Halifax Water
Five Year Business Plan
2015/16 to 2019/20

Approved by the Halifax Water Board

October 30, 2014

Glossary

AM	Asset Management
AMI	Advanced Metering Infrastructure
AWWA	American Water Works Association
BMPs	Best Management Practices
BOD5	Biochemical Oxygen Demand (5 Day Period)
BPF	Biosolids Processing Facility
CBOD	Carbonaceous Biochemical Oxygen Demand
CCC	Capital Cost Contribution
CCME	Canadian Council of Ministers of the Environment
CCS	Customer Care and Service
CCTV	Closed Circuit Television
CEU	Continuing Education Unit
CFIA	Canadian Food Inspection Agency
CIP	Capital Infrastructure Program
COSS	Cost of Service Study
COSM	Cost of Service Manual
CRM	Customer Relationship Module
CSIF	Canada Strategic Infrastructure Fund
CSO	Combined Sewer Overflow
CUPE	Canadian Union of Public Employees
DIA.	Diameter
DOE	Department of Energy
EM	Environmental Management
EMO	Energy Management Opportunities
EP	Environmental Protection
ERA	Environmental Risk Assessment
FCM	Federation of Canadian Municipalities
GTU	Green Thermal Utility
HIAA	Halifax International Airport Authority
HHSP	Halifax Harbour Solutions Project
I&I	Inflow & Infiltration
ICI	Industrial, Commercial & Institutional
IFRS	International Financial Reporting Standards
IRS	Internal Responsibility System
IS	Information Systems
IWA	International Water Association
JOHSC	Joint Occupation Health & Safety Committee
LSL	Lead Service Line
m3	Cubic Metre
MRIF	Municipal Rural Infrastructure Fund
NGO	Non-Government Organization
NSE	Nova Scotia Environment
NSERC	Natural Sciences and Engineering Research Council

NSPI	Nova Scotia Power Incorporated
NSUARB	Nova Scotia Utility and Review Board
PI	Plant Information
P2	Pollution Prevention
RAM-W	Risk Assessment Methodology for Water
RFP	Request for Proposal
RTU	Remote Terminal Unit
RWWFP	Regional Wastewater Functional Plan.
SCADA	Supervisory Control and Data Acquisition
SIR	Stormwater Inflow Reduction
SOP	Standard Operating Procedure
SNSMR	Service Nova Scotia Municipal Relations
SSO	Sanitary Sewer Overflow
TRC	Total Residual Chlorine
TSS	Total Suspended Solids
UV	Ultraviolet
WEF	Water Environment Federation
WRF	Water Research Foundation
WSC	Wastewater and Stormwater Collection
WSER	Wastewater Systems Effluent Regulations
WWM	Wet Weather Management
WWTF	Wastewater Treatment Facility
WQMP	Water Quality Master Plan

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APPENDICES

1. EXECUTIVE SUMMARY

With the completion of the Cost of Service Manual (COSM), Integrated Resource Plan (IRP), and Debt Strategy, a sustainability framework is in place to guide the utility's strategic goals. As directed by the Nova Scotia Utility and Review Board (NSUARB), a rate application was submitted in January, 2013 based on a new COSM which outlined distinct rate structures for each of the three services provided by Halifax Water. Of particular note, in accordance with industry best practice, stormwater charges are now based on impervious surface area instead of water consumption. The NSUARB approved rates for a two year period ending March 31, 2015.

As part of the rate application process, Halifax Water submitted its Debt Strategy which indicated that the utility should base an efficient capital funding structure on a maximum debt service ratio of 35% and a debt to equity ratio of 40 to 60 %. The Debt Strategy was carried out in close consultation with the Municipal Finance Corporation and the Halifax municipality. In that same spirit of co-operation, Halifax municipality recently approved a blanket guarantee of Halifax Water debt as long as the debt service ratio is less than 35%, and also renewed a 5-Year Dividend Agreement.

This Five-Year Business Plan is being developed to support the November, 2014 rate application to cover the 2015/16 and 2016/17 fiscal years. As directed by the NSUARB, the rate application will reflect consolidation of the Urban Core/Satellite systems and the Airport/Aerotech system into one rate base. Several challenges, mainly of a capital nature, will garner the attention of the utility over the next five years, namely:

- **Impact of Significant Current and Imminent Capital Projects** – There is a need to accommodate new debt payments and depreciation for the Aerotech Wastewater Treatment Facility expansion, the Pockwock transmission main renewal along Kearney Lake Road, the new main on the MacDonald Bridge, the Northwest Arm sewer rehabilitation, the Beechville- Lakeside-Timberlea pipeline to transfer sewage to the Halifax sewer shed, and the implementation of advanced meter infrastructure.

