is at its capacity.

Currently, PS20 pumps to PS18 which pumps to PS17 which pumps to the treatment plant. Since a significant portion of the short term future development is expected to occur in the areas tributary to PS18 and PS20, scenarios to address both the short and long term situation have been identified and evaluated. The preferred scenario is to upgrade or replace PS 18 and PS20 and have them both pump to a common forcemain which would be connected to the existing forcemain discharging from either PS 14 or PS17 to the treatment plant. This would eliminate multiple pumping, remove significant loading from the gravity system leading to PS17 and enable PS17 to handle the 25-year projected flows. For the pumping station and gravity system analysis, it was assumed that this forcemain arrangement would be constructed within the next five years.

In the short term the wet wells and forcemains for pumping stations PS18 and PS20 have the capacity to handle additional flows, if the existing pumps are replaced with larger capacity pumps.

In addition to PS4, PS18 and PS20, the only other pumping station inadequate to handle the 25-year projected peak flow is PS15. This station was the subject of a detailed analysis conducted by Mr. Graham Doyle on behalf of the Municipality of East Hants in 1996. Following that study, the pumps and forcemain were modified as the first stage of a long-term strategy to handle the projected flows tributary to that station. These modifications included changing pump impellers and constructing two new forcemains to convey wastewater to a manhole located at Logan North at Brookside Avenue to provide a second pathway for the pumped wastewater into the gravity system.

The long-term strategy for PS15 developed in the 1996 study was based on a significantly larger tributary area than the one defined in the present study. Contrary to the 1996 strategy, future servicing within the area from Frederick Allan Drive north to Highway 102 was assumed, for the present study, to flow by gravity to Route No. 2 and by-pass PS15. This presumes that a route for the gravity main can be acquired (i.e.; landownership and environmental constraints can be overcome). In the event that a route for the proposed gravity main can not be negotiated, the Municipality can revert to the strategy described in the 1996 study, however, the approach proposed here is considered to be superior from both a capital expenditure and operations point of view.

The reduction in the tributary area results in significant reduction in flows to the station from previous estimates. For example, the ultimate population serviced by PS15 in the 1996 study was 4,600 persons (ultimate peak flow of 2,000,000 USGPD) while the serviced population estimated in the present study is 1,755 person (ultimate peak flow of 842,000 USGPD).

The findings of this study indicate that the current pumps have a capacity of 216,000 USGPD which is less that the projected 25-year peak flow of 321,000 USGPD. Therefore, the pumping station will likely have to be upgraded or replaced in the next 5 to 10 years.

As shown on Table 4-1, calculated peak flows to PS3 currently exceed its measured capacity. However, during pump-down testing, there were no signs of overloading. Since the flow projections only indicated an increase in peak flows of about 17%, the station was deemed to have sufficient capacity for the 25-year projected flow.

4.2.3 Gravity Collection System

The capacity of each link of the gravity collection system was compared with the calculated flow received by the link under present and projected development conditions. Projected conditions included the 5, 10, 15, 20 and 25-year time horizons. For each 5-year increment, deficiencies in the system were identified and the overloaded links were replaced with pipes capable of carrying the ultimate flows. The summary of this analysis is presented in Table 4-2. Section identification numbers refer to sewer links on Drawing No. 1 - Regional Sanitary System Existing Conditions and 25 Year Upgrades.

The entire gravity system was found to be capable of handling the calculated peak flows under the present conditions. As discussed in Section 4.2.2, the 5-year scenario (and all subsequent scenarios) were based on completion of modifications to the forcemains from PS18 and PS20 resulting in the flows from Lantz by-passing the existing gravity mains and pumping systems located in south Lantz and flowing directly to the treatment plant. Under this arrangement, significant upgrades to the gravity system and PS17 would be avoided or reduced and postponed.

The first set of gravity system upgrades will only be required once the 15-year flow projections are realised. At that time, Links Y and Z (along Route No. 2 just north of the Green Road intersection) would require upgrading to handle the development projected for the Lantz area. At

Table 4-2 Existing Gravity Collection System Capacity

Section ID	Capacity (usgpm)	Existing Flow (usgpm)	5-year Projected Flow (usgpm)	10-year Projected Flow (usgpm)	15-year Projected Flow (usgpm)	20-year Projected Flow (usgpm)	25-year Projected Flow (usgpm)
a	567	30	32	33	34	34	35
b	389	179	156	160	163	167	175
c	1059	13	37	38	39	40	41
d	492	13	20	21	22	22	23
e	661	169	169	173	177	182	186
f	932	2	8	8	9	9	10
g	5103	385	434	437	440	443	522
h	1758	664	772	807	843	879	991
i	470	12	13	14	14	15	15
j	561	24	24	28	32	35	39
k	246	48	61	70	79	88	97
l	381	213	238	243	248	252	257
m	344	89	112	130	148	166	184
n	1239	24	38	38	38	38	38
o	799	13	34	34	34	34	34
p	-	-	-	-	-	-	-
q	-	-	-	-	-	-	-
r	3479	636	687	702	717	732	823
s	1349	325	460	485	510	534	559
t	393	223	297	303	309	315	321
u	681	102	163	182	201	220	239
v	344	73	98	112	127	141	156
w	321	24	37	42	48	53	58
x	-	688	809	845	881	917	1028
y	697	477	514	537	560	584	607
z	704	516	558	583	607	632	657
aa	630	211	244	250	257	263	274
ab	1724	230	261	267	274	281	292
A	504	34	45	54	63	72	81
B	971	53	38	41	45	48	53
C	1611	55	44	50	56	62	70
D	563	22	111	193	275	358	440
E	6877	64	103	128	154	179	651
F	1392	29	48	79	110	141	171
G	385	26	6	10	14	18	22
H	1530	3	39	64	90	115	140
I	397	234	307	333	359	385	[411]
J	373	6	2	2	2	2	2
K	1109	485	321	330	339	348	357
L	661	427	294	301	309	317	325
M	344	143	58	60	62	65	67
N	486	139	30	31	32	34	35
O	663	238	4	4	4	4	4
P	408	109	20	21	21	22	22
Q	510	171	171	174	177	180	184
R	534	68	19	19	19	20	20
S	365	239	199	203	207	211	215
T	326	281	218	222	227	231	236
U	389	245	323	350	377	[403]	431
V	697	250	341	369	397	424	452
W	704	287	390	419	448	477	506
X	8758	772	711	749	787	825	863
Y	389	21	158	287	[416]	545	674
Z	408	65	192	322	[452]	582	712
AA	1218	88	300	439	577	716	854
AB	389	107	68	70	72	74	76
AC	419	3	7	10	12	14	17
AD	1657	78	154	243	331	420	511
AE	7655	93	151	207	263	319	823
AF	1409	287	390	419	448	477	506
AG	460	97	188	273	359	444	[529]

Notes:

1. Bracketed flows (e.g., [411]) indicate flows which exceed pipe's capacity - refer to Section 5.4.3 for discussion of recommended improvements
2. Missing data (-) is due to the lack of as-built record drawings for the trunk sewer system in question.
3. Section ID numbers refer to sewer links illustrated on Drawing No. 1 - Regional Sanitary System Existing Conditions and 25-Year Upgrades.

the 20-year time horizon, Link U (Highway 277 east of Highway No. 2 intersection) requires upgrading and, at the 25-year horizon, Links I (Highway 2 south of Highway 277 intersection) and AG (Highway No. 2 south of Robert Scott Drive intersection) require upgrading.

Assuming that the proposed strategy for servicing lands in Area 5 tributary to PS18 and PS20 is adopted in the near future, there are no short term upgrades required to the gravity collection system.

5.0 INFRASTRUCTURE PLAN

This section presents a conceptual infrastructure plan designed to provide a series of trunk improvements to the wastewater collection and treatment system at regular intervals over the next 25 years. The infrastructure plan includes short term (1999-2000), intermediate term (2001-2023) and long term (beyond 2023) improvements recommended to accommodate the projected extent of development.

5.1 Time Horizons

Flow projections have been developed for the analysis of the wastewater system on the basis of 5, 10, 15, 20 and 25-year time horizons as well as the ultimate condition where all lands considered developable have been developed. These flow projections indicate the average daily wastewater flow will double over the next 15 years.

Three distinct groups of improvements have been noted as significant:

- Short Term (1999 - 2000) Improvements are required to address existing deficiencies within the wastewater system as currently configured and under existing levels of development. These improvements are considered to be necessary at this time and are recommended for implementation over the next two years.

- Intermediate Term (2001 - 2023) Improvements will be required as development proceeds to address capacity limitations in the wastewater collection and treatment system. These improvements may be phased in as they become necessary.

- Long Term Improvements (Beyond 2023) are required when the serviced population and associated development exceeds the 25 year projections. While not strictly required under the terms of this study, certain long term improvements have been identified so that the

Municipality can begin to consider their implications and to plan to address them at a future date.

5.2 Short Term Recommendations (1999-2000)

Immediate and short term infrastructure upgrading recommendations are limited to improvements to the pumping stations and forcemains since the capacity of the treatment plant and gravity system has been found to be adequate. As discussed in Section 4.2.2, there are three stations currently at or exceeding their pumping capacity or that will exceed their capacity within a short time frame.

PS4 and PS18 were found to require immediate replacement or upgrading while PS20 was found to be marginal under current loadings, but incapable of handling additional loading from future development. The two pumping stations which comprise PS4 should be decommissioned and replaced with a single pumping station with a capacity to handle the 25-year peak flow projection of 450 usgpm. The two existing forcemains from PS4 have the capacity to handle the 25 year peak flows from the new station and, therefore, would not have to be upgraded with the pumping station.

In the short term PS18 and PS20 should be upgraded by replacing the existing pumps with larger capacity pumps and modifying the electrical and controls equipment accordingly. The pumps used to replace the existing pumps could be relocated from another pumping station following detailed evaluation of the pump curves relative to pumping requirements. For example, it appears the pumps currently operating in PS18 could be relocated to PS20 to substantially improve its capacity.

The existing PS 18 and PS20 forcemains and wetwells have been found to have significant excess capacity to handle pumps with higher capacities. If new pumps are purchased for either PS18 or PS20, consideration should be given to longer term flow requirements with a view to selecting a pump that can provide a long service life in a new pumping station with minor modifications such as changing the impeller.

These short term modifications are expected to be completed over the next two years or so.

A preliminary design study has been commissioned (Porter Dillon, 1998) to identify specific details of the work required to complete the short term upgrades to PS18 and PS20.

5.3 Intermediate Term Recommendations

The intermediate term (2-year to 25-year projections) infrastructure upgrades include modifications to gravity piping, treatment facility, pumping stations and forcemains. As identified on Drawing No. 1 - Regional Sanitary System Existing Conditions and 25 Year Upgrades.

5.3.1 Wastewater Treatment

The only upgrade requirement at the treatment plant will be additional aeration capacity to treat wastewater flows beyond approximately 900,000 USGPD (at about the 10-year flow projection). At this point, aeration to supplement the existing static tube system in the form of blowers with submerged aeration tubing suspended by a floating header pipe (i.e.; Biolac-type system) or additional static tube aerators would be required.

5.3.2 Pumping Stations and Forcemains

PS18 and PS20 will have to be replaced with larger capacity stations suitable to handle the 25-year peak flow projections, that is, with pumping capacities of 835 and 550 usgpm, respectively. The new stations will require significantly larger wet wells than those currently in use. The plan dimensions of the new pre-cast concrete wet wells have been estimated to be 8 ft by 8 ft for PS20 and 10 ft by 10 ft for PS18 offering significantly greater volumes than the existing 6 ft diameter wet wells. It is envisaged, as described in Section 5.3, that the new (short-term improvements) pumps will be relocated from the current wet well to the new one and remain in service for several years until flows from additional development warrant their replacement or upgrading.

Modifications will also be required to the forcemains from PS18 and PS20. There are two reasons for modifying the forcemains. First, the existing 3 inch and 4 inch diameter forcemains do not have sufficient capacity for the anticipated flows. Second, constructing a common forcemain for both PS20 and PS18 and connecting it to the forcemain from PS17 will alleviate substantial loading on the gravity system, PS18 and PS17. The new common forcemain should be 10 inch diameter from PS20 to PS18 (length of 2,150 ft) and 14 inch diameter from PS18 to the connection with the existing 12 inch diameter forcemain from PS17 (length of 5,900 ft) and constructed of PVC with air release valves at high spots. The forcemain from PS18 will require a significant stream crossing at Barneys Brook. If, following detailed analysis, it appears impractical to connect to the forcemain from PS17, the 14 inch diameter forcemain from PS14 should be considered as an alternative.

In addition to PS18 and PS20, PS15 will also reach its pumping capacity within the intermediate term. It is anticipated that modification requirements will be limited to changing the existing pumps to new units capable of conveying 225 usgpm and possibly modifications to the electrical service to handle the increased electrical draw of the larger pumps. There is sufficient forcemain capacity to carry the anticipated flows for the next 25 years. Assuming that the Municipality adopt the strategy presented here for servicing lands near Highway 102 in south Lantz by gravity, the existing receiving sewer system in Maplewood Subdivision is adequate to accept outflow from PS15.

5.3.3 Gravity Collection System

As discussed above, the modifications to PS18 and PS20 and the common forcemain changes will result in significant reductions in the flows through the gravity system to PS17. Therefore, once these changes are completed, upgrades will not be required to the gravity system until the 15-year flow projections are reached. Upgrades to the gravity system have been proposed in the form of twinning the existing piping as opposed to replacement. That is, the existing pipe would remain is service following construction of the new pipe. The principal benefit of twinning is the significant reduction in the number and cost of sanitary service lateral reconnections, including the associated roadway crossings. Even though the existing pipe is twinned, the new pipe has been sized to handle the ultimate flows; therefore, the existing pipe can be decommissioned in the future without additional upgrades.

Once the 15-year flow projections are attained, the existing 8 inch diameter pipes along Links Y and Z, for a total length of 1,750 ft. on Highway 2 north of Green Road, will have to be twinned with 12 inch diameter pipes. At the 20-year projections, 8 inch diameter pipes along Link U in Lantz at end of Highway 277 will have to be twinned with 12 inch diameter pipes (total length of 645 ft). Under the 25-year flow projections, two short 8 inch diameter links, I and AG (total length of 490 ft), will have to be twinned with 12 inch diameter pipes. Link I is at Highway 2 just south of Highway 277 intersection and Link AG is in the north of Lantz. The total length of all the gravity system upgrades required to handle the 25-year peak flow projections is 2,885 ft.

5.4 Long Term Recommendations

A review of the remaining capacity of the sanitary infrastructure beyond the 25-year time horizon was undertaken to identify key issues related to the long term servicing of the area. The most significant deficiency identified, once the 25-year projections are exceeded, is the lack of available capacity at the treatment lagoons. When these lagoons have reached their capacity, several options will have to be evaluated to identify the preferred approach to obtain additional treatment capacity. These options will include:

- Converting the lagoon system to an activated sludge system. This would involve converting one of the lagoon cells to a high rate activated sludge reactor and constructing a secondary clarifier, inlet bar screen and sludge management system. Sludge would be recirculated from the clarifier to the aeration cell to increase the concentration of microorganisms resulting in higher organic material removal efficiencies.

- Constructing a second treatment facility to share the flows. This second facility would likely be constructed between Highway 214 and the Nine Mile River or in the Lantz area.

- Adding another cell to the existing lagoon system. A fourth cell could be constructed to increase the capacity of the existing system.

In the long term, these options will be evaluated in conjunction with a detailed investigation of the condition of the lagoons.

In addition to the limitations at the treatment plant, a number of the pumping stations will likely require upgrading or replacement. The stations approaching capacity will be PS3, PS8, PS10 PS11A and PS17. Forcemains for these stations appear to have capacity exceeding that of the station; therefore, they may not have to be replaced at the same time as the station. Future upgrading of these stations should also include provision of standby power to ensure continued operation during regional power outages.

In addition, larger pumping stations will also require emergency standby power to ensure continued operation during regional power outages. The capital costs of providing emergency standby power to the major station (PS7, PS8, PS9, PS10, PS13, PS14 and PS17) have been included in the capital cost estimates in Section 6.0 - Financial Plan.

Emergency backup pumping capacity for the other, smaller pumping stations will be provided through portable pumps dedicated to specific stations. The Municipality has already initiated this strategy at PS15.

As for the gravity collection piping, a review of the capacities at the 25-year projections reveals significant excess capacity for the majority of the system. Piping approaching capacity at that time will be Links t, y, z and D. These will be required to handle the continued increase in development in the northern section of Service Area 4 and in Service Area 5 as well as the central section Service Area 3.

6.0 FINANCIAL PLAN

6.1 Capital Cost Estimates

6.1.1 Short Term Upgrades

The short term upgrades, in summary, include upgrading PS18 and PS20 and replacing PS4 with a new station. The costs for replacing the existing pumps in PS18 and PS20 and making the necessary electrical modifications to both panels were estimated to be in the range of $60,000. A new station at PS4, including wet well, panel, pumps and emergency stand-by power and connections to the existing piping have been estimated to cost $190,000 plus engineering and contingency. The cost of the pumping station assumes little or no rock excavation will be required and does not include the cost of land acquisition if required.

Therefore, the estimated costs for the upgrades to be completed with in the next two years or so amount to approximately $250,000 plus engineering and contingency.

6.1.2 Intermediate Term Upgrades

These costs for the upgrades to the wastewater system were based on the following assumptions:

- little or no rock excavation required for the construction of the piping and pumping stations;
- new gravity will twin the existing pipe (minimizing the number of lateral reconnections) and will be sized to carry the ultimate flows;
- land acquisition costs not included;
- forcemain unit cost of $75 per foot, including air release valves;

- gravity piping average unit cost of $120 per foot including manholes; and

- pumping station costs based on Flygt-type station, including allowance for piping connections, valve chamber, SCADA radio transmission unit, decommissioning of existing station and stand-by power.

The intermediate term upgrades which consist of replacing PS18 and PS20, constructing a new 8,050 ft long forcemain from PS20 to the forcemain from PS17 and replacing gravity sanitary piping totalling 2,885 ft. The estimated total capital cost for these items amounts to $3,387,000 (in 1998 dollars) including engineering and contingency. Table 6-1 provides the breakdown of the capital cost estimates and the year in which the expenditures are expected to occur. Capital costs presented in the table are expressed in both current dollars (1998) and inflated future dollars (at time of construction).

Table 6-1 Capital Cost Estimates - Regional Wastewater System

Year Required	Infrastructure Element	Code[1]	Total Capital Cost[1]	
			1998 Dollars[2]	Actual Inflated[3]
1999	• Upgrade PS18 and PS20 • Replace PS4		$ 337,000	$ 337,000
2003	• Replace PS18 and PS20 • Forcemain PS18 and PS20 • Emergency Power PS17		$ 1,535,000	$ 1,779,000
2008	• Upgrade PS15 • Upgrade STP Aeration • Emergency Power PS7		$ 357,000	$ 480,000
2013	• Upgrade Gravity Mains • Emergency Power PS8 • Emergency Power PS9	Links Y and Z	$ 572,000	$ 891,000
2018	• Upgrade Gravity Mains • Emergency Power PS10 • Emergency Power PS13	Link U	$ 364,000	$ 657,000
2023	• Upgrade Gravity Mains • Emergency Power PS14	Links I and AG	$ 222,000	$ 465,000
	Totals		$ 3,387,000	$ 4,609,000

Notes:

1. Refer to Drawing No. 1.
2. Costs include a 10% allowance for engineering, a 15% allowance for contingency and the fraction of the HST payable by the Municipality (3/7 of 15%).
3. Cost includes a 3% per year inflation factor; a 10% allowance for engineering and a 15% contingency and the fraction of the HST payable by the Municipality 3/7 of 15%).

7.0 IMPLEMENTATION PLAN

7.1 Short Term

Pumping stations 18 and 20 should be upgraded with new pumps and associated electrical modifications and PS4 should be replaced with a single larger capacity station as soon as possible to effectively handle the existing loadings and provide excess capacity to allow additional development. More detailed engineering investigations should be initiated immediately to refine the design criteria of these stations and determine the most cost effective means of conducting the upgrades while ensuring the stations and/or pumps are flexible enough for use well into the intermediate term time frame.

7.2 Intermediate Term

The upgrades to PS18 and PS20 described in Section 7.1 are intended only to provide capacity for the short term. Once the flows approach the 5-year projections, the wet wells and forcemains will be approaching their capacity and the pumping stations will require replacement. The two new pumping stations should be constructed adjacent to the existing stations to facilitate connections to the existing gravity piping. The new forcemain from PS20 to the PS17 forcemain will also have to be constructed. At that time, the pumps in PS15 will also have to be upgraded.

At the 10-year flow projections, the aeration system at the treatment plant will have to be supplemented. Engineering investigations preceding this upgrade will have to take into consideration the various types of aeration systems as well as an evaluation of capital and operating costs.

When the 15-year flow projections are reached, the existing 8 inch diameter pipes along Links Y and Z, for a total length of 1,750 ft. on Highway 2 north of Green Road will have to be twinned with 12 inch diameter pipes. Since this piping could be installed in the same trench as a portion of the new forcemain between PS20 and the forcemain from PS17, consideration should be given to constructing these gravity system upgrades while the forcemain is being installed.

At the 20-year projections, 8 inch diameter pipes along Link U in Lantz will have to be twinned with 12 inch diameter pipes (total length of 645 ft).

Under the 25-year flow projections, two short 8 inch diameter links, I and AG (total length of 490 ft), will have to be twinned with 12 inch diameter pipes. Link I is at the south of Lantz and Link AG is in the north of Lantz.

The total length of the all the gravity system upgrades required to handle the 25-year peak flow projections is 2,885 ft.

Appendix B-1

Detailed Capital Cost Estimates for Wastewater System Improvements

Sewer Capital Cost Estimate
25 Year Projection

15-Jul-98

Item	Unit	Estimated Quantity	Unit Price	Est. Total Cost	Total Including ng., Cont., HST	ctual Inflated
SEWER INFRASTRUCTURE						
Present - 1998						
1 Upgrade Pump Station 18 and 20	L.S.	1	$60,000	$60,000		
Replace pump station 4	L.S.	1	$190,000	$190,000		
			Total 1998:	$250,000	$337,000	$337,000
year 2003						
1 Replace PS 18 and 20	L.S.	1	$450,000	$450,000		
Force main from PS 20 to existing force main from PS	m	2400	$250	$600,000		
2 Emergency Power for Pump Station 17	L.S.	1	$90,000	$90,000		
			Total 2003:	$1,140,000	$1,535,000	$1,779,000
year 2008						
1 Upgrade pump station 15	L.S.	1	$60,000	$60,000		
Upgrade aeration at STP	L.S.	1	$115,000	$115,000		
2 Emergency Power for Pump Station 7	L.S.	1	$90,000	$90,000		
			Total 2008:	$265,000	$357,000	$480,000
year 2013						
1 Gravity main upgrades	L.S.	1	$245,000	$245,000		
2 Emergency Power for Pump Station 8	L.S.	1	$90,000	$90,000		
Emergency Power for Pump Station 9	L.S.	1	$90,000	$90,000		
			Total 2013:	$425,000	$572,000	$891,000
year 2018						
1 Gravity main upgrades	L.S.	1	$90,000	$90,000		
2 Emergency Power for Pump Station 10	L.S.	1	$90,000	$90,000		
Emergency Power for Pump Station 13	L.S.	1	$90,000	$90,000		
			Total 2018:	$270,000	$364,000	$657,000
year 2023						
1 Gravity main upgrades	L.S.	1	$75,000	$75,000		
2 Emergency Power for Pump Station 14	L.S.	1	$90,000	$90,000		
			Total 2023:	$165,000	$222,000	$465,000
SUBTOTAL CAPITAL COSTS				$2,515,000	$3,387,000	$4,609,000
ENGINEERING (10%)				$251,500		
SUBTOTAL ESTIMATED COST				$2,766,500		
CONTINGENCY (15%)				$415,000		
SUBTOTAL ESTIMATED COST				$3,181,500		
HST Payable (3/7)*15%				$204,500		
TOTAL ESTIMATED Sewer COST				$3,386,000		

Inflation Rate 0.03

Part C

Regional Water System Analysis

Table of Contents
Part C - Regional Water System Analysis

Page No.

1.0 INTRODUCTION C-1
1.1 Background C-1
1.2 Scope of Work C-1
1.3 Units C-2

2.0 SERVICE BOUNDARIES AND DEMAND PROJECTIONS C-3
2.1 Existing Water Serviceable Boundaries C-3
2.2 Population and Demand Projections C-4

3.0 EXISTING WATER SUPPLY AND DISTRIBUTION SYSTEM C-6
3.1 Raw Water Supply C-7
3.2 Low Lift Pumps and Supply Line C-7
3.3 Water Treatment Plant Capacity C-8
3.4 High Lift Pumps and Clearwell C-9
3.5 Transmission Main Capacity C-9
3.6 Storage Reservoir Capacity C-10

4.0 DESIGN ASSUMPTIONS C-12
4.1 Hydraulic Design Standard C-12
4.2 Servicing Restrictions C-13
4.3 Fire Flow Requirements C-14
4.4 Storage Requirements C-14
4.5 Transmission Main Requirements C-18

5.0 HYDRAULIC ANALYSIS C-19
5.1 Hydraulic Network Model C-19
5.2 Required Hydraulic Improvements C-21
5.2.1 Reservoir Storage C-21
5.2.2 Primary Transmission Main C-22

Table of Contents
(Continued)

Page No.

5.2.3 Clearwell Capacity C-26
5.2.4 Pumping System Improvements C-26
5.2.5 Raw Water Source Limitations and Water Treatment Plant Capacity C-28

6.0 INFRASTRUCTURE AND IMPLEMENTATION PLAN C-30
6.1 Infrastructure Timeline C-30
6.1.1 Year 1999 Improvements - Average Day Demand 320 USGPM C-30
6.1.2 Year 2009 Improvements - Average Day Demand of 550 USGPM C-32
6.1.3 Year 2013 Improvements - Average Day Demand of 615 USGPM C-32
6.1.4 Year 2018 Improvements - Average Day Demand of 700 USGPM C-33
6.1.5 Year 2024 Improvements - Average Day Demand of 850 USGPM C-33

7.0 CAPITAL COST ESTIMATES C-35

Appendices

Appendix C-1 Detailed Capital Cost Estimates for Water System Improvements

List of Figures

		Page No.
Figure 5-1	East Hants Water Distribution System Conceptual Layout	C-20
Figure 5-2	Ridgefield/Willowcrest Storage Reservoir #1 Schematic	C-23
Figure 5-3	Willowcrest Storage Reservoir #2 Schematic	C-24
Figure 5-4	Business Park Storage Reservoir Schematic	C-25
Figure 6-1	Infrastructure Timeline	C-31

List of Tables

		Page No.
Table 2-1	Future Maximum Day Water Demand Projections (1998 - 2023)	C-5
Table 4-1	Estimated Fire Flow Requirements	C-15
Table 4-2	Storage Reservoir Requirements	C-17
Table 5-1	Total Volume of Stand Pipe Reservoir Storage for 25 Year Horizon	C-22

1.0 INTRODUCTION

The Municipality of East Hants Regional Water Utility provides treated potable water to residents within the Serviceable Area of the Municipality. The Water Supply System analysis is intended to identify water infrastructure requirements to remediate deficiencies in the existing water supply, treatment, storage and transmission system and to provide adequate capacity for intermediate and long term growth within the East Hants Regional Serviceable Area.

1.1 Background

The Study Area includes the serviceable areas of the communities of Enfield, Elmsdale and Lantz as well as the East Hants Business Park. Map 2 located in the pouch at the back of this report provides an illustration of the Study Area and the existing water distribution infrastructure.

Additional adjacent communities which have indicated an interest in being included within the serviceable area include Horne Settlement, Belnan and East Milford. While these areas are not currently within the Serviceable Area and have not been included for consideration as part of the scope of this study, improvements to the water infrastructure have considered implications on existing and future infrastructure requirements, of including one or more of these communities.

1.2 Scope of Work

The water system analysis work program was prepared in response to the Terms of Reference prepared by the Municipality. Work tasks under this Regional Water System Analysis include:

1. Review of background information and design criteria.

2. Upgrade of the existing preliminary computer model prepared under the recently completed Water Supply Capacity/Storage Needs Analysis.

3. Development of water demand projections based on population projection presented in Part A.

4. Definition and modelling of alternative water servicing scenarios.

5. Identification of the preferred servicing scenarios.

6. Development of capital cost estimates for infrastructure improvements.

7. Preparation of an implementation plan for a systematic construction of recommended improvements; and

8. Preparation of this report.

Municipal water utilities typically require the preparation of a detailed water service master plan which includes execution of a thorough review of the performance of the existing supply treatment and distribution system, preparation of a calibrated hydraulic network model to be used as an analytical tool to examine existing and future configurations, determination of long term population and demand projections, determination of long term infrastructure requirements complete with capital and operating cost estimates and, preparation of an implementation plan and schedule with recommendations for capital cost recovery.

1.3 Units

The Municipality of East Hants provides treated water in imperial units (imperial gallons) and previous design reports related to the water system have been written using imperial and American units. In recognition of these factors, this report is written using imperial units throughout with the exception of water flow rates which are denominated in U.S. gallons per minute (usgpm) as is the industry standard.

2.0 SERVICE BOUNDARIES AND DEMAND PROJECTIONS

2.1 Existing Water Serviceable Boundaries

The existing water serviceable boundary is defined as the Community of Enfield (inclusive) to the Community of Lantz (inclusive), between the Shubenacadie River and the Number 102 Highway in the corridor area of the Municipality of East Hants and including the East Hants Business Park located at the junction of Highway No. 102 and Highway No. 214. Map No. 2 (in pouch) presents the boundaries of the existing regional water serviceable area and the East Hants Business Park.

Lands within the regional water serviceable boundary are designated as potentially serviceable from the existing water supply, treatment, and distribution system. Certain areas outside of the regional water service boundary, such as Horne Settlement, Belnan, East Milford, areas adjacent the East Hants Business Park, and the Highway No. 214 commercial zones, may be considered by future Municipal Councils for inclusion within an expanded service boundary. Analysis conducted under this study recognizes the long term potential for limited expansion of the regional water serviceable boundary, however the primary emphasis has been on provision of service within the existing regional serviceable area.

It must be clearly understood, however, that expansion of the existing serviceable boundary cannot be accommodated without an increase in source of supply and treatment capability. Servicing areas outside the present boundaries without making provision for additional raw water supply and treatment capacity will result in reduced serviceability of lands within the presently defined serviceable boundary. Further analysis or investigation of this issue is beyond the scope of this study. In addition, it should be understood that extension of water service to areas which will not also receive sanitary sewer service is not recommended.

For the purposes of this study, the existing service area has been subdivided into five subareas as discussed in Section 1.3 of Part A - Background and Demographics. Proposed infrastructure improvements and capital cost estimates are presented for each of these subareas.

2.2 Population and Demand Projections

Serviced population projections within the Study Area, which have been presented in Section 2.0 of Part "A", include five year incremental population estimates for each of the five subareas. It was projected that the existing population of 4,914 will increase to approximately 14,426 by the year 2023 and ultimately to a population of 25,000 or more. Water treatment and transmission infrastructure is typically designed based upon average day and maximum day consumption within the service life of the infrastructure elements.

Average day per capita water demand used for design of buried infrastructure is 90 imperial gallons per capita per day (IGCD) or 108 USGCD based on the Nova Scotia Department of Environment general specification and the maximum day per capita water demand 135 IGCD. However, based on water usage records for MEH, the actual per capita water usage is 70 igcd and actual maximum day usage is 100 IGCD. Therefore, for infrastructure implementation planning, the actual maximum day demands of 100 IGCD were used. Table 2-1 provides a summary of maximum day water demand estimates for each of the five subareas at five year intervals. These maximum day water demand estimates have been used throughout the regional water system analysis to determine the hydraulic performance of the existing and future systems.

Table 2-1 Future Maximum Day Water Demand Projections (1998 - 2023)

Service Area	Future Maximum Day Water Demand (USGPM)					
	1998	2003	2008	2013	2018	2023
Area 1 - Enfield	126	153	164	176	187	199
Area 2 - Elmsdale	122 ~~143~~	176 ~~240~~	193 ~~288~~	211 ~~336~~	228 ~~384~~	246 ~~432~~
Area 3 - Clayton	15	58	98	139	179	220
Area 4 - Maplewood	107 ~~135~~	158	168	179	189	199
Area 5 - Willowcrest	41	106	166	226	286	346
Total	~~437~~ ~~458~~ 410	~~654~~ ~~715~~ 651	789 ~~884~~	~~858~~ ~~1,056~~ 931	1,069 ~~1,225~~	1,310 ~~1,396~~

Note:

1. Future maximum day water demand is based on per capita maximum day demand of ~~135~~ 100 IGCD.

based on figures given and populations from Table 2-5.

This table does not line up with Table 2-5, page A-18 eg.'s in 2023 area ~~6~~ has the largest population but not the largest water demand. Area 2 figures wrong.

3.0 EXISTING WATER SUPPLY AND DISTRIBUTION SYSTEM

The existing East Hants Regional Water System serves the communities of Enfield, Elmsdale and Lantz as well as the East Hants Business Park. The existing East Hants water supply, treatment, transmission and distribution system which consists of the former independent Enfield, Elmsdale and Lantz systems, includes the following elements:

- Raw water supply from the Shubenacadie River south of Enfield immediately upstream of the Highway No. 102 bridges;
- Low lift pumping from the raw water supply well;
- Water treatment of up to 500 igpm (600 USGPM) and a backup for emergency services with a capacity of 200 igpm (240 USGPM).
- Treated water clearwell storage capacity of approximately 280,000 IGAL.
- High lift pumping at an average throttled rate of approximately 400 igpm (480 USGPM). The nominal unthrottled capacity of the high lift pumps is 700 USGPM at 247 feet TDH.
- Transmission of treated water along the corridor utilizing a single linear transmission main (12"/10"/8") located primarily in Highway No. 2 from the Enfield treatment plant to the Milford/Lantz boundary.
- Water distribution piping throughout developed areas of the Study Area are summarized on the conceptual water system plan located in the pouch.
- Elevated reservoir storage in two steel standpipes.

- The Lantz water treatment plant has been removed from service and has been "moth balled" for future use if needed. A 30,000 imperial gallon wetwell complete with high lift pumps is available at the Lantz WTP to potentially serve as additional storage if required.

The specific characteristics of each of these existing infrastructure elements are discussed in the following sections.

3.1 Raw Water Supply

Untreated, raw water for the East Hants system is currently drawn from the Shubenacadie River through a 21" diameter supply main. The Municipality has the right through a water rights permit to withdraw water at a maximum rate of 700 USGPM (840,000 IGD) from the Shubenacadie River at the Enfield WTP.

Historically, the Shubenacadie River has exhibited extreme low flow conditions during extended summer dry spells. The existing raw water supply line intake is located in a major pool upstream of the Highway No. 102 bridges and long term potential may exist to construct an expanded impoundment on the river with appropriate fish passage features. An alternative long term option for increasing raw water supply could involve access to Grand Lake or development of a groundwater resource in the vicinity of the regional system.

The Municipality also has a water rights permit at the idle Lantz water treatment facility which allows an extraction rate of 200 USGPM (240,000 IGD) from the Shubenacadie River. For the purpose of this study, it has been assumed that this extraction rate can be relocated to the existing Enfield WTP but this must be approved by Nova Scotia Department of the Environment.

3.2 Low Lift Pumps and Supply Line

A 21" diameter raw water supply line delivers river water to the raw water intake well located at the Enfield WTP. The low lift pumping system consists of one duty pump and one standby pump designed to deliver 500 USGPM at a total dynamic head of 60 feet. These Fairbanks Morse single stage vertical turbine pumps were installed as part of the 1991 WTP construction.

The secondary (backup) treatment plant is currently configured to withdraw raw water from the Shubenacadie River through the older 8" diameter supply line. Future operation of the backup plant required during maximum day demand conditions, will require reconfiguration of the raw water supply to access the 21" diameter supply line.

3.3 Water Treatment Plant Capacity

The primary Enfield WTP which was constructed in 1991, has a nominal capacity of 600 USGPM (720,000 IGD) through two parallel treatment trains. The plant output is reduced by the need to accommodate periodic backwashes which are typically more frequent in summer months. In recent years, the plant has provided average day demand of approximately 250,000 IGD (209 USGPM) during winter months and 350,000 IGD (292 USGPM) during summer months. The WTP delivered peak daily demand of approximately 500,000 IGD (416 USGPM) to the distribution network during the final week of July, 1997 which was the driest July on record with only 16 mm of precipitation recorded at the Halifax International Airport.

The secondary (backup) Enfield WTP, which is a Mircofloc 40 package plant, located next to the primary plant, is maintained as a reserve standby plant for emergency conditions and has a nominal capacity of 240 USGPM (288,000 IGD).

The Lantz WTP, which previously served the Community of Lantz, has been decommissioned and is currently maintained in a "moth-balled" state and may be relocated to the Enfield WTP to augment treatment capacity in the future. The 30,000 IGAL Lantz WTP clearwell and high lift pumping system has been considered in this study as potentially serving as an emergency treated water reservoir or as a second token meter station for filling bulk water tank trucks.

3.4 High Lift Pumps and Clearwell

Filtered water from the Enfield WTP is stored in a pair of clearwells with a total capacity of 280,000 igal comprised of a 60,000 igal clearwell located beneath the floor of the plant and a 220,000 igal clearwell located adjacent the plant. Treated water is drawn from the clearwell and delivered directly into the water transmission and distribution system through a pair of Fairbanks Morse, three stage, vertical turbine high lift pumps (one duty and one standby) with a rated capacity of 700 USgpm at a total dynamic head of 247 feet.

Recently (1998), the Water Utility has constructed an additional 220,000 IGAL of treated water clear well storage adjacent the Enfield WTP. This additional clear well capacity provides sufficient storage to permit flexible operating hours during normal demand conditions and to permit regular backwashes, periodic plant shutdown and regular maintenance during maximum day demand conditions.

3.5 Transmission Main Capacity

Water transmission within the Corridor Area is provided by one linear transmission main which delivers treated water from the high lift pumps to the north boundary of the Study Area. The existing transmission main consists of a relatively short section of 12" diameter pipe running along Highway No. 2 from the intersection of Doyle Drive to the intersection of the Horne Settlement Road; a longer section of 10" diameter pipe extending to the vicinity of the Elmsdale/Enfield boundary; a section of 6" diameter and 10" diameter in parallel extending from the Enfield/Elmsdale boundary to Endale Drive; a section of 8" diameter main from Endale Drive to Highway 214; a section of 12" diameter from Highway 214 to the vicinity of the Sportsplex and an 8" diameter pipe extending from the Sportsplex to the Milford boundary.

There is no other major water transmission main provided within the Study Area except for the newly constructed Park Road transmission main (16" diameter) and failure of nearly any portion of the existing main will result in loss of supply to residents who do not have access to reservoir storage. Analysis and design of additional parallel water transmission capacity has been a significant design consideration within this study.