- **Future Capital Demands** – The current water, wastewater and stormwater rates are insufficient to meet the capital needs for sustainable infrastructure as identified in the IRP. The IRP acknowledges that wastewater and stormwater assets have been grossly underfunded historically. Institutional capacity will have to increase over the term of this Business Plan in order to deliver the expected capital projects.

- **New Environmental Regulations** – Increased operating expenses will be incurred by Halifax Water as it conforms to wastewater regulations recently entrenched in the federal Fisheries Act related to the CCME municipal wastewater effluent strategy.

- **Increasing Energy and Chemical Costs** – electricity and chemical costs will continue to increase at a rate higher than inflation.

Although the previous business plan indicated a steep increase in capital spending to match the requirements of the IRP, which stipulated average annual investments of $131 million, this business plan presents a more gradual increase. This is in recognition of current economic conditions and to ensure customers do not experience rate shock. A rate smoothing strategy will be employed to keep annual increases in the single digit range. Capital budgets are anticipated to grow from $59.4 million in 2015/16 to $82.2 million in 2019/20. As capital budgets increase, the utility will see related increases in debt and depreciation expense, the key drivers for revenue requirements.

Over the course of the Business Plan, most operating expenses (excluding depreciation) are projected to be stable with annual increases tracking at or below the Halifax Consumer Price Index [CPI], with the exception of energy and chemical costs. To mitigate cost increases associated with energy and chemicals, Halifax Water has a formal energy management program more fully described in this document.

Over the next five years, Halifax Water will likely file three rate applications, including the November, 2014 application, for a single rate base (Urban Core/Satellite systems and Airport/Aerotech system). Overall annual revenues will need to increase approximately 25% above 2014/15 levels over the five-year period with the primary focus on the capital needs of wastewater and stormwater assets. Halifax Water is not alone in its quest for more sustainable funding. Unfortunately, wastewater and stormwater assets have been underfunded throughout North America, and other municipalities/utilities have made, or are making plans to increase rates. The projected rate increases associated with this business plan have been viewed in the context of customer affordability in relation to median household income (an industry benchmark) with proposed rates less than 1% of median household income. Where low income households experience difficulty with affordability, the utility is proposing to continue with the H20 (Help to Others) program to support these customers, with funding from unregulated activities.

Although significant growth is forecast within the span of the five-year plan, the recent Decision from the NSUARB on the Regional Development Charge ensures it is cost neutral to ratepayers, i.e., growth pays for growth.

Inherent in the business activities for Halifax Water is an obligation to provide value for customers as stewards of critical assets. To that end, the business plan highlights very formal programs to deliver efficient and effective service through Asset Management, Energy Management, and Wet Weather Management programs. The Wet Weather Management program, in particular, presents an opportunity to improve service delivery at a lower cost. A structured approach is in place, similar to the process used by the utility for water loss control. Halifax Water is recognized as a world leader in water loss control and the corporate goal is to put wet weather management in the same category.

2. INTRODUCTION

In accordance with sound management principles, Halifax Water has compiled a Five-Year Business Plan for the 2015/16 to 2019/20 period to incorporate the latest information to guide activities over the long term. With the completion of a COSM, IRP, and Debt Strategy, a sustainability framework is in place for future infrastructure investments and associated rate applications. With the framework entrenched, Halifax Water is now moving to the implementation plan, with a particular emphasis to increase capital investments as contemplated in the IRP, although at a more moderate pace. These investments are necessary for the renewal of aging infrastructure, compliance with new Federal wastewater system effluent regulations and new infrastructure to facilitate growth.

In recognition that the utility inherited a significant infrastructure deficit from Halifax municipality when it assumed responsibility for wastewater and stormwater assets in 2007, and the new Wastewater Systems Effluent Regulations (WSER) are legal requirements, future rate increases are inevitable. These rate increases must follow the principle of gradualism to balance rate shock and affordability to customers. Accordingly, Halifax Water will attempt to implement its infrastructure investments with a smoothing strategy in mind. In conformance with the Public Utilities Act, all of these collective investments and associated funding must be based on cost causation principles and occur within the context of intergenerational equity.

The last five years were particularly challenging and rewarding for Halifax Water with the integration of water, wastewater, and stormwater service delivery. In conjunction with the establishment of a sustainability framework, many key projects were advanced with a theme of asset renewal, environmental compliance and facilitation of growth. In particular, the construction of the Eastern Passage Wastewater Treatment Facility was completed in 2014, and the diversion of sewage from the Beechville, Lakeside, Timberlea sewershed to the Halifax sewershed is well underway, with completion anticipated in 2015.

On the water side, 2014 saw the continuation of the renewal of the Pockwock transmission main along Kearney Lake Road, with an anticipated completion date of December, 2014, achieving the objective of rehabilitating a problematic section of main. Several stormwater projects are also underway in partnership with Halifax municipality, recognizing the complex and multi-jurisdictional responsibilities for this service. The next five years will see continued growth in capital investment, including the expansion and upgrade of the Aerotech Wastewater Treatment Facility during the 2015/16 and 2016/17 fiscal years. It is anticipated that this project will benefit from funding associated with the Canadian Building Fund to minimize the impact on Halifax Water's rate base.

Although construction of capital projects can be challenging, a bigger challenge will be to further convince customers that protection of the environment is critical to our society, local economy, and quality of life. We must continue with corrective action to not only upgrade deteriorating infrastructure and achieve compliance with regulations, but mitigate

and adapt to climate change. Recent research indicates that climate change is accelerating, as evidenced by projections of sea level rise, more intense storm events, and changing precipitation patterns.

Based on a new COSM, Halifax Water received approval from the NSUARB for rate increases in 2013 and 2014, for both the Urban Core and Airport/Aerotech systems. In addition, Halifax Water received a positive decision from the NSUARB on its application for a Regional Development Charge, which ensures that growth pays for growth, in line with the principles of the Public Utilities Act. Halifax Water will be submitting a rate application in November, 2014 for the Urban Core system, which will include consolidation of the Airport/Aerotech system, in line with recent directives from the NSUARB. The rate application will cover a two year test period with a public hearing scheduled for February 23 to 27, 2015.

3. CURRENT RATE STRUCTURES

Halifax Water currently has two separate rate structures as approved by the NSUARB: 1) the Urban Core and Satellite systems; and 2) the Airport/Aerotech system. In the June 28, 2012 Decision for the Airport/Aerotech system (NSUARB-W-HRWC-R-12[3]) the NSUARB directed Halifax Water to consider a combined Urban Core & Airport/Aerotech rate structure for submission by January 31, 2013. Subsequent to the January 9, 2013 rate application, the issue of consolidation of the Airport/Aerotech system was severed from the April 2013 hearing process with a separate hearing scheduled for November, 2013. The hearing was stayed as Halifax Water and Halifax International Airport Association (HIAA) agreed to pursue a settlement agreement. In June 2014, Halifax Water and HIAA filed a joint application for the consolidation of the Airport/Aerotech system with the Urban Core & Satellite system based on a settlement agreement. A recent Decision and Order from the NSUARB approved the consolidation and related settlement agreement. Effective April 1, 2015 there will be one rate structure and one set of Rules and Regulations for Halifax Water. The existing rate structures are discussed below. The proposed combined rate structure is discussed in Section 4 – Cost of Service/Rate Design.

3.1 Urban Core & Satellite Systems

The Urban Core and Satellite systems have had one uniform rate structure for water service since May 1, 2006, when the Nova Scotia Utility and Review Board rendered a decision to harmonize the rate structure.

The existing rates for water service consist of a base and consumption charge. The base charge varies by meter size and ranges from $36.00 per quarter for a 15 mm (5/8") dia. meter to $1,559.00 per month for a 250 mm (10") dia. meter. Consumption charges are $0.731 per cubic metre ($m^3$). The water-rate structure also provides for a fire-protection

charge that is billed annually to Halifax municipality based on a formula approved by the NSUARB. For 2014/15, this amounts to $8,952,880.

In 2007, wastewater and stormwater services were transferred to Halifax Water from Halifax municipality. The rate structure has evolved from those previously levied by the regional municipality, to separate cost of service based rates for wastewater and stormwater service.

The current wastewater rates, like the water rates, incorporate a base charge that varies by meter size and consumption as measured by the water meter. The current charges include a base charge that varies from $39.00 per quarter for a 5/8" dia. meter to $1,903.00 per month for the 10" dia. meter, and a discharge rate of $1.658 per m^3.

For unmetered customers, where there is no meter to measure consumption, the charge is based on the average usage for customers in a similar rate class. Approximately 0.4% of water customers are unmetered, and 1.6% of wastewater customers are unmetered. The issue of appropriateness of the rate and billing process for unmetered customers was raised as part of the Cost of Service/Rate Design hearing in November 2011. The NSUARB addressed this issue in their Order dated January 16, 2012 and confirmed that the use of averaging in the absence of meters is an accepted ratemaking practice.

3.2 Airport/Aerotech System

The NSUARB in its previous decisions on the water and wastewater/stormwater rate applications ordered that the Airport/Aerotech water, wastewater, and stormwater systems be recognized as stand-alone systems and have their own rate structure. In the most recent Aerotech rate hearing in 2012, the NSUARB included in their Order, that Halifax Water was to file a rate application on or before January 31, 2013, with consideration given to consolidating both the Urban Core and Airport/Aerotech systems into one rate structure.