In spite of the recent construction of the Park Road transmission main, the existing water transmission system significantly limits the replenishment of the storage tanks and the delivery of fireflows to areas remote from the tanks and treatment plant. The water transmission limitations associated with the existing transmission main results in excessive time required to replenish the Lantz reservoir during maximum day demand conditions as experienced in late July, 1997. Successful operation of a proposed new water storage reservoir near the Milford/Lantz boundary will depend on the capacity of the transmission system to deliver water during peak hour conditions.

Secure and efficient delivery of water throughout the water service area requires the construction of a new high capacity primary water transmission main throughout the length of the serviceable area with interconnections to existing and future subdivision developments. This primary transmission main may be constructed in segments over the near future with each segment significantly improving service within the Regional Serviceable Area. Primary water transmission mains are typically sized to service ultimate development within the service area due to the expense of upgrading subsurface elements in the system.

3.6 Storage Reservoir Capacity

The existing elevated water storage capacity totals approximately 780,000 imperial gallons with approximately 140,000 igal of active storage available for peak balancing. In addition to the clearwells at the Enfield WP, which provides approximately 280,000 igal of pumped storage, the Enfield reservoir has 330,000 igal capacity and the Lantz reservoir has 450,000 igal storage. Both reservoirs float on the system with no booster pumps required and the entire distribution system is in one pressure zone. The specific characteristics of the two storage reservoirs are as follows:

Enfield Tank

Volume . . . . 330,000 imperial gallons
Height . . . . 102 feet
Diameter . . . . 25'10"
Normal Top Water Level (Geodetic) . . . . 218'
Constructed 1976
Refurbished 1991

Lantz Tank

Volume . . . . 450,000 imperial gallons
Height . . . . 99.5 feet
Diameter . . . . Approximately 30'
Normal Top Water Level (Geodetic) . . . . 218'
Constructed 1990

The top water level (TWL) in both reservoirs is approximately 218.5 feet above mean sea level (amsl) with a normal low water level (LWL) of approximately 203.5 ft. amsl (85 feet above tank bottom). Assuming a minimum desirable static pressure of 40 psi (92 ft), the highest ground elevation serviceable from the storage reservoir is approximately the 110 ft contour. Certain existing residential developments above the 110 foot contour which are currently being serviced, such as the upper end of Robert Scott Drive in the Ridgefield Subdivision, are experiencing low water pressure during both normal and fire flow conditions. Potential exists for extension of service into lands above the 110 foot contour, however this will require the establishment of a high service zone with a requirement for a booster pumping station and a dedicated storage reservoir.

A small portion of lands within the East Hants Business Park is located above the 110 foot contour. Development of these higher lands will require establishment of a high service zone with similar requirement for a booster pumping station and potentially a dedicated storage reservoir. The industrial and commercial development along Highway No. 214 requires a significant fireflow capability which currently is not being met. Construction in the future of a new storage reservoir within the business park will significantly increase available fireflows in the area to meet Insurers Advisory Organization Standards.

4.0 DESIGN ASSUMPTIONS

This section presents a brief summary of the hydraulic and planning assumptions which have been applied throughout the development of this analysis.

4.1 Hydraulic Design Standard

Typical industry-wide standards for water pressure within a municipal water system indicate maximum and minimum desirable static pressures at all points within the system under normal operating conditions representing maximum day demand.

Under extraordinary conditions, such as during fire flow demand, the system should also be capable of providing a minimum residual pressure at all points within the service area. Currently, the Municipality does not provide fireflows to the Insurers Advisory Organization (IAO) standard at all points across the system.

For the purposes of this hydraulic analysis, the following design parameters have been applied:

- Minimum Static Service Pressure: . . . . 40 psi
- Maximum Static Service Pressure: . . . . 95 psi
- Minimum Fire Flow Residual: . . . . 22 psi
- Regional Design Discharge . . . . Maximum Day Demand
- Local Design Discharge: . . . . Maximum Day Demand Plus Fire Flow
- Desirable Maximum Pipe Flow Velocity: . . . . 1.5 m/s (5 ft./s)
- Maximum Day Demand Factors
    - Average Day Demand x 1.44 (for local areas)
- Per Capita Average Day Demand (Buried Infrastructure): . . . . 90 IGCD*
- Per Capita Maximum Day Demand (Buried Infrastructure): . . . . 135 IGCD*
- Per Capita Average Day Demand (Actual) . . . . 70 IGCD**

- Per Capita Maximum Day Demand (Actual) . . . . 100 ICGD**
- Pipeline Friction Factor (C-Value): 120

Notes:

* These average and maximum day per capita NSDOE design demand values are consistent with the Municipality of East Hants general service specifications.

** These actual average and maximum day per capita demand values are consistent with recent operating experience.

It should be noted that these design parameters represent desirable values for the operation of the water system, however, there are currently some areas of the system which do not receive minimum static and residual pressures during normal and fireflow conditions. With the exception of the existing condition analysis, these design standards have been applied to define future infrastructure requirements and system performance.

4.2 Servicing Restrictions

Lands within the East Hants Regional Water Service Boundary, which are to be approved for development, should meet water pressure requirements of the Canadian Plumbing Code. To this end, all water distribution infrastructure within the Study Area should provide normal domestic water pressures at the street between 40 psi and 95 psi under maximum day demand and adequate fire flow protection at a minimum residual pressure of 22 psi (Insurers Advisory Service Requirement) throughout the system. Typically, water pressures within the trunk transmission mains in excess of 95 psi are permitted provided no residences are exposed to these extreme pressures.

4.3 Fire Flow Requirements

Required fire flow is the rate of water flow for a defined duration, at a residual pressure of 22 psi at any point in the system, that is necessary to control a major fire for a specified structure type. The Fire Underwriters Survey (FUS, 1991), through the Insurers Advisory Organization (IAO), has established criteria under which required fire flow capacities for residential, commercial and institutional areas may be determined.

For fire flow calculation purposes, the specified structure types to be considered are directly related to proposed land usages within the development to be protected. The primary land use within the East Hants Water Service District will continue to be single family residential, however, significant commercial and industrial development also exists within the Water Service District. There are also many new developments with multi-unit buildings and semi-detached structures.

The required fire flow for residential, commercial and industrial occurrences is determined from the Fire Underwriters Survey (FUS, 1991) Water Supply for Public Fire Protection, A Guide to Recommended Practice.

Table 4-1 provides a summary of typical calculated fire flow requirements for residential, commercial and industrial occupancies within the Water Service District. These fireflow demands are consistent with those presented in recent fire protection studies conducted by the Insurers Advisory Organization.

4.4 Storage Requirements

Potable water reservoir storage will provide security of supply for the Water Service District during fire flow demand conditions and other emergency situations such as minor supply interruptions due to watermain breakage. Storage requirements also consider the potential of providing equalization storage or peak balancing during periods of high demand. Each of these storage requirements is discussed briefly below.

Table 4-1 Estimated Fire Flow Requirements

Occupancy Type	Type of Construction	Description	Fire Flow Required (IGPM)	Duration Required (hours)
Residential	Wood frame	Detached one-family, not exceeding two stories	880	1.5
Residential	Wood frame	Modern row or townhouse	2,000	2.0
Residential	Wood frame	Semi detached, not exceeding two stories	1,200	1.75
Commercial	Wood frame, sprinklered	Single storey 743 m^2 (8,000 ft^2)	2,000	2.0
Industrial	Metal frame average combustible contents	Single storey 3700 m^2 (40,000 $ft.^2$)	3,000	3.0
Industrial	Sawmill and lumber storage	Wood products	2,200	2.0

Equalization storage is required to meet water system demands in excess of instantaneous delivery capability. Equalization storage is generally sized to carry demands in excess of the maximum day demand up to peak hour demand and usually makes up about 25 to 35 percent of the average day demand. Equalization storage is intended to supply all system demands above the average system demand.

Fire storage is typically provided for fire flow requirements of the IAO. Estimates of fire flow requirements for the East Hants Service District have been presented in Section 4.3, with the noted maximum governing IAO requirement being approximately 3,000 IGPM for a period of 3.0 hours in the vicinity of the intersection of Highway No. 102 and Highway No. 214.

Emergency storage provides stored water during emergency situations such as pipeline failures, major trunk main failures, equipment failures, temporary water supply contamination, or natural disasters. The amount of emergency storage included within a particular water distribution system is at the discretion of the Water Utility, based on an assessment of risk and the desired degree of system reliability. One day emergency storage requirement has been assumed for the Study Area based on an estimate of the maximum time required to repair a standard length of watermain with locally available materials.

Currently, the Enfield tank and the water treatment plant clearwell serves the communities of Enfield and Elmsdale and the Lantz tank serves lands north of the Nine Mile River. Improvements to the existing transmission main system will expand the service area for existing and future storage reservoirs.

Table 4-2 provides a summary of existing and future reservoir requirements within the water service district by subarea. It should be noted that individual reservoir storage tanks are typically sized for specific service sub areas because of the requirement to provide emergency supply in their locality. For this study, existing and future reservoir storage needs have been analyzed on a local basis and new tanks have been sited to accommodate future development as it occurs.

Table 4-2 Storage Reservoir Requirements

Existing Storage Requirements 1998

Location	Population 1998	Avg. Day Demand (MIGD)	Equalization Storage* (IGAL)	Fire Storage** (IGAL)	Emergency Storage*** (IGALL)	Total Storage (IGAL)	Existing Storage (IGAL)
East Hants Service Boundary							
Area 1 - Enfield	1,500	0.1350	47,250		135,000	722,250	610,000
Area 2 - Elmsdale	1,698	0.1528	53,487	540,000	152,820	206,307	
Area 3 - Clayton Dev.	180	0.0162	5,670		16,200	21,870	
Area 4 - Maplewood/Lantz Road	1,578	0.1420	49,707		142,020	191,727	450,000
Area 5 - Willowcrest/Robert Scott	489	0.0440	15,404		44,010	59,414	
Total	5,445	0.4901	171,518	540,000	490,050	1,201,568	1,060,000
					New Tank Currently Required	141,568	

Future 25 Year Storage Requirement (2023)

Location	Probable Population 2023	Avg. Day Demand (MIGD)	Equalization Storage* (IGAL)	Fire Storage** (IGAL)	Emergency Storage*** (IGAL)	Required Total Storage (IGAL)	Existing Storage (IGAL)	Recommended Future Tanks (IGAL)
East Hants Service Boundary								
Area 1 - Enfield	2,368	0.213	74,607		213,162	287,769	610,000	
Area 2 - Elmsdale	2,951	0.265	92,949	540,000	265,569	898,518		813,477
Area 3 - Clayton Dev.	2,620	0.235	82,522		235,777	318,299		
Area 4 - Maplewood/Lantz Road	2,369	0.213	74,610		213,171	287,781	450,000	
Area 5 - Willowcrest/Robert Scott	4,118	0.370	129,727	126,000	370,647	626,374		545,265
Total	14,426	1.298	454,415	666,000	1,298,000	2,419,000	1,060,000	1,358,742
					Additional Storage Required:	1,358,742		

* 35% of Average Day Demand
** 3000 igpm for 3 hours for commercial and 1200 igpm for 1.75 hours for duplex
*** 1 day of Average Day Demand

4.5 Transmission Main Requirements

Most modern water systems are equipped with a major water transmission main system designed to deliver water during normal maximum day conditions from the treatment plant to the water storage reservoirs and the load centers across the system and to deliver water during emergency fireflow conditions from the storage reservoirs to the major fire loads such as schools, shopping malls and industrial facilities.

Typically, the water transmission system, which is constructed of large diameter piping equipped with air release valves and pressure control features, is designed to accommodate expected growth over a longer time horizon than other above ground infrastructure due to the high cost of upgrading subterranean piping.

The existing water transmission main system is located in Highway No. 2 is composed of a variety of relatively small diameter piping with a limited capacity to handle additional development. The Park Road water transmission main (1700 m of 400 mm (16") diameter PVC) recently constructed between the Elmwood Subdivision and the Business Park in the first phase of the construction of a new trunk water transmission main system intended to significantly upgrade the delivery of water throughout the system. Additional phases of water transmission main and the required schedule will be identified in the Infrastructure Improvement Plan (Section 6.0) and the required capital expenditures for construction will be identified in the Capital Cost Estimates (Section 7.0).

5.0 HYDRAULIC ANALYSIS

This section provides a brief summary of the hydraulic analysis conducted on the existing water transmission and distribution system within the study area and of the future water system infrastructure improvements proposed for the study area.

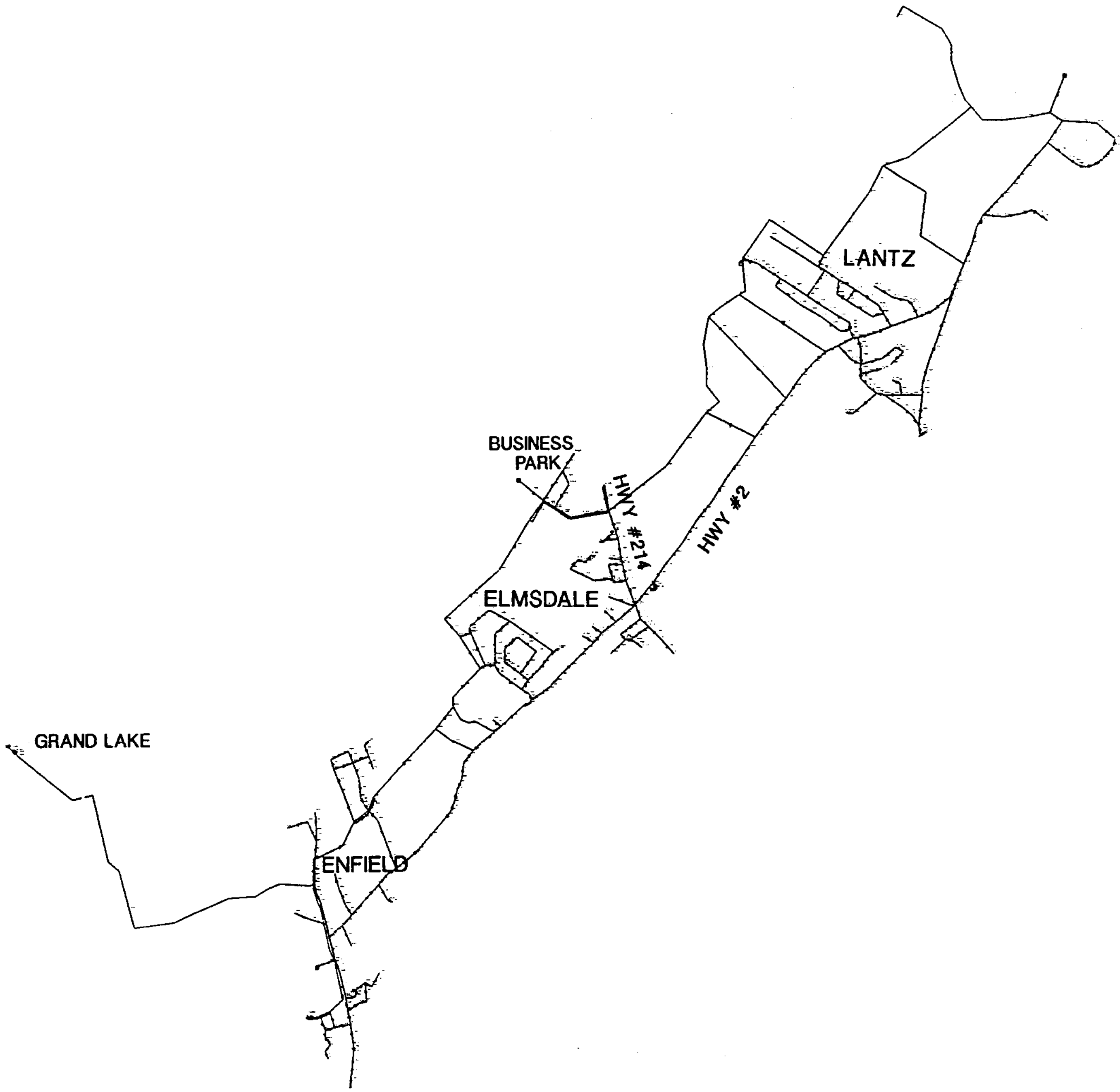
5.1 Hydraulic Network Model

An existing computer network model prepared as part of the Water Supply Capacity Storage Needs Analysis (PDL, 1997) has been edited to simulate the East Hants regional water supply, transmission and distribution system for existing population and several stages of future population. The layout of the system is presented in Map No. 2 (in pouch).

The computer model has been transferred from EPANET to WaterCad which is a respected dynamic modelling environment capable of simulating extended time hydraulic behaviour of the system including pumps, tanks and control logs.

The network model was modified to several demand scenarios including existing demands, future 5 year, 10 year, and a 25 year demands and an ultimate demand model for 25,000 people. Each model used the diurnal curve pattern to simulate the changes in water demand over the course of the day, reflecting times when people are using more and less water than average.

These existing and future models were executed for a period of 3 days in which the second day simulated maximum day demands. These models were used to determine infrastructure required to provide adequate fire flow and normal domestic flow to the communities as the population increases. The models also serve to size new transmission mains. The layout of the East Hants water distribution model is presented in Figure 5-1. It is recognized that the actual rate and pattern of growth within the study area may be significantly different from that assumed, therefore it is



Porter Dillon Limited	TITLE EAST HANTS DISTRIBUTION SYSTEM CONCEPTUAL LAYOUT	PROJECT No. 98-5106
DATE OCTOBER 1998	PROJECT EAST HANTS INFRASTRUCTURE CAPACITY STUDY	FIGURE No. 5-1

essential that the utility monitor the demands within the community and use the water demand rather than the year as a trigger point for implementing infrastructure.

The existing population, 5 year, 10 year, 25 year and 25,000 population models have provided an implementation plan for required infrastructure. The models indicated that eventually a new 16" transmission main is required from the existing WTP to the Milford boundary; storage reservoirs are required in Lantz and the business park to provide adequate fire flows to these areas; a booster pump is required in Lantz to ensure filling of reservoirs; and additional high lift pump capability is required at the existing WP. The following sections describe these hydraulic improvements along with the requirement of additional water treatment and supply capabilities.

5.2 Required Hydraulic Improvements

This section presents a brief discussion of the rationale behind the selection of certain recommended infrastructure improvements presented below in Section 6.0.

5.2.1 Reservoir Storage

The existing water transmission and distribution system has approximately 780,000 igal of reservoir storage and 280,000 igal of clearwell pumped storage. Existing and future storage requirements were previously presented in Table 4-2.

The total storage required for the projected 25 year population is approximately 2.4 MIGAL, therefore an additional 1.35 MIGAL of storage is to be installed in the community within the next 25 years.

Currently the business park (Sobeys Mall Area) and the area near the Lantz/Milford boundary (Ridgefield Subdivision) have inadequate fire flow capabilities. It is also expected that these areas will continue to grow in population therefore it is recommended that the proposed future storage be installed in the business park and in north Lantz.

It is also recommended that the storage required in Lantz be installed in two phases. This decreases the costs which are to be funded immediately to solve existing fireflow problems and also ensures that the Municipality does not install a tank which is too large, in case the projected development does not occur in this area.

The total volume of these storage tanks is provided in Table 5-1. Schematics for tanks 1 and 2 in Lantz and for the business park tank are presented in Figure 5-2, 5-3 and 5-4 illustrating tank dimensions and hydraulic gradelines.