In January 2013, Halifax Water filed a rate application that reflected consolidation of the Airport/Aerotech System with the Urban Core System. The issue of consolidation was severed from the process, and through 2013 and 2014 Halifax Water has worked with HIAA and Halifax municipality to reach agreement on terms and conditions for consolidation of the Airport/Aerotech System with the Urban Core. A Settlement Agreement was approved by the HIAA Board, the Halifax Water Board, and Halifax Council in June 2014, and then submitted to the NSUARB for approval. The Decision approving the consolidation was received on October 31, 2014. The current rates for the Airport/Aerotech system will remain in place until March 31, 2015, and the Urban Core rates will take effect on April 1, 2015.

The existing charges for water service vary by meter size and range from $30.64 per month for a 15 mm (5/8") diameter meter to $598.09 per month for a 100 mm (10") diameter meter. The consumption charge for water service is $1.921 per m^3. The water-rate structure also provides for a fire-protection charge based on a formula approved by the NSUARB. For 2013/14, this amounts to $192,890.

The rates for wastewater services also consist of a base and consumption charge. The base charge varies by meter size and ranges from $16.59 per month for a 15 mm (5/8") diameter meter to $414.60 per month for a 100 mm (10") diameter meter. The consumption charge for wastewater service is $2.290 per m^3.

3.3 Regional Development Charge

The Halifax Water Regional Development Charge (RDC) is a fee payable at the building permit stage of a new development to fund regional water and wastewater infrastructure expansion requirements related to growth. The fee model provides fairness across the rate base, and helps ensure current customers do not subsidize new growth and development.

The Application for the Regional Development Charge (RDC) was presented to the Nova Scotia Utility and Review Board (NSUARB) on July 26, 2013. A Hearing in support of the Application was held December 2 to 5, 2013. Subsequent to the Decision, Halifax Water prepared and submitted the required compliance filings to the NSUARB. During this same time frame, Halifax Water staff worked with Halifax municipal staff to develop and implement the required enhancements to the municipal building permit process to collect the new charges. On July 9, 2014, the NSUARB approved the formal Order whereby the revised Schedule of Rates, Rules and Regulations for Water, Wastewater and Stormwater (that include the new RDC rates) were adopted by the NSUARB effective July 14, 2014. There are currently different RDC rates for the Urban Core and Satellite Systems and the Airport/Aerotech system. Due to NSUARB approval of the consolidation of the Airport/Aerotech system effective April 1st, Halifax Water's proposed Regulations in the next Rate Application will reflect a combined RDC.

Money collected from the RDC will fund the upgrades and improvements to the regional wastewater and water systems that are required to accommodate growth anticipated within the Halifax municipality's Regional Plan. The latest growth related costs are estimated at $521 million, based on a 30 year growth horizon. Through the application process with the NSUARB, and input from Interveners, the growth horizon, and subsequently the Infrastructure Master Plans were reduced to a 20 year growth horizon. The approved RDC reflected that change.

With the NSUARB Order, staff are committed to update the RDC on a 5 year cycle, or mid-cycle if any of the assumptions used in determining the RDC impact the value of the charge by +/- 15%. As well, staff will be initiating a more formalized Stakeholder Consultation as

detailed Infrastructure Plans are developed to implement the projects identified within the Wastewater and Water Infrastructure Master Plans.

The first Infrastructure Plan for the West Region commenced in the winter of 2014. Staff will use the outcomes from this study as inputs to the first 5 year update to the Regional Development Charge.

4. COST OF SERVICE/RATE DESIGN

As part of the December 2010 rate Decision, the NSUARB directed a stand-alone Cost of Service and Rate Design proceeding be conducted prior to the next rate application. The current NSUARB *Water Utility Accounting and Reporting Handbook* pertains to water utilities and does not provide guidance with respect to rate design for wastewater or stormwater. In May 2011, Halifax Water submitted an application for approval of a Cost of Service/Rate Design, and the hearing was held on November 21, 2011. Prior to the hearing, Halifax Water signed a settlement agreement with the Consumer Advocate and Income Property Owners' Association of NS. At the hearing on November 21, 2011, Halifax Water recommended that the settlement be approved by the NSUARB. The settlement indicated that the parties accepted the AWWA and WEF based methodologies for cost of service/rate design with future activities to occur. A decision by the NSUARB was rendered on January 16, 2012[1] with the following pertinent directives

[33] The Board has considered the evidence in the proceeding, including the Settlement Agreement and submissions by the parties, and is satisfied that the Settlement Agreement is in the public interest. The Board approves the Settlement Agreement as filed.

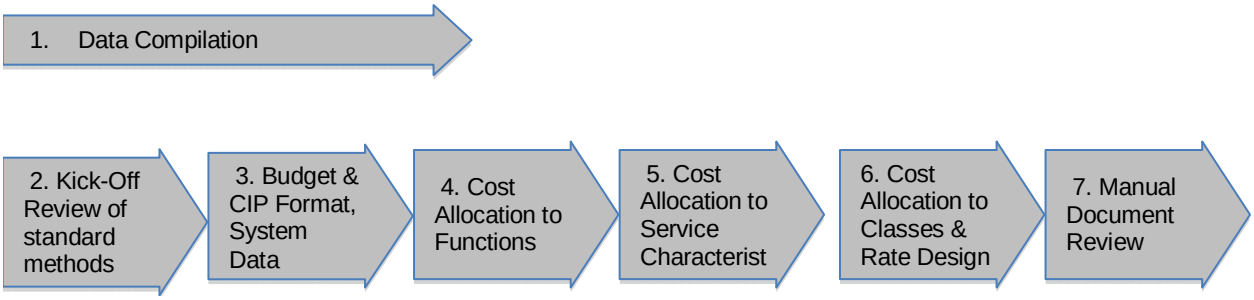
[34] HRWC, in accordance with the Settlement Agreement, and in collaboration with the Interveners, is to prepare a Cost of Service Manual which will be submitted to the Board for approval. The Board orders HRWC to complete this manual no later than August 30, 2012 and provide a schedule to achieve this deadline by January 30, 2012.

The Terms of Reference for development of the Cost-of-Service (COS) Manual were approved on February 17, 2012. The timeline was altered as a result of the NSUARB Decision regarding Halifax Water's Airport/Aerotech Rate Application. In this decision, the NSUARB directed Halifax Water to submit a Rate Application for consideration of a combined Urban Core & Airport/Aerotech system by January 31, 2013. As a result of this direction, the COS Manual deadline was extended to October 31, 2012 to permit inclusion of the Airport/Aerotech system.

[1] NSUARB-W-R-11 2012 NSUARB 9

The COS Manual was developed through a seven-step process highlighted by engagement with interested parties, including prior rate case interveners and the NSUARB. This process is illustrated below and is aligned with the cost allocation processes outlined in industry standard manuals of practice:

Figure 4.1 – Cost Allocation Process



Stakeholder consultation meetings were held in 2012 and feedback from stakeholders was accepted throughout the process, resulting in many changes and improvements in the final product. The COS Manual was filed with the NSUARB on October 31, 2012, and accepted in the June, 2013 NSUARB Rate Decision.

The Cost of Service/Rate Design is based on American Water Works Association (AWWA)/Water Environment Federation (WEF) best practice frameworks. The AWWA/WEF Framework achieves a substantial improvement over the existing rate structure in terms of fairness, defensibility, and relationship to costs. Additionally, because cost allocations are tailored to reflect system characteristics, the approach is adaptable to changing circumstances. This model is more complex than the previous rate design, however it is appropriate given the fact that Halifax Water's operations are increasingly complex and a cost of service and rate design are required that can adapt in response to change, and allocate costs in a fair and equitable manner.

It is important to note that when this framework was implemented a slightly higher percentage of Halifax Water's revenues came from volumetric charges versus base charges. This sends a pricing signal promoting conservation of water and operational efficiency, but places increased pressure on the utility and the NSUARB to recognize and respond to trends in declining consumption.

The Cost of Service/Rate Design methodology does not result in increased revenue for Halifax Water, but it does cause shifts in the rates between various types of customers and services. The Cost of Service/Rate Design will provide a solid foundation for future rate applications.

WATER

The cost of service/rate design model for water is based on the AWWA framework as it is the most defendable from the perspective of cost causation, promotes fairness and equity, is widely accepted, and will be adaptable on a go-forward basis to changes in the way the utility operates. There is a single volumetric charge for water customers based on consumption, base charges that will vary by meter size, and a customer charge that will be levied to all customers.

With respect to public fire protection, costs will be recovered from Halifax municipality. Private fire protection is treated as a separate and distinct additional service. Private fire-protection costs are extrapolated from public fire-protection costs based on the cost of serving a single hydrant and recognition of a pipe-size/capacity relationship.

WASTEWATER

The cost of service/rate design model for wastewater is a hybrid WEF framework with recognition and allocation of the costs of handling and treating inflow and infiltration (I&I) between the volumetric charge and the customer/base charge with 10% of the I&I-related costs allocated to flow (volumetric charge), 45% to meter-equivalent charge, and 45% to the customer charge.

This option produces the strongest alignment with actual cost causation and is felt to be the most fair and equitable of the models. It acknowledges that some portion of the I&I (10%) is related to faulty joints in the network including manholes, which allow flow to enter the system regardless of the number of customers connected. The second allocation of I&I to the meter-equivalent charge (45%) relates to the increased water consumed (and discharged) by larger-diameter meters resulting in more flow in the wastewater system and requiring larger-diameter pipes, which increase the risk of leakage due to the increased surface area of joints in larger pipes. The final allocation to customer connections (45%) relates to leakage that is associated with connections between the service pipe and Halifax Water's collection network, and the potential for the customer to discharge other flows from sump pumps and roof drains to the system.