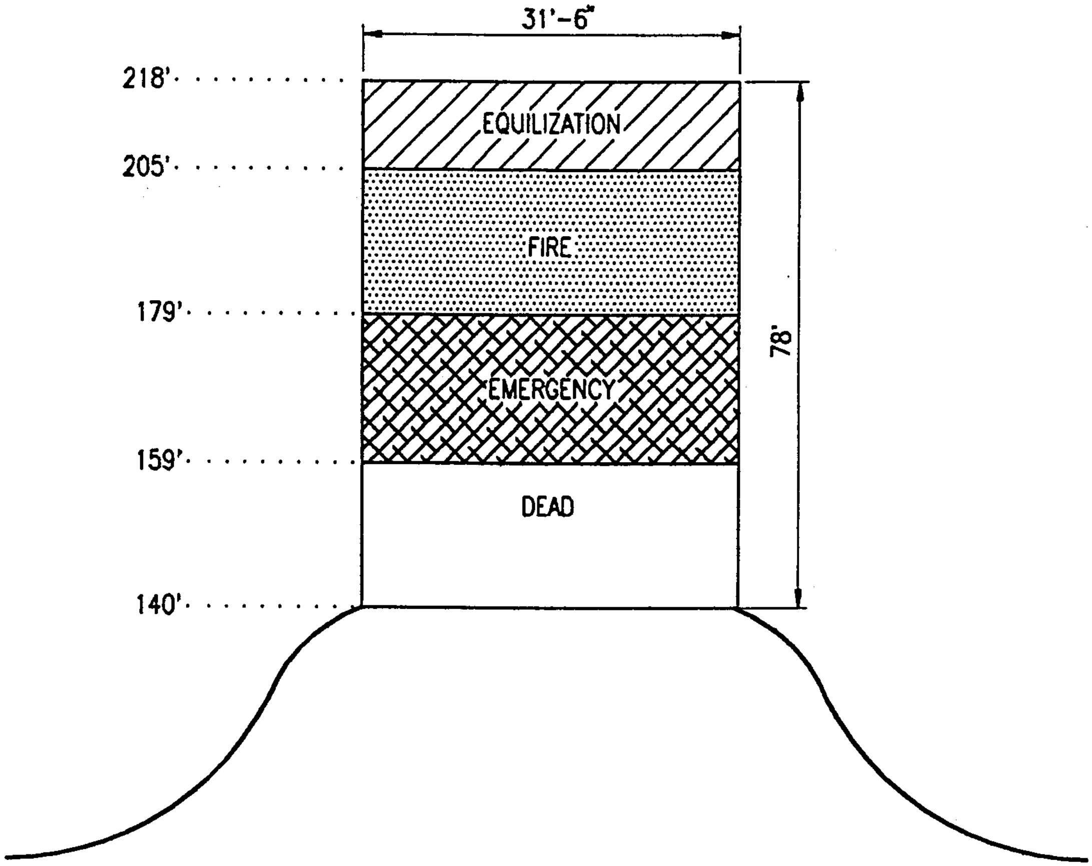
Table 5-1 Total Volume of Stand Pipe Reservoir Storage for 25 Year Horizon

Tank Location	Tank Name	Storage Volume Required		
		Active Storage[1] (igal)	Dead Water[2] (igal)	Total Volume Standpipe (igal)
Lantz (near Lantz/Milford boundary)	Ridgefield/Willowcrest Tank 1	285,000	85,000	370,000
	Willowcrest Tank 2	260,500	195,500	456,000
Business Park	Business Park Tank	813,500	148,500	962,000

Notes:
1. Total active storage volume required as calculated in Table 4-2.
2. A volume of "dead water" is required to elevate active storage to its minimum height.

5.2.2 Primary Transmission Main

The existing water transmission main system is inadequate from a hydraulic capacity and security of supply view point. A new primary water transmission main from the existing WTP to the Milford boundary is required to supplement the existing system. The preferred alignment for this new transmission main is shown on Map 2 in the pouch.



RIDGEFIELD/WILLOW CREST TANK #1

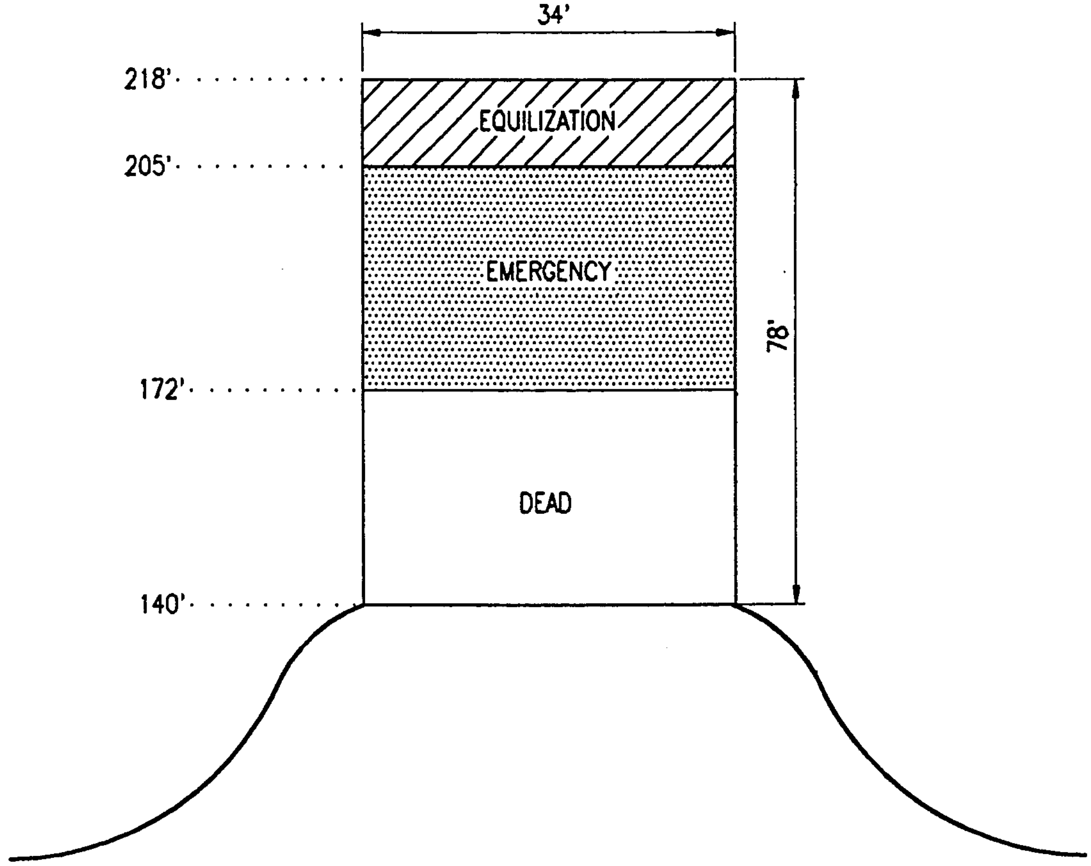
N.T.S.

Water Storage Reservoir Servicing Limits

	Service Lands < 115'
Min. Water Level for Domestic Service (p>40 psi)	205'
Min. Water Level for Fire Protection (p>22 psi)	170'
Water Level After Fire:1200igpm @ 1.75 hrs	179'

Porter Dillon Limited	TITLE RIDGEFIELD/WILLOW CREST STORAGE RESERVOIR #1 SCHEMATIC	PROJECT No. 98-5106
DATE OCTOBER 1998	PROJECT EAST HANTS INFRASTRUCTURE CAPACITY STUDY	FIGURE No. 5-2

G:\CAD\985106\5106FG52 19980603.1300

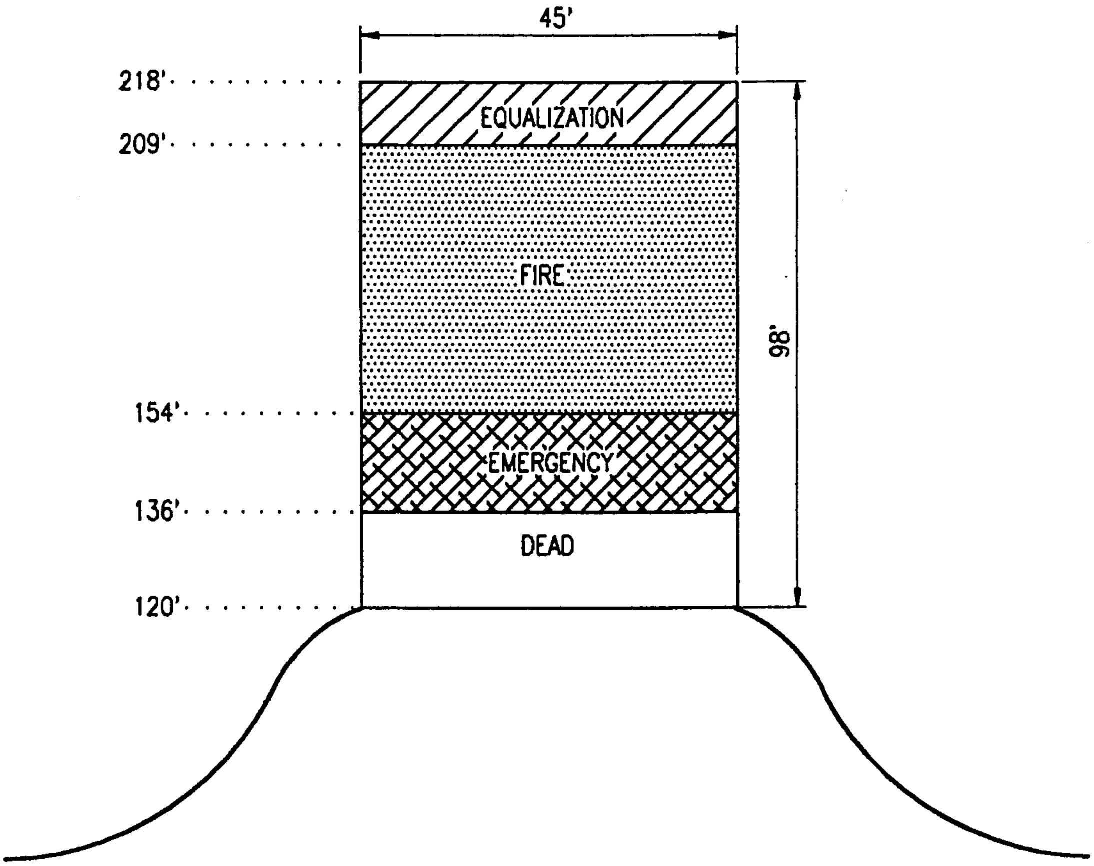


WILLOW CREST TANK #2

N.T.S.

G:\CAD\985106\5106FG53 19980603.1357

Porter Dillon Limited	TITLE WILLOW CREST STORAGE RESERVOIR #2 SCHEMATIC	PROJECT No. 98-5106
DATE OCTOBER 1998	PROJECT EAST HANTS INFRASTRUCTURE CAPACITY STUDY	FIGURE No. 5-3



BUSINESS PARK TANK

N.T.S.

Water Storage Reservoir Servicing Limits

	Service Lands < 105'
Min. Water Level for Domestic Service (p>40 psi)	205'
Min. Water Level for Fire Protection (p>22 psi)	150'
Water Level After Fire: 3000igpm @ 3 hrs	154'

Porter Dillon Limited	TITLE BUSINESS PARK STORAGE RESERVOIR	PROJECT No. 98-5106
DATE OCTOBER 1998	PROJECT EAST HANTS INFRASTRUCTURE CAPACITY STUDY	FIGURE No. 5-4

G:\CAD\985106\5106FG54 19980603.1314

The proposed 16" primary water transmission main will provide security of supply through redundancy while greatly improving the system's ability to replenish the storage tanks and to deliver fire flows. Static and dynamic pressure swings in Enfield associated with the cycling of the high lift pumps will be greatly reduced.

To increase the fireflow capabilities in Elmsdale the proposed 16" pipe from the water treatment plant to the Sobeys area should be installed in the immediate future. The Sobeys mall area currently has the fireflow capability of approximately 700 USGPM however it requires approximately 3600 USGPM; it is estimated that this capability will be increased to approximately 2000 USGPM upon installation of this portion of transmission main.

5.2.3 Clearwell Capacity

A 220,000 igal clearwell was constructed in 1997 to supplement the existing 60,000 igal clearwell. This total clearwell volume of 280,000 igal is adequate to service the existing water treatment plant and future upgrades to the water treatment plant provided that the volume of water entering the clearwell (water treatment plant capacity) is increased when the quantity of water leaving the clearwell (pump capacity) is increased.

5.2.4 Pumping System Improvements

The existing low lift and high lift pumping systems are adequate for the immediate future. As the service population increases, a number of pumping system upgrades are required to deliver adequate quantities of raw water from the river to the water treatment plant and to deliver treated water into the transmission and distribution system. A new booster pumping station is also required north of the Nine Mile River to provide sufficient head to fill the proposed Willowcrest water storage reservoir.

Specific modifications required to the various pumping systems are discussed in the following sections:

5.2.4.1 Low Lift Pumping System

The existing low lift pumping system comprises one vertical turbine duty pump and one identical standby with a nominal capacity of 500 USGPM at a total dynamic head of 60 feet. These low lift pumps are adequate to meet the total rated capacity of the existing primary WTP (2006), however, they must be upgraded in 2006, when the existing WTP is upgraded, to 900 USGPM at 60 feet of head to handle future development to the maximum allowable withdrawal rate permitted at the Enfield source of 900 USGPM. This expansion will cover future development to the year 2013 at which point the Municipality must seek a new source either from Grand Lake or from another approved source. The existing 21" diameter raw water supply line is adequate for expansion to 2013.

5.2.4.2 High Lift Pumping System

The existing high lift pumping system, which consists of a pair of Fairbanks Morse, three stage, vertical turbine pumps (one duty and one standby), is adequate to handle development to the year 2006. At this point, new high lift pumps with a capacity of approximately 1200 USGPM at a TDH of 280 feet must be installed in the new clearwell. These pumps will be sufficient to handle future development to 2013 when the Municipality's water rights at the river source has been exhausted.

5.2.4.3 Lantz Booster Pump

The existing high lift booster pumping system is sufficient to replenish the existing Lantz tank, however, the plant operators have recognized the need to restrict or throttle the outlet pressure from these pumps using a pressure reducing valve so that they do not expose the southend of the system in Enfield to excessive pressures. As the demand grows across the system and new highlift pumps are installed, it becomes more difficult simultaneously to deliver sufficient quantities of water into the network while controlling local pressures around the Enfield WP. In addition, construction of a new water storage reservoir in the vicinity of the Ridgefield/Willowcrest Subdivisions simply adds to this problem.

Construction of a new booster pump station on Highway No. 2 immediately north of the Nine Mile River allows the system to replenish both the existing Lantz tank and the proposed Willowcrest tank while still allowing the existing high lift pumps to work at acceptable pressures.

5.2.5 Raw Water Source Limitations and Water Treatment Plant Capacity

The Municipality has a water rights permit at Enfield to withdraw water at a maximum rate of 700 USGPM from the Shubenacadie River. They also have a water rights permit at the idle Lantz WTP site with an extraction rate of 200 USGPM from the Shubenacadie River. For the purposes of this study, we have assumed that the water rights permit can be relocated to Enfield. A hydrologic study will likely be required to satisfy the regulators that the river can support a total withdrawal greater than 900 USGPM maximum day demand.

When the maximum day demand within the Study Area has reached 900 USGPM, the Municipality must have a new source to permit further growth. Potential new sources for longer term growth within the Municipality include:

Option 1: Expansion of the Existing Water Rights from the Shubenacadie River at Enfield. This will require execution of a hydrologic study to satisfy the regulators. The prospects of successfully expanding the withdrawal rights from the river at Enfield is unknown. This option which involves expansion of the Enfield WP is the most cost effective since it is an extension of the existing system. Potential options for extending withdrawal from the river include construction of a new intake complete with an impoundment and weir, construction of a raw water transmission main from Grand Lake and construction of an infiltration gallery to draw water from gravel deposits near the lake.

Option 2: Construction of a New Water Treatment Facility at Grand Lake which may be considered as a limitless source. This option will also require construction of a large diameter treated water transmission main and high lift pumping station. The total capital cost of this option is high, however it may represent the only viable long term course of action for the Municipality. This is the most certain option considered, however, the high capital cost may mitigate against it.

Option 3: Development of a Local Groundwater Aquifer in the vicinity of the Study Area with a new water treatment plant. The potential for substantial groundwater close to the Study Area is limited by the geology which is characterized by the presence of gypsum and other minerals. The more distant Hardwood Lands Aquifer holds some potential for large quantities of water, however, its distant location and existing surface uses make it a less promising option.

For the purposes of this study, we have proceeded with the Grand Lake source (Option 2) as the most likely longer term future potential raw water source. Due to the large capital costs of constructing a new water treatment plant at Grand Lake and treated water transmission main to supply the system, we have included this option in a longer term development scenario presented in Part D - Financial Analysis. Eventual adoption of a less costly option will result in reduced longer term capital costs which will be reflected in lower costs to future development. These longer term source options have no impact on the short term capital costs considered under the twenty year plan presented in Part D - Financial Analysis.

6.0 INFRASTRUCTURE AND IMPLEMENTATION PLAN

This section presents a series of recommended water infrastructure improvements designed to improve water service to meet future demands within the study area. In addition to infrastructure upgrades, there are basic policy approaches and issues related to design and operation of an integrated water system which should be considered.

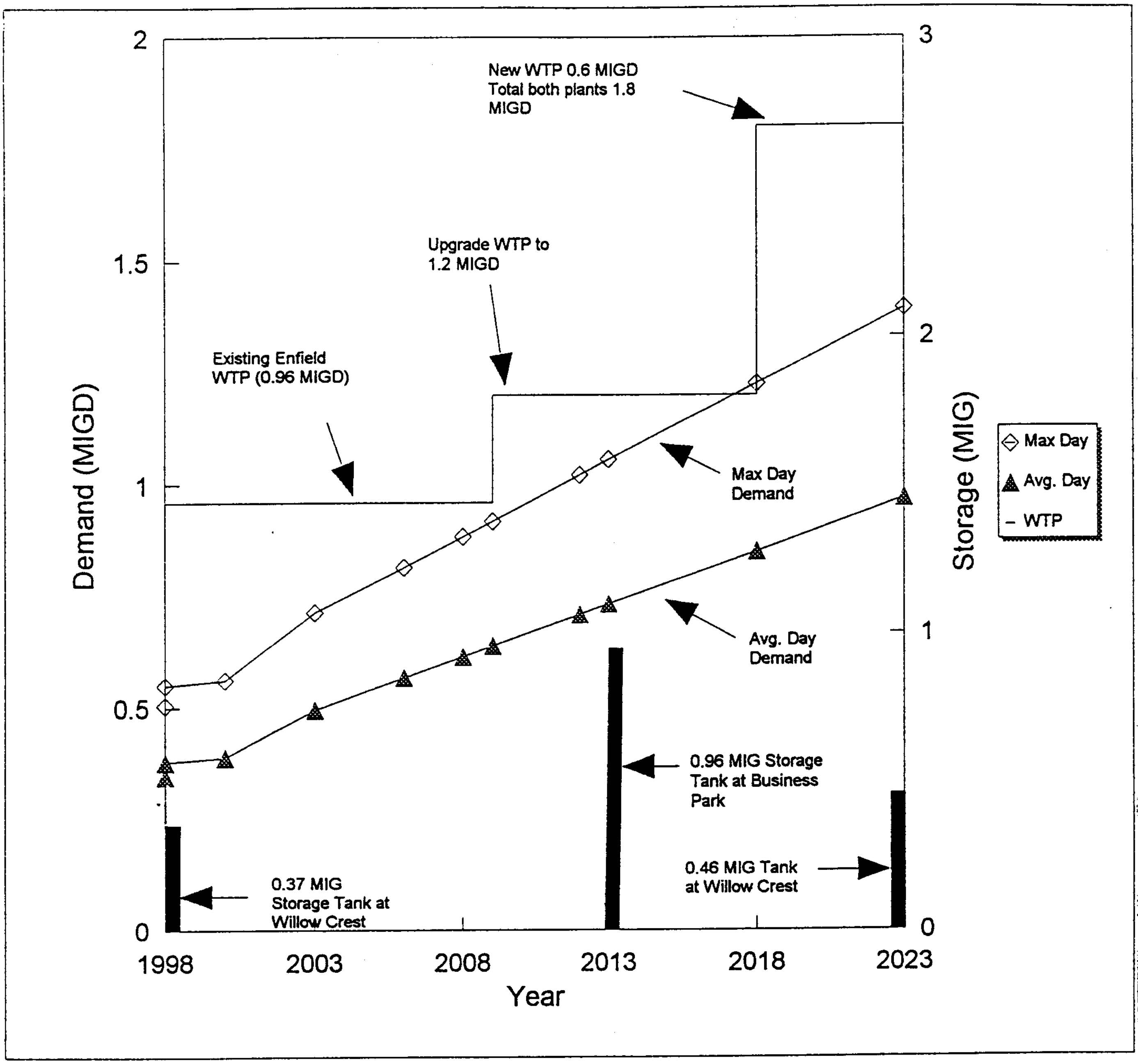
6.1 Infrastructure Timeline

Recommended water infrastructure improvements are presented under a range of time horizons. The infrastructure requirements discussed in Section 5.2 are required at different intervals which we have indicated as a year and as a water demand. The year in which the upgrade is required is a projection and therefore the trigger for installation of infrastructure should be based on the regional demands. A schematic presenting the infrastructure timeline is presented in Figure 6-1.