There is a single volumetric charge for wastewater customers for discharge, which is based on consumption, a base charge that will vary by metre size, and a customer charge that will be levied to all customers. The cost of service/ rate design also supports the continued use of an extra-strength surcharge. Under the recommended methodology for wastewater, a slightly higher portion of costs are attributed to the extra-strength surcharge than have historically been included due to the inclusion of capital and debt-servicing costs.

STORMWATER

The cost of service rate design for stormwater is based on the principles of the AWWA/WEF framework and billed as a two-part charge: a right-of-way portion and a site-generated portion with some exemptions and rebates to recognize properties that do not drain into Halifax Water's system.

This model recognizes that roughly 30% of the stormwater originates from the street area with the remainder (70%) originating from the adjoining properties. This division has been used to calculate the portion of the costs relating to each service. Customers who can demonstrate they do not discharge into the Halifax Water system can apply for an exemption.

The model is in keeping with the same fundamental principles and cost allocation approaches for water and wastewater. Separation of stormwater charges from wastewater charges will increase transparency with utility customers, provide more adaptability on a go-forward basis, and best meet the objectives of fair and equitable cost allocations.

5. WASTEWATER SYSTEM EFFLUENT REGULATIONS

The final Wastewater Systems Effluent Regulations (WSER) were released in June 2012. These regulations, made under the Fisheries Act, implement those aspects of the CCME Strategy for the Management of Municipal Wastewater Effluent which fall under federal jurisdiction, namely the discharge of deleterious substances to fish habitat. The WSER define the following as deleterious substances, and set national standards for their discharge: Carbonaceous Biochemical Oxygen Demand (CBOD) – 25 mg/L; Total Suspended Solids (TSS) – 25 mg/L; Total Residual Chlorine (TRC – for those facilities using chlorine for disinfection) – 0.02 mg/L; and un-ionized ammonia – 1.25 mg/L as Nitrogen, at $15^0C \pm 1^0C$.

Wastewater treatment facilities (WWTFs) are authorized to discharge these substances at levels below the defined limits, provided that the effluent is not acutely lethal to trout as determined by standard toxicity testing. Facilities not in compliance must apply for a Transitional Authorization (TA) to deposit effluent exceeding those limits. The Authorization will be valid for a period of 10, 20 or 30 years, depending on the risk level associated with the effluent, as determined by a defined risk-ranking system in the WSER.

Halifax Water has submitted applications for TAs for the Halifax and Dartmouth WWTFs, and is awaiting a decision on these applications. Both Halifax and Dartmouth WWTFs are medium risk, and would normally have 20 years (from 2010) to achieve compliance. However, both of these systems have Combined Sewer Overflows (CSOs) which are higher risk than the WWTFs. The WSER provides that for systems having at least one CSO which is higher risk than the WWTF, the compliance period for high or medium risk facilities may

be extended from 10 or 20 years respectively, to 30 years to upgrade the WWTF. Combined sewer overflow discharges must also be reduced beginning in 2040, after the TA has expired. Although there are no further details in the WSER regarding the reduction, such as extent of and timing, Environment Canada staff have indicated in correspondence that "a significant reduction … must be achieved immediately after the TA's expiry date".

Well before 2040, Halifax Water will need to begin planning and design, and allocate funding, to reduce CSO discharges. This will require early identification of reduction mechanisms, and construction of such mechanisms, so that they will be in place prior to 2040.

Wastewater treatment facilities having effluent which is acutely lethal due to un-ionized ammonia must apply for a *Temporary Authorization to Deposit Un-ionized Ammonia*. Such Authorizations are valid for three years, and may be renewed. Effluent which is acutely lethal due to substances other than un-ionized ammonia is not authorized under the WSER, and is in contravention of the Fisheries Act. No Halifax Water facility to date has had toxicity due to un-ionized ammonia in the treated effluent. Instances of toxicity detection have been due to chlorine levels (where chlorine is used as a disinfectant), or are unknown at this time, and are under investigation. The occurrence of pH drift during the tests may be a factor, and a pH-stabilized version of the toxicity test may be required. WWTFs using chlorine (Lakeside-Timberlea, Frame, Springfield) will need to provide for de-chlorination prior to discharge, or switch to UV disinfection.