6.1.1 Year 1999 Improvements - Average Day Demand 320 USGPM

Water system upgrades which should be considered immediately to upgrade current fire flow deficiencies in the communities and enhance the overall system include:

- 0.37 MIG storage reservoir and associated controls and appurtenances near the Lantz/ Milford boundary as shown on Map 2.
- 12" supply main along Highway 2 from the end of the existing 8" pipe to Willowcrest Subdivision entrance.
- 16" supply main from Willowcrest Subdivision to new storage reservoir.
- Booster pump on Highway 2 in Lantz north of Highway 214.



Porter Dillon Limited	TITLE: INFRASTRUCTURE TIMELINE	PROJECT No. 98-5106
DATE OCTOBER 1998	PROJECT: EAST HANTS INFRASTRUCTURE CAPACITY STUDY	FIGURE No. 6-1

- 16" primary transmission main from the existing WTP in Enfield to Elmwood Subdivision.

- 16" pipe from the newly constructed Park Road transmission main to Sobeys Mall area.

- It should be recommended to the developer of Ridgefield Subdivision that a minimum of a 10" pipe is required to supply that subdivision from the opposite end of the subdivision as the existing 8".

6.1.2 Year 2009 Improvements - Average Day Demand of 550 USGPM

Water system improvements which should be considered when the average day demand approaches 550 USGPM and maximum day of 800 USGPM include:

- Upgrade existing Enfield WTP by:

    - installing an additional packaged WTP which has a capacity of 200 USGPM (provided additional supply from the Shubenacadie River is approved).

    - upgrade low lift pumps at the WP.

    - upgrade high lift pumps at the WP.

6.1.3 Year 2013 Improvements - Average Day Demand of 615 USGPM

Water system improvements which should be considered when the average day demand approaches 615 USGPM and maximum day of 885 USGPM include:

- 0.96 MIG storage reservoir and associated controls and appurtenances in the business park. A recommended location is shown on Map 2.

- 16" supply main from Park Road to the reservoir.

6.1.4 Year 2018 Improvements - Average Day Demand of 700 USGPM

Water system improvements which should be considered when the average day demand approaches 700 USGPM include:

- New Water Treatment Plant - As the upgraded Enfield WTP nears its capacity (population in the corridor approaches 11, 000), a decision will be required on whether a new WTP will be constructed. If at that time development is still strong and it is decided to build a new WP, the type of plant, size, and supply must be evaluated.

For this study it is assumed:

  - 16" transmission main from Grand Lake to Enfield Road.

  - A new WTP would be constructed at Grand Lake with an ultimate capacity of 1000 USGPM (1.2 MIGD) with 500 USGPM (0.6 MIGD) being installed initially.

6.1.5 Year 2024 Improvements - Average Day Demand of 850 USGPM

Water system improvements which should be considered when the average day demand approaches 850 USGPM and maximum day of 1225 USGPM include:

- 0.46 MIG storage reservoir and associated controls and appurtenances in the Willowcrest area of Lantz.

- 16" transmission main from Sobeys mall area, across Clayton Developments to the existing Lantz reservoir on Logan Drive.

- 16" transmission main from Sobeys mall area, across Clayton Developments to the existing Lantz reservoir on Logan Drive.

- 16" transmission main from the Logan Drive reservoir across Willowcrest to the Ridgefield/ Willow Crest reservoirs.

Note: These 16" mains should be phased in as development occurs and warrants the construction of roads in the development. These transmission mains should be constructed before the demands reach 970 USGPM average day or the year 2024.

7.0 CAPITAL COST ESTIMATES

This section provides the capital cost estimates of the recommended improvements within the regional water system as described in Section 6.2.

Table 7-1 provides a summary of estimated capital costs for design and construction of the recommended capital infrastructure improvements, including an allowance of 10% for engineering design and 15% for construction contingency. These cost estimates do not include the cost of land acquisition for service easements associated with the transmission main alignment. The costs were then inflated at 3% per year to the year in which the infrastructure is expected to be constructed.

These estimates are for planning purposes only and must be refined during the detailed design of the project.

As shown in Table 7-1 the cost of improving the East Hants water system over the next 25 years to service future populations, is approximately $29.3 million in actual future inflated dollars and approximately $18.5 million in 1998 dollars. The detailed capital costs are presented in Appendix C-1. Cost recovery methods, which ensure the Municipality and existing customers are cost neutral with respect to the expense associated with implementing trunk infrastructure required as a result of new development, are discussed in Part D- Financial Analysis.

Table 7-1 Capital Cost Estimates - Regional Water System

Year Required	Infrastructure Element	Code on Map 2	Total Capital Cost[1]	
			1998 Dollars	Actual Inflated Dollars
1999	• 0.37 MIG Water Reservoir (North Lantz) • Lantz Water Booster Pumping Station • Transmission Mains	A C B, D, E, G, F	$ 5,633,000	$ 5,802,000
2009	• Upgrade Enfield Water Treatment Plant	H	$ 1,252,000	$ 1,733,000
2013	• 0.96 MIG Water Reservoir (Business Park) • Water Transmission Main	I J	$ 1,397,000	$ 2,176,000
2018	• Build New Water Treatment Plant @ Grand Lake • Build Grand Lake Transmission Main	N O	$ 7,169,000	$ 12,948,000
2024	• 0.46 MIG Water Reservoir (North Lantz) • Upgrade and Construct Water Transmission Main in Lantz	K L, M	$ 3,074,000	$ 6,629,000
	Totals		$ 18,530,000	$ 29,288,000

Notes:

1. Total Capital Cost includes a 3% per year inflation factor, a 10% allowance for detailed engineering design and a 15% contingency.

Appendix C-1
Detailed Capital Cost Estimates for Water System Improvements

Capital Cost Estimate
25 Year Demand Projection

15-Jul-98

Item	Unit	Estimated Quantity	Unit Price	Est. Total Cost	Total including Eng., Cont., HST	Actual Inflated $
WATER INFRASTRUCTURE						
Year 1999						
1 WATER RESERVOIR - Willow Crest (0.37 MIG)						
.1 Tank Supply & Install	L.S.	1	$220,000	$220,000		
.2 Tank Connections	L.S.	1	$100,000	$100,000		
.3 Tank Control Systems	L.S.	1	$50,000	$50,000		
.4 Site Work / Landscaping	L.S.	1	$50,000	$50,000		
.5 SCADA System	L.S.	1	$50,000	$50,000		
.6 Land Acquisition'	L.S.	1	$20,000	$20,000		
			Subtotal tank:	$490,000		
2 16" (400 mm) PVC Supply Main - From Willow Crest to Willow Crest tank	m	375	$550	$206,250		
12" (300 mm) PVC Supply Main - Hwy. 2 from existing 8" to Willow Crest entrance	m	400	$450	$180,000		
Infrastructure Study	L.S.	1	$70,000	$70,000		
Booster Pump in Lantz (Hwy. 2 - East of Hwy. 214)	L.S.	1	$405,000	$405,000		
16" (400 mm) PVC Supply Main - Enfield WTP to Alderney	m	2250	$550	$1,237,500		
16" (400 mm) PVC Supply Main - Alderney to Elmwood Subdivision	m	2000	$550	$1,100,000		
16" (400 mm) PVC Supply Main - Hwy. 214 to Sobeys	m	250	$550	$137,500		
16" (400 mm) PVC Supply Main - Twin existing 10" from Park Rd to Hwy. 214	m	650	$550	$357,500		
			Subtotal misc.	$3,693,750		
			Total 1999:	$4,184,000	$5,633,000	$5,802,000
Average day demand of 555 usgpm - year 2009						
1 UPGRADE EXISTING WTP ²						
200 usgpm packaged water treatment plant	L.S.	1	$350,000	$350,000		
Package Plant Building	L.S.	1	$200,000	$200,000		
Low lift pump	ea.	2	$30,000	$60,000		
High lift Pump	ea.	2	$60,000	$120,000		
Electrical upgrades (VFD, new services, transformer)	L.S.	1	$200,000	$200,000		
			Subtotal plant:	$930,000		
			Total 2009:	$930,000	$1,252,000	$1,733,000
Average day demand of 615 usgpm - year 2013						
1 WATER RESERVOIR - Business Park (0.96 MIG)						
.1 Tank Supply & Install	L.S.	1	$575,000	$575,000		
.2 Tank Connections	L.S.	1	$100,000	$100,000		
.3 Tank Control Systems	L.S.	1	$50,000	$50,000		
.4 Site Work / Landscaping	L.S.	1	$50,000	$50,000		
.5 SCADA System	L.S.	1	$50,000	$50,000		
.6 Land Acquisition'	L.S.	1	$20,000	$20,000		
			Subtotal tank:	$845,000		
2 16" (400 mm) PVC Supply Main - To business park tank	m	350	$550	$192,500		
			Subtotal pipe:	$192,500		
			Total 2013:	$1,038,000	$1,397,000	$2,176,000
Average day demand of 700 usgpm - year 2018						
1 NEW WATER TREATMENT PLANT @ Grand Lake						
New WTP at Grand Lake - Install 500 usgpm of the total 1000 usgpm (1.2 MIGD) Includes: Low Lift Pump, high lift pump, plant, clearwell	L.S.	1	$3,400,000	$3,400,000		
2 16" (400 mm) PVC Supply Main - Grand lake WTP to Enfield Rd	m	3500	$550	$1,925,000		
			Total 2018:	$5,325,000	$7,169,000	$12,948,000
Average day demand of 900 usgpm - year 2024						
1 WATER RESERVOIR - Willow Crest (0.46 MIG)						
.1 Tank Supply & Install	L.S.	1	$275,000	$275,000		
.2 Tank Connections	L.S.	1	$100,000	$100,000		
.3 Tank Control Systems	L.S.	1	$50,000	$50,000		
.4 Site Work / Landscaping	L.S.	1	$50,000	$50,000		
.5 SCADA System	L.S.	1	$50,000	$50,000		
.6 Land Acquisition'	L.S.	1	$20,000	$20,000		
			Subtotal tank:	$545,000		
2 16" (400 mm) PVC (upsize cost 12" to 16") - Through Clayton Dev. to Lantz tank	m	1400	$100	$140,000		
16" (400 mm) PVC Supply Main - From Hwy. 214 to Clayton Dev.	m	1150	$550	$632,500		
16" (400 mm) PVC (upsize cost 12" to 16") - Through Willow Crest Dev. to Willow Crest Tank	m	2500	$100	$250,000		
16" (400 mm) PVC Supply Main - From Lantz tank to Willow Crest Dev.	m	1300	$550	$715,000		
			Total 2024:	$2,283,000	$3,074,000	$6,629,000
SUBTOTAL CAPITAL COSTS				$13,760,000	$18,530,000	$29,288,000
ENGINEERING (10%)				$1,380,000		
SUBTOTAL ESTIMATED COST				$15,140,000		
CONTINGENCY (15%)				$2,270,000		
SUBTOTAL ESTIMATED COST				$17,410,000		
HST Payable (3/7)*15%				$1,120,000		
TOTAL ESTIMATED WATER COST				$18,530,000		

NOTE: (1) Land Acquisition Cost is an estimated cost of $20,000/acre
(2) Upgrade of Existing plant is provided that the supply from Shubee can be increased from 700 usgpm to 900 usgpm (add the 200 usgpm from Old Lantz WTP).
(3) Pipe cost includes pipe, valves, tees, bends, 25% Rock excavation.
(4) Grand Lake WTP cost based on WTP of similar size, costed by CBCL and reviewed by PDL 1998
(5) Cost of upsizing 12" to 16" based on HRWC costs. Developer is responsible for installing the 12" pipe as recommended by Municipality.
(6) Assumed interest rate of 6.5%

Inflation Rate 3%

Part D

Financial Analysis

Table of Contents
Part D - Financial Analysis

Page No.

1.0 INTRODUCTION . . . D-1
1.1 Background . . . D-1
1.2 Scope of Study . . . D-3
1.3 Approach to Financial Analysis . . . D-3

2.0 EXISTING MUNICIPAL POLICIES AND PROCEDURES . . . D-6

3.0 CAPITAL COST ESTIMATES . . . D-8
3.1 Wastewater System . . . D-8
3.2 Water System . . . D-10

4.0 CAPITAL COST RECOVERY ALTERNATIVES . . . D-12
4.1 Uniform Capital Cost Recovery Charges . . . D-12
4.1.1 Water Servicing Scenario 1 - Twenty Year Plan . . . D-13
4.1.2 Water Servicing Scenario 2 - Longer Term Plan . . . D-13
4.2 Capital Cost Contribution for Water Infrastructure . . . D-14
4.3 Wastewater Capital Cost Recovery Charges . . . D-17
4.3.1 Recommendation . . . D-18

5.0 RESULTS OF CAPITAL COST RECOVERY ANALYSIS . . . D-19
5.1 Wastewater Capital Cost Recovery Charges . . . D-19
5.2 Water System Capital Cost Recovery Charges . . . D-20
5.2.1 Scenario 1 - Twenty Year Plan . . . D-20
5.2.2 Scenario 2 - Longer Term Plan . . . D-22
5.2.3 Recommended Water Capital Cost Charge . . . D-23
5.3 Stormwater Management Costs . . . D-24
5.4 Road Paving Costs . . . D-25
5.5 Policy Recommendations Summary . . . D-26

Appendices

Appendix D-1	Development of Capital Cost Contributions in New and Existing Developments Serviced by the Municipality of East Hants
Appendix D-2	Detailed Calculations for Capital Cost Contributions for Water System
Appendix D-3	Detailed Calculations for Capital Cost Contributions for Water System

List of Tables

		Page No.
Table 3-1	Capital Cost Estimates - Regional Wastewater System	D-9
Table 3-2	Capital Cost Estimates - Regional Water System	D-11
Table 5-2	Summary of Water System Charges - Scenario 1 - Twenty Year Plan	D-21
Table 5-3	Summary of Water System Charges - Scenario 2 - Longer Term Plan	D-23

1.0 INTRODUCTION

This part of the Infrastructure Capacity Study provides a financial analysis of the capital costs of providing trunk water and wastewater infrastructure to service the portions of the Study Area within the communities of Enfield, Elmsdale and Lantz. This financial analysis includes the approach to financial analysis, a brief review of relevant existing municipal planning policies and procedures, a summary of capital cost estimates; a review of capital cost recovery alternatives, identification of the preferred capital cost recovery model, calculation of applicable capital cost recovery charges for water and wastewater trunk infrastructure and a summary of the proposed implementation plan.

1.1 Background

The Municipality of East Hants has been experiencing substantial development pressures within the serviced Corridor Section over the past decade. The Municipality has commissioned this Infrastructure Capacity Study to determine what additional trunk infrastructure will be required in the future both for wastewater and water systems to provide adequate service to new developments within the regional system. The requirements for trunk infrastructure upgrading has been established based on projected maximum development over the next 20 years and beyond.

Over the past decade, other municipalities in the region have recognized the financial impact of servicing new developments on the existing customer base and on the operation of the wastewater system and the Water Utility. Specifically, two basic principles, which have been identified as relevant to the financing of new trunk services, are "user pay" and "revenue/cost neutrality".

The application of a "user pay" guideline has most frequently been considered for the costs of operations particularly in the water system. However, directly or indirectly, capital costs incurred to provide trunk infrastructure are also recovered from the existing customers/taxpayers and are normally a significant component of the total costs of services to be recovered from those customers/taxpayers through property taxes or approved rates. As an alternative to a broad based levy, a portion of the capital costs to service new development could be recovered through specific "capital cost recovery charges" such as lot levies, frontage charges, etc., applied against those who benefit directly from the improvements.

The principle of "revenue/cost neutrality" simply states that the Municipality and the Utility are not prepared to assume all of the costs and risks of future capital expenditures to service new developments except on the "user pay" basis.

As a result, such capital expenditures necessary to service new developments must be borne by the new and future customers/taxpayers who will benefit from those improvements. A corollary of this principle is that the portion of any capital expenditures which benefit the existing customer/taxpayer base must be paid for through water rates or property taxes. In the instance where new capital expenditures will benefit both existing and future customers/taxpayers, the costs must be fairly and equitably allocated to each category of citizen.

In general, municipalities are free, with the approval of the Minister of Municipal Affairs, to establish capital cost recovery mechanisms such as sewer taxes, area rates, lot levies or "hookup charges" to recover capital costs associated with improvements to the sanitary wastewater system. The Municipality of East Hants currently collects a sanitary sewer lot levy in the form of the Trunk Sewer Tax and a sanitary hook-up fee pursuant to the existing sewer bylaw on each new lot on the regional system and an area rate to fund the wastewater system with regard to system improvements. The area rate also raises funds for operating costs of the sanitary sewer system. The development and implementation of a capital cost contribution for water infrastructure, on the other hand, requires the approval of the Nova Scotia Utility and Review Board (NSUARB).

Recently, a set of procedures has been established and ratified in favour of the former County of Halifax Water Utility by the NSUARB for application of a capital cost recovery charge for water improvements and these procedures include a formula, known as the "Gates Formula", for appropriating capital costs. Currently, the NSUARB is considering a challenge to these procedures as applied by the Halifax Regional Municipality (HRM) and the Halifax Regional Water Commission (HRWC) with respect to trunk water improvements required to service the Bedford South area. The NSUARB decision on Bedford South has recently been brought down and the results have been be incorporated into the final report of this study.

The financial analysis of capital costs for the funding of wastewater and water system improvements are considered separately throughout this study to facilitate future consideration by the Municipality, the Nova Scotia Department of Municipal Affairs and the NSUARB.

1.2 Scope of Study

This study is intended to provide a financial analysis of the capital costs of providing trunk wastewater and water infrastructure to existing and future customers/taxpayers within the Study Area. The capital costs of providing stormwater infrastructure and paving of local roads within new and existing developments within the Study Area are presented in this report in a generic form to provide the Municipality with a general sense of the costs associated with provision of these services.

1.3 Approach to Financial Analysis

The principal goal of this financial analysis is the establishment of an equitable procedure for apportioning to existing and future customers/taxpayers the capital costs required to fund future upgrades to the trunk wastewater and water system. The approach to this financial analysis has included the following elements:

1. A review of the existing municipal planning and administrative policies, bylaws and procedures with respect to current methods of financing wastewater and water system trunk infrastructure.

2. Assembly and review of capital cost estimates for the phased construction of wastewater and water system trunk infrastructure requirements.

3. Determination of a time line for capital cost expenditure over the 25 year time horizon of the study and beyond.

4. Determination of an associated timeline for capital borrowing consistent with capital expenditures and determination of the periodic increases in debt servicing required to carry the capital debt.

5. Estimation of the average debt servicing costs over the period of capital cost recovery for the specific debt (typically ranging from 5 years to 20 years depending on the number of new lots to be serviced).

6. Estimation of the potential range of number of new lots per year which will be approved for development and for which a capital cost recovery contribution will be received. It is essential that the Municipality understand that the accumulated capital debt must be serviced annually whether there is a high or low level of development in any particular year. The preferred capital cost recovery strategy must consider the potential impact of a decline in development over one or more years on the financial position of the Municipality and the Water Utility.

7. Determination of the percentage of capital cost carrying charges which benefits the existing customer base and the percentage which benefits potential new development.

8. Calculation of capital cost recovery charges per new lot of development for the wastewater and water systems necessary in a specific year to support/service the level of development expected.

9. Recommendation of a specific capital cost recovery formula for wastewater and for water improvements which will be presented for approval to the Municipal Council and eventually to the appropriate regulatory agency (NSDMA, NSUARB, etc.).

2.0 EXISTING MUNICIPAL POLICIES AND PROCEDURES

This section presents a brief discussion of specific municipal policies, bylaws and procedures which relate to the development and execution of a capital cost recovery strategy for wastewater and water trunk infrastructure.

1. Trunk Sewer Tax By-Law (Bylaw No. 155) provides the authorization and procedures for the definition, design, permitting, operation and financing of sanitary trunk sewer infrastructure within the Corridor Section with particular reference to the existing $3,000.00 tax per lot of new development required to fund the trunk sanitary wastewater system improvements carried out from 1988 to 1991.

2. East Hants Regional Water Utility Schedule of Rules and Regulations which define the duties and responsibilities of the East Hants Regional Water Utility to provide water within the Regional Serviceable Boundary of the Municipality and the rights and duties of the customer base. No provisions currently exist within these Rules and Regulations for the establishment of a water system capital cost recovery charge however, this study recommends that the rules and regulations be modified with the approval of the NSUARB to support such an alternative.

3. Municipality of East Hants, Subdivision By-Law which establishes the process and standards under the Planning Act of the Province of Nova Scotia by which subdivision development is to be permitted, designed and constructed.

4. Municipal Services System General Specifications which define the technical standards for the design and construction of Municipal Infrastructure for Wastewater and Water Systems among others.

5. Sewer Bylaw (Bylaw No. 139) provides the authorization and procedures for the design, construction and operation of sanitary and storm sewers within the Corridor Section.

6. Policy regarding extension of services within the Serviceable Area as passed by Municipal Council and enacted by municipal staff.

7. Miscellaneous policies and procedures regarding service connection installation cost sharing which are currently in effect with respect to new development.

The Municipality of East Hants is currently engaged in the review and revision of all the aforementioned documents to make them consistent with the Municipality's desire to enact a capital cost recovery mechanism for wastewater and water system trunk infrastructure.

3.0 CAPITAL COST ESTIMATES

This section provides a summary of capital cost estimates for wastewater and water system trunk infrastructure improvements as defined in Part B - Regional Wastewater System Analysis and Part C - Regional Water System Analysis. Generally, the capital cost estimates are presented in five year increments consistent with and as required by incremental growth estimates for future developments. It should be understood that the periodic infrastructure improvement requirements identified in this report are driven by population growth and that rates of growth significantly different from those projected in Part A - Background and Demographics will result in a revised timeline for the implementation of capital improvements and a revised funding arrangement to pay carrying charges for the capital debt incurred to that date.

3.1 Wastewater System

Capital cost estimates for trunk infrastructure improvements to the regional wastewater system have been presented in Part B - Regional Wastewater system analysis. They are repeated here for consistency. Table 3-1 provides a summary in five year increments of capital cost estimates for wastewater system trunk infrastructure requirements. These cost estimates include an inflation factor of 3% per annum and an allowance of 10% for detailed engineering design and 15% for contingency. Detailed calculation of capital costs for wastewater system trunk improvements are presented in Appendix D-2.

The capital cost estimates for wastewater system improvements which are expressed in 1998 dollars, and in inflated future dollars represent the anticipated capital debt financing stream which must be borne by future development within the Service District.

Table 3-1 Capital Cost Estimates - Regional Wastewater System

Year Required	Infrastructure Element	Infrastructure Code[1]	Total Capital Cost[1]	
			1998 Dollars[2]	Actual Inflated[3]
1999	• Upgrade PS18 and PS20 • Replace PS4		$ 337,000	$ 337,000
2003	• Replace PS18 and PS20 • Forcemain PS18 and PS20 • Emergency Power PS17		$ 1,535,000	$ 1,779,000
2008	• Upgrade PS15 • Upgrade STP Aeration • Emergency Power PS7		$ 357,000	$ 480,000
2013	• Upgrade Gravity Mains • Emergency Power PS8 • Emergency Power PS9	Links Y and Z	$ 572,000	$ 891,000
2018	• Upgrade Gravity Mains • Emergency Power PS10 • Emergency Power PS13	Link U	$ 364,000	$ 657,000
2023	• Upgrade Gravity Mains • Emergency Power PS14	Links I and AG	$ 222,000	$ 465,000
	Totals		$ 3,387,000	$ 4,609,000

Notes:
1. Refer to Drawing No. 1.
2. Costs include a 10% allowance for engineering, a 15% allowance for contingency and the fraction of the HST payable by the Municipality (3/7 of 15%).
3. Cost includes a 3% per year inflation factor; a 10% allowance for engineering and a 15% contingency and the fraction of the HST payable by the Municipality 3/7 of 15%).

3.2 Water System

Capital cost estimates for trunk infrastructure improvements to the regional water system have been presented in Part C - Regional Water System Analysis. They are repeated here for consistency. Table 3-2 provides a summary of water system capital cost estimates for water trunk infrastructure requirements. These cost estimates include an inflation factor of 3% per annum and an allowance of 10% for detailed engineering design and 15% for contingency. Detailed calculations for water system trunk infrastructure improvements are presented in Appendix D-3.

The capital cost estimates for water system improvements, which are expressed in 1998 dollars and inflated future dollars, represent the anticipated capital debt financing stream which must be borne by future development within the Service District.

Table 3-2 Capital Cost Estimates - Regional Water System

Year Required	Infrastructure Element	Code on Map 2	Total Capital Cost[1]	
			1998 Dollars	Actual Inflated Dollars
1999	• 0.37 MIG Water Reservoir (North Lantz) • Lantz Water Booster Pumping Station • Transmission Mains	A C B, D, E, G, F	$ 5,633,000	$ 5,802,000
2009	• Upgrade Enfield Water Treatment Plant	H	$ 1,252,000	$ 1,733,000
2013	• 0.96 MIG Water Reservoir (Business Park) • Water Transmission Main	I J	$ 1,397,000	$ 2,176,000
2018	• Build New Water Treatment Plant @ Grand Lake • Build Grand Lake Transmission Main	N O	$ 7,169,000	$ 12,948,000
2024	• 0.46 MIG Water Reservoir (North Lantz) • Upgrade and Construct Water Transmission Main in Lantz	K L, M	$ 3,074,000	$ 6,629,000
	Totals		$ 18,530,000	$ 29,288,000

Notes:
1. Total Capital Cost includes a 3% per year inflation factor, a 10% allowance for detailed engineering design and a 15% contingency.
2. Fraction of HST payable by the Municipality (3/7 of 15%).

4.0 CAPITAL COST RECOVERY ALTERNATIVES

This section provides a discussion of the potential alternative approaches to structuring the capital cost recovery model for wastewater and water system improvements. The preferred capital cost recovery model is presented in Section 5.0.

4.1 Uniform Capital Cost Recovery Charges

Over the past decade the Municipality has collected a sewer tax from each new lot to fund the capital trunk sewer improvements constructed in the late-1980's to amalgamate the three former sanitary collection and treatment systems. While this $3,000 per lot sewer tax has not varied over the intervening years, the Municipality has been forced to initiate a sanitary area rate as part of the municipal property tax to cover shortfalls in revenue due to lower than expected levels of development.

Capital cost estimates for wastewater and water system improvements indicate that the potential incremental numbers of new lots available as the result of particular capital expenditures is not uniform. In fact, the marginal capital expenditure per lot required to service a lot with water in the short term is relatively modest due to the presence of existing excess capacity in the system whereas that required to service a lot following year 2018, when a new water treatment plant and source are required, is quite high due to the significantly increased capital expenditures required to create new capacity.

Due to the increasing capital expenditure requirements per lot as the community moves beyond the capacity of the existing water source, it is recommended that the Municipality consider two phased development scenarios and their associated capital cost recovery charges per lot for the water system. Two time dependent scenarios or plans for financing capital improvements for the water system are provided in the following sections.

4.1.1 Water Servicing Scenario 1 - Twenty Year Plan

The water system infrastructure improvements proposed under Scenario 1 address existing deficiencies in water supply, treatment, transmission and storage within the Study Area as well as future development to year 2018 when the water rights capacity of the existing source will be exhausted.

Proposed intermediate term improvements to the water transmission and storage system will accommodate future growth until the year 2018 or until the average day demand reaches 700 USGPM when the capacity of the existing raw water source, the Shubenacadie River, has been reached. Prior to reaching that critical point (2018), the Municipality must make a decision whether it wishes to incur the substantial capital cost associated with the construction of a new water treatment facility at Grand Lake and a new high lift pumping station and larger diameter treated water supply main or look at other alternatives. The improvements proposed under Scenario 1 will create sufficient excess capacity to service approximately 1500 additional new housing units beyond the existing housing base.

In view of the sudden increase in capital expenditure at Year 2018, the Municipality may wish to consider the application of a capital cost recovery charge based on a twenty year infrastructure plan which will improve the system to the point where a new source is required. Scenario 1 represents the twenty year capital expenditure/recovery system including the immediate short term improvements required to address existing system deficiencies and subsequent intermediate term improvements to year 2018 when the capacity of the existing source will be fully allocated.

4.1.2 Water Servicing Scenario 2 - Longer Term Plan

Scenario 2 represents the stream of capital expenditures and revenues required to provide for development beyond the twenty year horizon including the significant capital expenditures in year 2018 associated with the construction of a new water treatment plant at Grand Lake and treated water transmission main which will provide for development beyond 20 years. The principal issue with regard to the adoption of Scenario 2 - Longer Term Plan is the willingness of the Municipality to burden all future development from now to beyond 2018 with the capital cost of expanding the serviced population in the community beyond the capacity of the existing source and thereby to risk discouraging future development in the short to intermediate future.

4.2 Capital Cost Contribution for Water Infrastructure

The proposed capital cost contribution formula presented here is based on a method approved by NSUARB. The capital cost contribution is intended to enable the Water Utility to remain cost neutral in the construction of trunk water infrastructure required to service new developments. In this study, capital cost contributions are determined in accordance with a formula (the Gates Formula) set out in detail Appendix D-1.

Specific significant issues related to the proposed capital cost contribution formula are discussed in the following:

1. Required Infrastructure

   Any extension or improvement to the water system required to provide water service to any new development must be cost neutral to the Municipality of East Hants Regional Water Utility. Required infrastructure shall include, but shall not be limited to, supply, storage, transmission, distribution, pressure control and fire protection as required by the Utility.

2. Capital Cost

   The Capital Cost of the required infrastructure will be established by the Utility and the cost estimates will be used to establish the Capital Cost Contributions.

3. Area of Developable Land

The area of land that can not be developed, such as water courses, floodplains, etc., shall be established by the Council of the Municipality of East Hants. The land area that cannot be used for development will be subtracted from the total area. Roads, parks, right of way, schools etc. shall be included in the developable area.

4. Density

The average and actual population density applicable to a specific development area will be established by the Municipal Council of the Municipality of East Hants. These density determinations will be used to calculate the per acre contribution of a development above or below the average density of the total developable area. As an example, if the average density is established at 15 ppa, a higher density area of 20 ppa would pay 33% more than the average cost. Conversely, if the area being developed is 10 ppa the developer would pay 33% less than the average cost.

5. Rezoning or Change of Use

Property owners who seek a rezoning or change of use, which will affect a water demand and increase densities, will be required to pay an additional capital cost contribution. The Utility will review the density implications and apply the capital cost contribution density calculation to determine whether a further capital cost shall be required from the customer (developer). The Utility shall apply previously collected capital cost contributions towards a revised required capital cost, based on the applicant's proposed change of use or rezoning application. If the rezoning or change of use requires an upgrading or addition to the infrastructure as determined by the Utility, the applicant shall be required to cover the cost of such improvements or additions.

6. Expanded Development Boundaries

At the discretion of the Municipality, minor expansions to development boundaries may be considered if the proposed or existing water system infrastructure is capable of providing reliable service to areas under consideration. In the event that a development boundary is expanded, capital cost contributions that have been established and approved by the Nova Scotia Utility and Review Board (NSUARB) within the original development boundary shall apply to this expanded area.

The Municipality and Utility, at their discretion, may approve a significant expansion to the existing development area that requires infrastructure improvements or new installations. The Utility shall require the establishment of a new capital cost contribution for the proposed area under consideration. Any future submission to the NSUARB would provide a master plan of infrastructure required to service the new area, consistent with the methodology approved by the Board. The Utility will apply all capital cost contributions collected from customers (developers) in the existing development area directly towards the revised capital works required to service the larger area. Any new capital cost contribution approved by the NSUARB would apply to all new water customers (developers) within the revised development area. The Municipality or the Utility, unless otherwise ordered by the NSUARB, is in no way obligated to expand development boundaries or service areas.

7. Fire Protection

The portion of capital cost paid by means of a public fire protection charge shall be the percentage of the demand assets of the Utility that are allocated to public Fire Protection. Demand assets are those Utility assets that are required to meet customer demand and include, but not limited to, reservoirs, transmission and distribution mains, fire flow pumping equipment and pressure control equipment. The percentage calculation shall be based on asset allocation used in the most current decision of the NSUARB for new rates and charges.

8. Capital Cost Contribution Calculation

The Capital Cost Contributions will be funded based on the method approved by the NSUARB.

9. Application of Procedures and Regulations

The capital cost contribution is intended to enable the Utility to remain cost neutral in the construction of infrastructure required for new development. The capital cost contribution shall be determined in accordance with the formula set out in Section 8 of Appendix D-1 (Calculation of Developers' Charges). It is intended that the density provision of the formula will be given effect so as to achieve an equitable allocation of costs to customers (developers) and cost neutrality for the Utility in any given case.

These basic principles have been incorporated into the proposed capital cost recovery formula presented in Appendix D-1. This formula, known as the "Gates Formula", has been utilized throughout this financial analysis to determine developer charges for funding water system trunk infrastructure improvements. The capital cost recovery formula for wastewater is discussed in Section 4.4.

4.3 Wastewater Capital Cost Recovery Charges

In the late 1980's, the Municipality of East Hants constructed a wastewater treatment plant and major additions to the trunk sewer system. To pay for the capital cost of the sanitary system improvements, the municipal council instituted a developer charge (Trunk Sewer Tax) of $3,000 per lot on all new development within the East Hants Regional Serviceable Area. Due to the lower than anticipated number of lots being developed, the Municipality found it necessary to institute an area rate of $0.06 per $100 of assessment to assist in covering the shortfall in debt servicing costs for the wastewater infrastructure improvement projects.

The Municipality expects to retire the current sanitary capital debt in the year 2005 and it is the intent of the Municipality to reduce or eliminate the area rate as soon as possible. The new wastewater system improvements proposed for the next 25 years should be funded by a capital cost recovery charge similar in appearance to the existing Trunk Sewer Tax.

4.3.1 Recommendation

It is recommended that the existing Trunk Sewer Tax be continued on new developments beyond the year 2005, to finance new wastewater infrastructure requirements (for the 25 year time horizon). The cost of this continued Trunk Sewer Tax is identified in Section 5.1.

5.0 RESULTS OF CAPITAL COST RECOVERY ANALYSIS

The basic assumptions and capital cost recovery formula outlined in Section 4.0 and Appendix D-1 have been applied to the analysis of capital cost recovery charges required to finance the wastewater and water system improvements recommended in Part B - Regional Wastewater System Analysis and Part C - Regional Water System Analysis. Specific basic assumptions which have been applied include:

1. One Uniform capital cost recovery charge will be applied to fund future improvements to the water systems for the entire service area.

2. One uniform wastewater charge (sewer tax) will be calculated to fund the full 25 year stream of capital wastewater expenditure requirements as presented in Part B - Regional Wastewater System Analysis.

   Two distinct time-dependent work programs (scenarios) have been evaluated with respect to the water system capital cost recovery charges required to fund their stream of capital expenditures identified in Part C - Regional Water System Analysis.

   - Scenario 1 - Twenty Year Plan
   - Scenario 2 - Longer Term Plan

The results of these capital cost recovery analyses are presented in the following sections.

5.1 Wastewater Capital Cost Recovery Charges

The wastewater trunk system improvements recommended to accommodate projected future development for the next twenty-five years will amount to $4,609,000 including an inflation factor of 3% per year and an allowance of 10% for detailed engineering design and 15% for contingency as presented in Section 3.0.

The average yearly debt servicing charge required to fund these improvements over 25 years is approximately $224,640 per year at an interest rate of 6.5% per year. This level of annual expenditure must be funded by the average number of lots approved each year. The long term average annual lot yield is expected to be approximately 75 lots per year. Actual annual lots yields can vary considerably due to market conditions and other factors potentially resulting in shortfalls in the capital cost recovery cash flow for extended periods of time.

The capital cost recovery charge to be recovered from the developers and necessary to fund the average annual wastewater debt servicing cost assuming a 20 year debt amortization period is $2,995 per dwelling unit or $13,403 per acre of developable land based on a development rate of 75 lots per year or 16.8 acres per year.

5.2 Water System Capital Cost Recovery Charges

Two distinct water system capital cost recovery scenarios have been evaluated. This section represents the results of the water system financial analysis.

5.2.1 Scenario 1 - Twenty Year Plan

Scenario 1 represents the water system infrastructure improvements required to address existing system deficiencies related to reservoir storage and transmission main capacity and to support projected development over the next twenty years (year 2018). The total capital debt which must be incurred over the next 20 years to address existing deficiencies and to fund growth is $8,282,000 in 1998 dollars or $9,711,000 in future dollars. Approximately 1500 additional lots are expected to be serviced as a result of these improvements over the next 20 years.

The portion of the capital expenditure which is attributable to fire protection is 50% of the total capital expenditures or approximately $4,855,500. It is assumed that the Municipality will finance their portion of the capital debt over 20 years while the portion of capital expenditures to be charged to the developers will be financed over a shorter period of time, either up to the point of the next major capital cost expenditure or to the end of the 20 year scenario horizon.

The remaining 50% of the carrying charges (beyond that for fire protection) is the responsibility of the Water Utility and is to be divided between existing customers and new development. Since existing customers represent 55% of the total potential service population under Scenario 1, the Water Utility will be responsible for $144,800 per year to be financed out of the water rate. The NSUARB will be required to ratify the right of the Utility to expend this capital and to collect the carrying charges through the water rate.

The final 45% of the 50% of total carrying charges attributable to the Water Utility and new development amounts to $225,000 per year. Assuming an average lot yield of 75 lots per year, this sum represents a capital cost recovery charge of $3,012 per lot or $13,514 per acre (see Appendix D). Table 5-2 provides a summary of the Scenario 1 capital cost contributions per year required to fund the developers portion of the capital debt carrying cost.