As required under the WSER, an Identification Report was submitted by May 15, 2013 for each WWTF, documenting various data and information including the location of all overflow points. In addition, for those systems which include CSOs, an Overflow Report is submitted by Feb. 15 of each calendar year for the prior year, beginning Feb. 15 of 2014 for the 2013 calendar year. The report must document the occurrence, duration and measured or estimated volume of each CSO event. Halifax Water is able to calculate overflow event volumes for most CSO locations using data from in-situ water level sensors. Volumes for older CSOs on the North-West Arm without such sensors may be estimated using modeling. Environment Canada has confirmed that hydraulic modeling results are acceptable as CSO volume estimates.

During 2013/14, Halifax Water entered into a Compliance Agreement with Oland Brewery reflecting construction of a pre-treatment facility by 2016 that will eliminate extra-strength discharges and enhance compliance at the Halifax WWTF.

The WSER also requires annual or quarterly (depending on WWTF size) Monitoring Reports for each WWTF, documenting the daily effluent volume and the concentrations of CBOD, TSS, and un-ionized ammonia. These reports have all been submitted as required by the WSER, beginning at the start of 2013.

6. FINANCIAL PROGRAMS & PRO FORMA BUDGETS

6.1 Capital Program

6.1.1 Asset Management Program

Halifax Water completed the Asset Management Assessment (AMA) in 2011 that outlined a series of initiatives to advance the asset management (AM) program. These initiatives are referred to as the Asset Management Roadmap. Implementation was anticipated to occur over several years. The first phase of the Asset Management Roadmap Implementation (AMRI) was undertaken in 2013/14 and provided a range of 'building block' activities upon which the remainder of the AM program will be structured. The AMRI Phase 1 activities included:

AM Governance Review – confirm Halifax Water's AM governance model and organizational structure necessary to support the AM program.

Institutional Capacity Assessment – review Halifax Water's ability to deliver the existing and proposed programs identified in the Integrated Resource Plan in addition to the increased capital program.

Business Process Mapping Inventory – list a range of business processes throughout the organization requiring mapping or revisions and carry out sample process mapping for several key processes.

Level of Service Review – compare range of initiatives in or anticipated to be in place involving performance measurement and reporting to identify overlaps and highlight areas requiring enhancement.
Condition Assessment Development – review industry standards and the current Halifax Water approach to develop a simplified, consistent condition assessment methodology across the asset classes.

CMMS Vision Confirmation – in coordination with efforts underway by Halifax municipality, confirm the Halifax Water vision for implementing a Computerized Maintenance Management System (CMMS).

Several of the AMRI program priorities that are currently underway will continue in 2015/16, 2016/17 and into future years (depending on the initiative). These include:

- Develop and implement asset management plans (AMPs) by major asset classes using the standardized condition assessment method (developed during AMRI – Phase 1). This is an ongoing condition assessment and asset renewal plan being implemented over several years on an asset class basis.

- Develop a Technology Master Plan/policy and an integrated technology solution (IS led initiative with participation by AM Team).
- Select and implement additional core technology systems (IS led initiative with participation by AM Team). This initiative includes technology solutions such as CMMS, SharePoint, and a future electronic document management system.
- Expand and complete the existing GIS asset mapping and asset attribute information (GIS led initiative with participation by AM Team). This important ongoing initiative will provide the foundation for relating asset management data to geographic information and enable specific analysis for basing renewal, replacement, or enhanced operations and maintenance decisions for Halifax Water's assets.
- Enhance existing project delivery and project management guidelines (Infrastructure Team led initiative). This initiative continues to improve the tools and templates that provide Halifax Water's standards for corporate project management.

AMRI key projects planned to start in fiscal 2015/16 include:

Develop AM Policies for Corporate Strategic Plan – this initiative will involve examining how AM initiatives can be incorporated into the annual strategic business planning process. Over time, this may guide the development of departmental strategic plans where AM strategies can be embedded.

Expand Existing Risk-Based Decision Model for Asset Renewal/Replacement – enhancing the risk-based framework, Halifax Water will be able to assess the probability that assets would fail to meet performance standards and the consequence on levels of service if failure occurs. This evaluation model will influence prioritization of projects/initiatives for consideration in the capital program.

Establish AM Procedures and Standards – building on previous initiatives that developed AM work processes and technology enablers, this activity will develop a library of asset management tools, templates, and standards. It will include developing the workflow for creating and managing AM standards/documents and deploying them for corporate use.

The AMRI implementation program is highlighted in Table 6.1.