Detailed calculation of the capital cost recovery charge is presented in Appendix D-3.

Table 5-2
Summary of Water System Charges - Scenario 1 - Twenty Year Plan

• Total Capital Expenditure (1998 - 2018)[1]	$9,711,000
• Debt Attributable to Fire Protection	$4,855,500
• Debt Servicing Attributable to Existing Utility Customers	$144,800/year
• Debt Servicing Attributable to New Development	$225,000/year

• Capital Cost Recovery Charge for 75 Lots per Year based on 15 ppa	$3,012 per lot or $13,514 per acre
• Estimated Number of New Lots to be developed.	1,500
• Number of Acres Developed Per Year	16.8
• Number of Years to Reach Limit of Improvements	Approximately 20 Years

1. Total capital expenditure in future dollars with inflation at 3% per year.

5.2.2 Scenario 2 - Longer Term Plan

Scenario 2 represents the water infrastructure improvements required to address existing and future system requirements beyond the year 2018. The total capital debt which must be incurred over the next twenty-five years is $29,288,000 in future dollars. Approximately 1,850 new lots are expected to be serviced over the next 25 years.

The average yearly debt servicing charge attributed to existing utility customers is$129,900 per year. The average yearly debt servicing charge to be recovered from the developers is approximately $438,000 per year.

The capital cost recovery charge necessary to fund the developers portion of the debt servicing charges for this level of expenditure is $5,840 per unit or $26,134 per acre.

Table 5-3 provides a summary of the Scenario 2 capital cost contributions per year required to fund the developers portion of the capital debt servicing costs. Detailed calculation of the Scenario 2 Capital Cost Recovery Charge is presented in Appendix D-3.

Table 5-3
Summary of Water System Charges - Scenario 2 - Longer Term Plan

• Total Capital Expenditure (1998-Beyond 2018)[1]	$29,288,000
• Debt Attributable to Fire Protection	$14,644,000
• Debt Servicing Attributable to Existing Utility Customers	$129,900/year
• Debt Servicing Attributable to New Development	$438,000/year
• Capital Cost Recovery Charge for 75 Lots per Year	$5,840 per lot of $26,134 per acre
• Estimated Number of New Lots to be Developed	1,850
• Number of Acres Developed Per Year	16.8
• Number of Years to Reach Limit of Improvements	Approximately 33 Years

1. Total Capital Expenditure in future dollars with inflation at 3% per year.

5.2.3 Recommended Water Capital Cost Charge

It is recommended that the Municipality adopt a water system capital cost recovery charge for Scenario 1 - Twenty Year Plan. This results in a capital cost recovery charge of $3,012 per lot or $13,514 per acre assuming an expected average development of 75 lots per year and 15 ppa over the twenty year development period from 1998 to 2018.

This scenario maximizes the potential development available to be serviced from the existing raw water source. It also defers the decision to fund a new water treatment plant and associated transmission main to a later date.

5.3 Stormwater Management Costs

The Municipality of East Hants has recently commissioned a Master Drainage Plan for the Corridor Section of the Municipality (Porter Dillon, 1998). The Master Drainage Plan identified existing specific stormwater management infrastructure (culverts) which are inadequate for existing or future levels of development within their particular tributary watershed. A capital cost formula for the replacement of deficient culverts was presented in The Master Drainage Plan report and it was recommended that the Municipality develop a procedure for funding the rehabilitation of existing culverts as it becomes necessary.

The design, financing and construction of stormwater management infrastructure within the boundaries individual developments is the responsibility of the developer. The developer is also responsible for any new offsite storm drainage infrastructure required to handle runoff from the development including culverts, ditches, storm sewers, detention ponds and other downstream structures. In addition to management of storm runoff quantity, the developer is also responsible for management of storm runoff quality especially as it relates to impact on receiving water quality.

Where the existing downstream stormwater management infrastructure such as culverts is adequate for the present but is determined to be inadequate to accommodate proposed future development, it is recommended that the Municipality seek to recover the cost of rehabilitating the existing infrastructure from the developer(s) who will benefit from the improvement. Where the existing downstream stormwater management infrastructure is inadequate for the present and therefore inadequate to accommodate proposed future development, it is recommended that the Municipality seek to recover from the developer(s) only that portion of the cost of rehabilitation which may be fairly attributed to the new developments and that the Municipality assume that portion of the costs which will benefit the existing development within the watershed. The apportionment of these costs may be based on the incremental increase in culvert diameter required to accommodate the new development(s) over that required to accommodate existing development. The costs for stormwater rehabilitation are specific to particular watersheds and therefore no specific capital cost estimate for stormwater management infrastructure are presented here. The developer will be required to negotiate the requirements for improvements to stormwater management infrastructure on a case by case basis.

As part of the approvals process, the Municipality should also require from the developer the preparation of the following stormwater management documentation:

1. An overall Stormwater Management Plan for the development including delineation of storm drainage watercourses, tributary subwatersheds, receiving water bodies and existing storm drainage infrastructure and computation of existing and future peak discharge estimates based on recognized hydrologic methodologies. The plan should also identify proposed trunk stormwater management infrastructure required to meet the planning and engineering standards of the Municipality.

2. Individual Local Stormwater Drainage Plans for each of the subwatersheds indicating direction and destination of stormwater runoff from the proposed lots into the receiving watercourses, storm sewers and detention devices as applicable.

3. Individual Grading Plans for each dwelling unit prior to final approval indicating the relative elevation of the foundation footings and floor slab with respect to the drainage ditches, streams and road surfaces and the overall direction of the drainage consistent with the Stormwater Management Plan and the Local Stormwater Drainage Plan for the neighbourhood.

5.4 Road Paving Costs

As part of the approvals process, the Municipality does not currently require that developers pave roads within new developments. The current standard for newly constructed roadways in residential subdivisions requires the preparation of the roadway to grade with a gravelled wearing surface and with open drainage ditches along both sides.

The Municipality is considering the cost implications of requiring developers to pave new roads in residential developments prior to assumption by the Municipality of responsibility for the completed development. The incremental capital cost per lot associated with paving residential roads in new developments is a function of road surface width and lot width. The typical residential road surface including shoulders is 30 feet wide and the paved surface is normally 20 feet wide in a 66 foot right-of-way.

Residential, R1 lots in the Municipality are required to be a minimum of 75 feet wide and Residential, R2 lots are also a minimum 75 feet wide but they may be subdivided into two equal 37.5 foot wide lots to accommodate semi-detached housing units.

Paving of residential roads requires the application of a gravel top dressing and an asphalt wearing surface to the standard of the Municipal General Specification. The typical paving cost for residential roads within the Municipality is estimated to be $2,000 to $2,500 per R1 or R2 lot or $1,000 to $1,250 per semi-detached dwelling unit. Assuming an average development density of 4.5 lots per acre, the cost of road paving is estimated at $9,000 to $11,250 per acre.

5.5 Policy Recommendations Summary

This section provides a summary of recommendations concerning the operation of the wastewater and water systems. It also provides a summary of recommendations concerning the establishment of capital cost recovery charges for trunk wastewater, water supply and stormwater management infrastructure.

Policy Recommendations

<u>Wastewater System</u>

1. The Municipality should adopt and periodically update a comprehensive wastewater general specification which is consistent with NSDOE Guidelines and with specifications currently

in effect throughout the Halifax Regional Municipality. It should be the policy of MEH to update their general specification on a regular basis. To make it consistent with that of Halifax Regional Municipality where possible, so that the development community in the region can work to one standard.

2. The Municipality currently has a policy which requires that all lands approved for development within the Serviceable Area be serviced by the regional wastewater system. It is recommended that the use of on-site sanitary systems be discouraged in all future residential developments within the Serviceable Area so that the Municipality can ensure that a fair proportion of the cost of trunk wastewater infrastructure will be recovered from new development.

3. The Municipality should consider adoption of a policy requiring that wastewater management within individual sewersheds be based on gravity collection and transmission sewer mains and that the use of sanitary pumping stations be minimized wherever possible.

Water System

1. Water supply design criteria consistent with those in effect within the Halifax Regional Municipality and Halifax Regional Water Commission should be adopted so that the Municipality is presenting similar regulatory requirements to the development community across the region.

2. Evaluate long term potential for expanding raw water supply beyond the existing water rights permit to accommodate long term growth. Potential additional supply may be available from the Shubenacadie River, Grand Lake or from groundwater sources.

3. Consider a policy to limit water service to the existing water service district boundary thereby reducing the potential for costly urban sprawl.

4. Establish a capital cost recovery mechanism to recover the capital costs associated with extending services to new development from the new homeowners or developers so that the burden does not fall on the existing customer base.

5. Institute a policy to encourage or require developers to integrate the water distribution piping in new developments with that in adjacent developments to improve interconnections and promote hydraulic cross flow thereby increasing fireflow capacity within the overall system.

Capital Cost Recovery

1. The new wastewater system improvements proposed for the next 25 years should be funded by a capital cost recovery charge of $3,000 per lot similar in appearance to the existing sewer tax charge which will be adequate to cover future sanitary system requirements. To this end, the existing sewer tax of $3,000 per lot should be retained to fund future wastewater system improvements.

2. The new water system improvements to 2018 as proposed in Scenario 1 - 20 year plan should be funded by a water system capital cost recovery charge of $3,012 per lot of $13,514 per acre.

3. The Municipality should initiate discussions with the Nova Scotia Utility and Review Board (NSUARB) with the goal of acquiring permission for the Water Utility to collect a water system capital cost recovery charge.

4. The Municipality should establish a policy on stormwater management to recover capital costs associated with improvements to the regional stormwater management infrastructure required by new development. The capital costs of these improvements should be recovered directly from those developments which benefit from them.

Bibliography

1. Porter Dillon Limited, 1997, *Water Supply Capacity/Storage Needs Analysis for the East Hants Regional Water Utility*, Halifax, Nova Scotia..

2. Porter Dillon Limited, 1998, *Master Drainage Plan - Corridor Section of the Municipality of East Hants*, Halifax, Nova Scotia..

3. E. D. M. Consultants Ltd., 1998, *Long Term Development Management Plan/Suitability Analysis*, Halifax, Nova Scotia.

4. CBCL Ltd., 1998, *Floodplain Mapping Study for the Shubenacadie and Nine Mile Rivers*, Halifax, Nova Scotia.

5. Municipality of the District of East Hants, April 20, 1994; *Municipal Services System General Specifications - Draft* (including Addendum No. 2), Shubenacadie, Nova Scotia.

6. Doyle, Graham, *Sewage Collection System Upgrading (Lantz), Sewage Lift Station 15 Report*, November 1996. Project No. 05-94-0082, prepared for the Municipality of East Hants, Shubenacadie, Nova Scotia.

7. Roberge, Renée, *Sewer Capacity Study (Lantz)*, prepared for Municipality of East Hants, December 1996, Shubenacadie, Nova Scotia.

8. Wallace, MacDonald and Lively, *Water Distribution System - Willowcrest Estates Phase 1-A*, July 2, 1997, Bedford, Nova Scotia.

9. Fire Underwriters Survey, 1991, *Water Supply for Public Fire Protection - A Guide to Recommended Practice*, Insurers Advisory Organization.

10. American Water Works Association, 1992, *Distribution System Requirements for Fire Protection, AWWA Manual M31*; Denver, Colorado.

11. Nova Scotia Department of the Environment, *Nova Scotia Standards and Guidelines Manual for the Collection, Treatment and Disposal of Sanitary Sewage*.

12. Streetwise Engineering, *Route 213 Transportation Study*, 1998.

Appendix D-1

Development of Capital Cost Contributions in New and Existing Developments Serviced by the Municipality of East Hants

DEVELOPMENT OF

CAPITAL COST CONTRIBUTIONS

IN

NEW AND EXISTING DEVELOPMENTS

SERVICED BY

THE MUNICIPALITY OF EAST HANTS

July 13, 1998

I

Background

The Municipality of East Hants has commissioned an infrastructure capacity study to determine what additional infrastructure will be required to provide adequate sewer and water service to existing residents and to any new development in the proposed serviceable area of the Municipality.

The requirements for infrastructure upgrading has been established based on anticipated maximum development over a 20 year time frame. Infrastructure required over a longer time frame has also been established.

From a financial point of view the Municipality wants to have developers pay their fair share of any sewer and water infrastructure upgrade. Over the recent past, there have been major capital expenditures on waste water trunk sewer collection and a waste water treatment plant as a result of deficiencies in the waste water system. Furthermore, in the case of the water system, deficiencies in fire protection and other supply issues have been identified.

As the development and implementation of a capital cost contribution for water infrastructure requires the approval of the Nova Scotia Utility and Review Board (NSUARB), a set of procedures has been established along with a formula for allocating costs among the stake holders. The formula is similar to the one approved for the Halifax Regional Water Commission by the NSUARB, pursuant to Order #NSUARB-W-HFXR-R-96.

The procedures and formula being proposed for contributions toward water infrastructure could also be applied, in part, to the waste water system.

II

A. Capital Cost Contribution for Water Infrastructure

1. Required Infrastructure

Any extension or improvement to the water system required to provide water service to any new development must be cost neutral to the Municipality of East Hants Water Utility. Required infrastructure shall include, but shall not be limited to, supply, storage, transmission, distribution, pressure control and fire protection as required by the Utility.

2. Capital Cost

The Capital Cost of the required infrastructure will be established by the Utility and the cost estimates will be used to establish the Capital Cost Contributions.

3. Area of Developable Land

The area of land that can not be developed, such as water courses, flood plains, etc., shall be established by the Council of the Municipality of East Hants. The land area that cannot be used for development will be subtracted from the total area. Roads, parks, right of ways, schools etc. shall be included in the developable area.

4. Density

The average and actual population density applicable to a specific development area will be established by the Council of the Municipality of

East Hants. These density determinations will be used to calculate the per acre contribution of a development above or below the average density of the total developable area. As an example, if the average density is established at 15ppa, a higher density of 20ppa would pay 33% more than the average cost. Conversely, if the area being developed is 10ppa the developer would pay 33% less than the average cost.

5. Rezoning or Change of Use

Property owners who seek a rezoning or change of use, which will affect a water demand and increase densities, will be required to pay an additional capital cost contribution. The Utility will review the density implications and apply the capital cost contribution density calculation to determine whether a further capital cost shall be required from the customer (developer). The Utility shall apply previously collected capital cost contributions towards a revised required capital cost, based on the applicant's proposed change of use or rezoning application. If the rezoning or change of use requires an upgrading or addition to the infrastructure as determined by the Utility, the applicant shall be required to cover the cost of such improvements or additions.

6. Expanded Development Boundaries

At the discretion of the Municipality, minor expansions to development boundaries may be considered if the proposed or existing water system infrastructure is capable of providing reliable service to areas under consideration. In the event that a development boundary is expanded, capital cost contributions that have been established and approved by the Nova Scotia Utility and Review Board (NSUARB) within the original development boundary shall apply to this expanded area.

The Municipality and Utility, at their discretion, may approve a significant expansion to the existing development area that requires infrastructure improvements or new installations. The Utility shall require the establishment of a new capital cost contribution for the proposed area under consideration. Any future submission to the NSUARB would provide a master plan of infrastructure required to service the new area, consistent with the methodology approved by the Board. The Utility will apply all capital cost contributions collected from customers (developers) in the existing development area directly towards the revised capital works required to service the larger area. Any new capital cost contribution approved by the NSUARB would apply to all new water customers (developers) within the revised development area. The Municipality or the Utility, unless otherwise ordered by the NSUARB, is in no way obligated to expand development boundaries or service areas.

7. <u>Fire Protection</u>

The portion of Capital Cost paid by means of a public fire protection charge shall be the percentage of the demand assets of the Utility that are allocated to Public Fire Protection. Demand assets are those Utility assets that are required to meet customer demand and include, but not limited to, reservoirs, transmission and distribution mains, fire flow pumping equipment and pressure control equipment. **The percentage calculation shall be based on asset allocation used in the most current decision of the NSUARB for new rates and charges.**

8. <u>Capital Cost Contribution Calculation</u>

The Capital Cost Contributions will be funded based on the method approved by the NSUARB.

9. Application of Procedures and Regulations

The capital cost contribution is intended to enable the Utility to remain cost neutral in the construction of infrastructure required for new development. The capital cost contribution shall be determined in accordance with the formula set out in Section b (Calculation of Developers' Contributions). It is intended that the density provision of the formula will be given effect so as to achieve an equitable allocation of costs to customers (developers) and cost neutrality for the Utility in any given case.

B. Calculation of Developers' Contribution

(Based on the utility alone or developers providing all necessary infrastructure)

1.	Debt servicing cost to the Utility for capital borrowing for infrastructure	A (Note 1)
2.	Deduct portion of debt servicing costs paid by Fire Protection	B (Note 2)
3.	Balance to be recovered from the Utility (existing customers) and new customers (developer) A - B	C
4.	Deduct portion of infrastructure (debt servicing) that benefits the Utility (existing customers)	D (Note 3)
5.	Balance to be recovered from new customers (Developer) D - C	E
6.	Area of developable land (acres)	F (Note 4)
7.	Developers contribution per acre $\frac{E}{F}$	G
8.	Average density of total development	H (Note 5)
9.	Density above average density	I

10. Developer's cost per acre, above average density

$$\frac{I \times G}{H}$$ J

11. Density below average density K

12. Developer's cost per acre, below average density

$$\frac{K \times G}{H}$$ L

Note 1 The infrastructure costs and timing will be based on engineering estimates developed by the Utility and will include interest during construction. These costs will be used to establish the debt servicing costs of the Utility.

Note 2 The Percentage of the Utility's demand assets allocated to Fire Protection shall be that percentage used in the most current decision of the NSUARB for new rates and charges. The most current allocation of assets to Fire Protection by the Utility is 50%.

Note 3 The cost of infrastructure (debt servicing) that benefits the Utility will be established by the engineering staff of the Utility and their Consultants.

Note 4 The total developable land area will be established by the Planning Department of the Municipality.

Note 5 Development charge per acre is based on an average density established by the Planning Department of the Municipality.

C. Fire Protection

Fire protection for infrastructure provided by the Utility in the development will be included in the yearly fire protection charge billed to the Municipality.

13. Portion of infrastructure (debt servicing) cost to be recovered from fire protection C (Note 6)

Note 6 This calculation to be a separate line item on fire protection billed to the Municipality and will be paid on an annual basis.

D. Establishing Lot Area For Development (Commercial, Educational or Institutional)

The lot area would apply for single storey development such as a strip mall consisting of all single storey buildings.

Development of one or more multi-storey buildings shall have the lot area calculated on the lot size plus the area of each floor above the first floor. Underground parking would be considered as an additional floor.

As these types of developments will be required to provide more on-site parking, we are recommending that the lot size be used as the basis of establishing developer's contribution.

This method of establishing lot areas will apply to all new customers (developers).

The capital cost contribution shall be assessed at the average acreage density applicable to the development area.

E. New Development within Existing Developed Area

The cost to the customer (Developer) who builds on a vacant lot shall be the same cost per acre as in all other undeveloped areas.

III

Waste Water System

In the 1980's the Municipality constructed a waste water treatment plant and major addition to the trunk sewer system. To pay for the capital cost of the infrastructure the Municipal Council instituted a developer charge of $3,000.00 per lot for all new development. Due to a lower number of lots being developed than anticipated, the Municipality found it necessary to institute an area rate of 0.06 per $100.00 of assessment to cover the shortfall in debt servicing costs of the waste water infrastructure projects.

It is the intent of the Municipality to reduce or eliminate the area rate as soon as possible.

When the debt on the existing waste water system is paid off in the year 2005 the current charge of $3,000. per lot is considered adequate to fund the proposed new infrastructure requirements.

Appendix D-2

Detailed Calculations for Capital Cost Contributions for Wastewater System

Sewer Capital Cost Estimate

15-Jul-98

25 Year Projection

Item	Unit	Estimated Quantity	Unit Price	Est. Total Cost	Total Including ng., Cont., HST	ctual Inflated
SEWER INFRASTRUCTURE						
Present - 1998						
1 Upgrade Pump Station 18 and 20	L.S.	1	$60,000	$60,000		
Replace pump station 4	L.S.	1	$190,000	$190,000		
			Total 1998:	$250,000	$337,000	$337,000
year 2003						
1 Replace PS 18 and 20	L.S.	1	$450,000	$450,000		
Force main from PS 20 to existing force main from PS	m	2400	$250	$600,000		
2 Emergency Power for Pump Station 17	L.S.	1	$90,000	$90,000		
			Total 2003:	$1,140,000	$1,535,000	$1,779,000
year 2008						
1 Upgrade pump station 15	L.S.	1	$60,000	$60,000		
Upgrade aeration at STP	L.S.	1	$115,000	$115,000		
2 Emergency Power for Pump Station 7	L.S.	1	$90,000	$90,000		
			Total 2008:	$265,000	$357,000	$480,000
year 2013						
1 Gravity main upgrades	L.S.	1	$245,000	$245,000		
2 Emergency Power for Pump Station 8	L.S.	1	$90,000	$90,000		
Emergency Power for Pump Station 9	L.S.	1	$90,000	$90,000		
			Total 2013:	$425,000	$572,000	$891,000
year 2018						
1 Gravity main upgrades	L.S.	1	$90,000	$90,000		
2 Emergency Power for Pump Station 10	L.S.	1	$90,000	$90,000		
Emergency Power for Pump Station 13	L.S.	1	$90,000	$90,000		
			Total 2018:	$270,000	$364,000	$657,000
year 2023						
1 Gravity main upgrades	L.S.	1	$75,000	$75,000		
2 Emergency Power for Pump Station 14	L.S.	1	$90,000	$90,000		
			Total 2023:	$165,000	$222,000	$465,000
SUBTOTAL CAPITAL COSTS				$2,515,000	$3,387,000	$4,609,000
ENGINEERING (10%)				$251,500		
SUBTOTAL ESTIMATED COST				$2,766,500		
CONTINGENCY (15%)				$415,000		
SUBTOTAL ESTIMATED COST				$3,181,500		
HST Payable (3/7)*15%				$204,500		
TOTAL ESTIMATED Sewer COST				$3,386,000		

Inflation Rate 0.03

Sewer Cost Contribution:

INPUT:

Scenario:	**25 year projection**
Water Supplied to:	East Hants Corridor
Total Capital Cost(1998$):	$3,387,000
Interest rate (6.5%):	6.5%
Inflation rate:	3%
Blended payment rate with 6.5% interest over 20 years:	9.1%

Population Info (based on 75 units per year):

Projected Total Acreage of Development:	1605
Acres Available for Capital Cost Contribution:	419
Average Density of Contributing Areas (ppa):	15.0
Total projected dwelling units **25 years** (@ 75 units/yr):	3691.0
Existing number dwelling units 1998:	1816.0
Total number new dwelling units in 25 years:	1875.0
Projected number of new Dwellings per year:	**75**
Projected number of new developed Acres per year:	**16.8**

Projected Capital Expenditures (based on 1998$ increased by 3% inflation per year):

	1998	$337,000
	2003	$1,779,000
	2008	$480,000
	2013	$891,000
	2018	$657,000
	2023	$465,000
TOTAL:		$4,609,000

Assumption Municipality borrows for required capital addition at 6.5% over **20 years** blended principal and interest. the yearly payment is 9.1% of capital borrowing.

Table 1
Average Debt Servicing Costs per Year

Year	Cost	Debt Servicing Costs	5 year increase in debt servicing	Average yearly debt servicing charge
1998	$337,000	$30,667	$30,667	
2003	$1,779,000	$161,889	$192,556	
2008	$480,000	$43,680	$236,236	$224,643
2013	$891,000	$81,081	$317,317	
2018	$657,000	$59,787	$346,437	
	4144000			

Developers Contribution required to cover debt servicing costs based on no contribution from area rates or existing customers.

Developers Contribution

Average Debt Servicing cost per year (25 ye	**$224,643**
Acres per Year:	16.8
Cost Per Acre:	**$13,403**
Average # Units/Acre:	4.5
Average Cost/Unit:	**$2,995**

Appendix D-3

Detailed Calculations for Capital Cost Contributions for Water System

Capital Cost Estimate
25 Year Demand Projection

15-Jul-98

Item	Unit	Estimated Quantity	Unit Price	Est. Total Cost	Total Including Eng., Cont., HST	Actual Inflated $
WATER INFRASTRUCTURE						
Year 1999						
1 WATER RESERVOIR - Willow Crest (0.37 MIG)						
.1 Tank Supply & Install	L.S.	1	$220,000	$220,000		
.2 Tank Connections	L.S.	1	$100,000	$100,000		
.3 Tank Control Systems	L.S.	1	$50,000	$50,000		
.4 Site Work / Landscaping	L.S.	1	$50,000	$50,000		
.5 SCADA System	L.S.	1	$50,000	$50,000		
.6 Land Acquisition'	L.S.	1	$20,000	$20,000		
			Subtotal tank:	$490,000		
2 16" (400 mm) PVC Supply Main - From Willow Crest to Willow Crest tank	m	375	$550	$206,250		
12" (300 mm) PVC Supply Main - Hwy. 2 from existing 8" to Willow Crest entrance	m	400	$450	$180,000		
Infrastructure Study	L.S.	1	$70,000	$70,000		
Booster Pump in Lantz (Hwy. 2 - East of Hwy. 214)	L.S.	1	$405,000	$405,000		
16" (400 mm) PVC Supply Main - Enfield WTP to Alderney	m	2250	$550	$1,237,500		
16" (400 mm) PVC Supply Main - Alderney to Elmwood Subdivision	m	2000	$550	$1,100,000		
16" (400 mm) PVC Supply Main - Hwy. 214 to Sobeys	m	250	$550	$137,500		
16" (400 mm) PVC Supply Main - Twin existing 10" from Park Rd to Hwy. 214	m	650	$550	$357,500		
			Subtotal misc.	$3,693,750		
			Total 1999:	$4,184,000	$5,633,000	$5,802,000
Average day demand of 555 usgpm - year 2009						
1 UPGRADE EXISTING WTP ²						
200 usgpm packaged water treatment plant	L.S.	1	$350,000	$350,000		
Package Plant Building	L.S.	1	$200,000	$200,000		
Low lift pump	ea.	2	$30,000	$60,000		
High lift Pump	ea.	2	$60,000	$120,000		
Electrical upgrades (VFD, new services, transformer)	L.S.	1	$200,000	$200,000		
			Subtotal plant:	$930,000		
			Total 2009:	$930,000	$1,252,000	$1,733,000
Average day demand of 615 usgpm - year 2013						
1 WATER RESERVOIR - Business Park (0.96 MIG)						
.1 Tank Supply & Install	L.S.	1	$575,000	$575,000		
.2 Tank Connections	L.S.	1	$100,000	$100,000		
.3 Tank Control Systems	L.S.	1	$50,000	$50,000		
.4 Site Work / Landscaping	L.S.	1	$50,000	$50,000		
.5 SCADA System	L.S.	1	$50,000	$50,000		
.6 Land Acquisition'	L.S.	1	$20,000	$20,000		
			Subtotal tank:	$845,000		
2 16" (400 mm) PVC Supply Main - To business park tank	m	350	$550	$192,500		
			Subtotal pipe:	$192,500		
			Total 2013:	$1,038,000	$1,397,000	$2,178,000
Average day demand of 700 usgpm - year 2018						
1 NEW WATER TREATMENT PLANT @ Grand Lake						
New WTP at Grand Lake - Install 500 usgpm of the total 1000 usgpm (1.2 MIGD) Includes: Low Lift Pump, high lift pump, plant, clearwell	L.S.	1	$3,400,000	$3,400,000		
2 16" (400 mm) PVC Supply Main - Grand lake WTP to Enfield Rd	m	3500	$550	$1,925,000		
			Total 2018:	$5,325,000	$7,169,000	$12,948,000
Average day demand of 900 usgpm - year 2024						
1 WATER RESERVOIR - Willow Crest (0.46 MIG)						
.1 Tank Supply & Install	L.S.	1	$275,000	$275,000		
.2 Tank Connections	L.S.	1	$100,000	$100,000		
.3 Tank Control Systems	L.S.	1	$50,000	$50,000		
.4 Site Work / Landscaping	L.S.	1	$50,000	$50,000		
.5 SCADA System	L.S.	1	$50,000	$50,000		
.6 Land Acquisition'	L.S.	1	$20,000	$20,000		
			Subtotal tank:	$545,000		
2 16" (400 mm) PVC (upsize cost 12" to 16") - Through Clayton Dev. to Lantz tank	m	1400	$100	$140,000		
16" (400 mm) PVC Supply Main - From Hwy. 214 to Clayton Dev.	m	1150	$550	$632,500		
16" (400 mm) PVC (upsize cost 12" to 16") - Through Willow Crest Dev. to Willow Crest Tank	m	2500	$100	$250,000		
16" (400 mm) PVC Supply Main - From Lantz tank to Willow Crest Dev.	m	1300	$550	$715,000		
			Total 2024:	$2,283,000	$3,074,000	$6,629,000
SUBTOTAL CAPITAL COSTS				$13,760,000	$18,530,000	$29,288,000
ENGINEERING (10%)				$1,380,000		
SUBTOTAL ESTIMATED COST				$15,140,000		
CONTINGENCY (15%)				$2,270,000		
SUBTOTAL ESTIMATED COST				$17,410,000		
HST Payable (3/7)*15%				$1,120,000		
TOTAL ESTIMATED WATER COST				$18,530,000		

NOTE: (1) Land Acquisition Cost is an estimated cost of $20,000/acre
(2) Upgrade of Existing plant is provided that the supply from Shubee can be increased from 700 usgpm to 900 usgpm (add the 200 usgpm from Old Lantz WTP).
(3) Pipe cost includes pipe, valves, tees, bends, 25% Rock excavation.
(4) Grand Lake WTP cost based on WTP of similar size, costed by CBCL and reviewed by PDL 1998
(5) Cost of upsizing 12" to 16" based on HRWC costs. Developer is responsible for installing the 12" pipe as recommended by Municipality.
(6) Assumed interest rate of 6.5%

Inflation Rate 3%

Water Cost Recovery Scenario 1

All required infrastructure for 20 year projection (does not include a new WTP)

15-Jul-98

East Hants Infrastructure Study
98-5106-01-01

Water Cost Contribution:

INPUT:

Scenario:	**20 year projection**
Water Supplied to:	East Hants Corridor
Interest rate (6.5%):	6.5%
Inflation rate:	3%
Blended payment rate with 6.5% interest over 12 years:	**12.3%**
Blended payment rate with 6.5% interest over 8 years:	**16.4%**
Blended payment rate with 6.5% interest over 20 years:	**9.1%**

Population Info (based on 75 units per year):

Projected Total Acreage of Development:	1519
Acres Available for Capital Cost Contribution:	333
Average Density of Contributing Areas (ppa):	15.0
Total projected dwelling units 20 years (@ 75 units/yr):	3310.0
Existing number dwelling units 1998:	1816.0
Total number new dwelling units in 20 years:	1494.0
Projected number of new Dwellings per year:	**75**
Projected number of new developed Acres per year:	**16.7**
Fire Reduction rate:	50%

Projected Capital Expenditures:

a)	1999	$5,802,000
b)	2011	$3,909,000
TOTAL:		$9,711,000

NOTE:

a) Cost estimates of 1999
b) Combined Cost estimates of 2009 and 2013

50% of the costs would have to be paid by the Municipality as a fire protection charge :

$4,855,500 This amount could be recovered by area rates or possibly a hook-up charge to all new home owners.

Cost per year (amortized over 20 years) to be carried by the Municipality for FF:

Table 1
Average Debt Servicing Costs per Year for Municipality for FF

Year	Cost	(1) Debt Servicing Costs	(2) Incremental Increase in debt servicing	Years which each Debt servicing charge applies
1999	$2,901,000	$263,991	**$264,000**	**1999 to 2010**
2011	$1,954,500	$177,860	**$442,000**	**2011 to 2018**
2019	$0	$0	**$178,000**	**2019 to 2031**
	$4,855,500			

The cost of infrastructure required for existing population is carried by the Water Utility as a % of existing dwellings to future # dwellings benefited by the upgrades.

% 1999 costs to be carried by Utility:	55%	of 1999 costs
Total Cost (due to existing requirements) to be carried by Utility:	$1,591,606	
Cost per year (amortized over 20 years) to be carried by Utility:	$144,800	due to existing requirements for upgrades

Debt servicing to be charged to development is total cost minus fire protection minus cost which benefits existing development:

$3,263,894

Table 2
Average Debt Servicing Costs per Year for Development

Year	Cost	(1) Debt Servicing Costs	(2) Incremental increase in debt servicing	(3) Weighted Average yearly debt servicing charge for development
1999	$1,309,394	$160,519	$160,519	
2011	$1,954,500	$321,124	$321,124	$225,000
	$3,263,894			

NOTES:

(1) Assumed water utility borrows for required capital addition at 6.5% over 12 years (for costs for 1999) blended principal and interest. The yearly payment is 12.3% of capital borrowing. Assumed that the 2009 and 2013 expenditure is spent in 2011 and amortized over 8 years in which the yearly payment is 16.4%.
(2) Increase in debt servicing over each period
(3) Average debt servicing of each increment.

Developers Contribution

Average Debt Servicing cost per year (20 years)	$225,000
Acres per Year:	16.7
Cost Per Acre:	**$13,514**
Average # Units/Acre:	4.5
Average Cost/Unit:	**$3,012**

Water Cost Recovery Scenario 2

All required infrastructure for 25 year projection including a new WTP

15-Jul-98

East Hants Infrastructure Study
98-5106-01-01

Water Cost Contribution:

INPUT:

Scenario:	**25 year projection**
Water Supplied to:	East Hants Corridor
Total Capital Cost(1998$):	$18,530,000
Interest rate (6.5%):	6.5%
Inflation rate:	3%
Blended payment rate with 6.5% interest over 20 years:	9.1%

Population Info (based on 75 units per year):

Projected Total Acreage of Development:	1605
Acres Available for Capital Cost Contribution:	419
Average Density of Contributing Areas (ppa):	15.0
Total projected dwelling units 25 years (@ 75 units/yr):	3691.0
Existing number dwelling units 1998:	1816.0
Total number new dwelling units in 25 years:	1875.0
Projected number of new Dwellings per year:	**75**
Projected number of new developed Acres per year:	**16.8**
Fire Reduction rate:	50%

Projected Capital Expenditures:

a)	1998	$5,802,000
b)	2003	$0
c)	2008	$1,733,000
d)	2013	$2,176,000
e)	2018	$12,948,000
f)	2023	$6,629,000
TOTAL:		$29,288,000

50% of the costs would have to be paid by the Municipality as a fire protection charge :

$14,644,000 This amount could be recovered by area rates or possibly a hook-up charge to all new home owners.

Cost per year (amortized over 20 years) to be carried by the Municipality for FF: $524,700

Table 1
Average Debt Servicing Costs per Year for Municipality for FF

Year	Cost	(1) Debt Servicing Costs	(2) 5 year increase in debt servicing	(3) Average yearly debt servicing charge for Municipality for FF
1998	$2,901,000	$263,991	$263,991	
2003	$0	$0	$263,991	
2008	$866,500	$78,852	$342,843	
2013	$1,088,000	$99,008	$441,851	**$524,714**
2018	$6,474,000	$589,134	$766,994	
2023	$3,314,500	$301,620	$1,068,613	
	$14,644,000			

The cost of infrastructure required for existing population is carried by the Water Utility as a % of existing dwellings to future # dwellings benefited by the upgrades.

% 1999 costs to be carried by Utility:	49%	of 1999 costs
Total Cost (due to existing requirements) to be carried by Utility:	$1,427,314	
Cost per year (amortized over 20 years) to be carried by Utility:	**$129,900**	**due to existing requirements for upgrades**

Debt servicing to be charged to development is total cost minus fire protection minus cost which benefits existing development:

$13,216,686

Table 2
Average Debt Servicing Costs per Year for Development

Year	Cost	(1) Debt Servicing Costs	(2) 5 year increase in debt servicing	(3) Average yearly debt servicing charge for development
1998	$1,473,686	$134,105	$134,105	
2003	$0	$0	$134,105	
2008	$866,500	$78,852	$212,957	
2013	$1,088,000	$99,008	$311,965	$438,000
2018	$6,474,000	$589,134	$766,994	
2023	$3,314,500	$301,620	$1,068,613	
	$13,216,686			

NOTES:

(1) Assumption water utility borrows for required capital addition at 6.5% over 20 years blended principal and interest. The yearly payment is 9.1% of capital borrowing.
(2) Increase in debt servicing over each 5 year period
(3) Average debt servicing of each increment.

Developers Contribution

Average Debt Servicing cost per year (25 years	**$438,000**
Acres per Year:	16.8
Cost Per Acre:	**$26,134**
Average # Units/Acre:	4.5
Average Cost/Unit:	**$5,840**

Maps (in Pouch)

Map 1 - Regional Sanitary System Existing Conditions and 20 Year Upgrades

Map 2 - Conceptual Water System Plan - Long Term

19980716.1000

G:\CAD\985106\5106A001

NO.	FOR	DATE

PRINT RECORD

NOT FOR CONSTRUCTION

Porter Dillon Limited

NO.	REVISIONS	DATE	BY
3	REISSUED FOR FINAL REPORT	OCT. 06/98	RWS
2	ISSUED FOR FINAL REPORT	JULY 14/98	RWS
1	DRAFT – FOR REVIEW AND COMMENT	JUNE 3/98	RWS

DESIGN	A.H.B./D.J.H.
DRAWN	G.A.L.
CHECKED	R.W.S.
APPROVED	R.W.S.
DATE	MAY 1998
SCALE	1:10000

EAST HANTS INFRASTRUCTURE CAPACITY STUDY

REGIONAL SANITARY SYSTEM
EXIST. CONDITIONS & 25 yr UPGRADES

PROJECT NO. 98–5106

SHEET NO. 1 OF 2

NOTES:

1. THIS CONCEPTUAL WATER SYSTEM PLAN FOR THE YEAR 2003 IS INTENDED TO ACCOMPANY A REPORT ON THE INFRASTRUCTURE CAPACITY STUDY (PORTER DILLON, 1998).
2. THE IMPLEMENTATION OF THIS CONCEPTUAL WATER SYSTEM PLAN IS PROVIDED IN THE ASSOCIATED REPORT.

NOT FOR CONSTRUCTION

Porter Dillon Limited

NO.	REVISIONS	DATE	BY
3	REISSUED FOR FINAL REPORT	OCT. 06/98	RWS
2	ISSUED FOR FINAL REPORT	JULY 13/98	RWS
1	DRAFT – FOR REVIEW & COMMENT	JUNE 3/98	RWS

DESIGN	K.Y.T./R.W.S.
DRAWN	T.L.R.
CHECKED	R.W.S.
APPROVED	R.W.S.
DATE	APR. 1998
SCALE	1:10000

EAST HANTS INFRASTRUCTURE CAPACITY STUDY

CONCEPTUAL WATER SYSTEM CONFIGURATION – LONG TERM

PROJECT NO. 98–5106

SHEET NO. 2 OF 2