Table 6.1 – Asset Management Roadmap Implementation Initiatives

AMRI Initiatives	Ongoing Priority	2015/16 Priority	2016/17 Priority	Future Priority	Est. Cost (1,000s)
Map Business Processes					$160
Develop IFRS Processes					$70
Implement AM Governance					$100
Develop Level of Service Framework					$165
Develop AM Policies for Corporate Strategic Plan					$30
Expand Existing Risk-Based Decision Model for Asset Renewal/Replacement					$110
Establish AM Procedures and Standards					$130
Develop and implement a People Skills & Competency Master Plan					$60
Develop a business case evaluation (BCE) framework					$60
Develop and implement a multi-criteria attribute analysis (MCAA) tool					$90
Develop an effective knowledge management practice for assets					$90
Develop and implement a strategic maintenance management program †					$115
Focus on efficiency and practice improvements					$60
Implement a quality management and audit process					$115
Enhance existing performance management program					$170

Ongoing or continuing tasks (started in previous years)

Tasks for 2015/16 (start or continue)

Tasks for 2016/17 or future years (start or continue)

† Deferred from 2014/15 activities pending implementation of CMMS

Including current budget amounts, the estimated remaining cost of the AMRI is $1,525,000 over the five year plan. The continued growth of the Asset Management program will require increased investment in financial and human resources to meet corporate goals. Current activities are centered on developing framework elements and collecting data. As the frameworks are established and the data compiled, the AM team will need to move into a mode of "driving decisions". This forms part of the larger AM program and the associated activities.

The AM Team has initiated several condition assessment and asset renewal projects beginning with the Wastewater Treatment Facility (WWTF) Condition and Performance

Assessment project. These projects are intended to develop the asset lists for each facility, assess the asset's condition and performance, calculate the remaining asset life, and use the collected information to develop the asset renewal program. Other projects underway are for wastewater pumping stations, wastewater/stormwater sewers (annual program), and for stormwater culverts. Over the next few years, additional projects will be initiated. Specifically for the 2015/16 fiscal year, projects for wastewater forcemains, water pumping stations, water chambers, and water transmission mains are planned. The wastewater/stormwater sewer program is an annual program that will include zoom camera inspections, closed circuit television (CCTV) inspection of main lines, and data extraction from historical CCTV inspections. This annual condition assessment program will be coordinated with other corporate needs including the Wet Weather Management Program, integrated capital program (with Halifax municipality), and Operations driven programs.

Table 6.2 – Condition Assessment Projects

Condition Assessment Projects	Ongoing Priority	2015/16 Priority	2016/17 Priority	Future Priority	Est. Cost (1,000s)
Wastewater Treatment Facility Condition & Performance Assessment					$400
Wastewater Pumping Station Condition and Performance Assessment					$600
Culvert Inventory and Condition Assessment					$325
Sewer Condition Assessment ‡					$650
Forcemain Condition Assessment					$185
Water Pumping Station Condition Assessment					$145
Water Pressure Control & Meter Chamber Condition Assessment					$325
Water Transmission Main Condition Assessment					$185
Condition Assessment of Remaining Asset Classes					tbd

Total: $2,815

Ongoing or continuing tasks (started in previous years)

Tasks for 2015/16 (start or continue)

Tasks for 2016/17 or future years (start or continue)

‡ This is an annual program with expected expenditures of approximately $650,000 per year depending upon priorities.

As indicated in Table 6.2, this results in an estimated $2,815,000 program initially. Note that the condition assessment program will be undertaken for most major asset classes over several years. The intention is to create sustainable processes for ongoing condition assessment activities that can be embedded into operational programs and the CMMS for

simplicity. The AM Team would continue to analyze data and information using the CMMS and validation by Operations personnel.

Specific asset management software or tools that can improve data management and decision making are available in the industry. However, Halifax Water needs to ensure that they are introduced at the appropriate point in the program evolution. Sufficient data must be collected to realize the benefits of using the tools. Therefore, AM staff will need to assess the suitability of the tools and software and the associated benefits, costs, and effort.

AM staff are involved in several projects being led by other departments. As participants, staff are engaged in a variety of activities to support these projects with a range of level of effort. Some of these projects and the respective level of effort from the AM Team include: Asset Registry Project (60%), CMMS Implementation (15%), Asset Accounting (10%), SharePoint Implementation (10%), and Halifax municipality's Enterprise Asset Management (EAM) Coordination (5%).

Halifax Water is implementing an Asset Accounting Module in SAP in November, 2016. Another key program area for the AM Team is long term planning including infrastructure system modeling. Halifax Water established the long term planning framework and identified how the first round of infrastructure plans originating from the Integrated Resource Plan (IRP) and the Regional Wastewater Functional Plan (RWWFP) would be undertaken. With confirmation of ownership for the overall long term planning function, the AM Team will develop interactions and coordination with Halifax municipal staff, and identify resourcing to meet the program needs.

Table 6.3 – Long Term Planning Projects & Activities

Long Term Planning Projects/Activities	Ongoing Priority	2015/16 Priority	2016/17 Priority	Future Priority	Est. Cost (1,000s)
West Region Wastewater Infrastructure Plan					$730
Mill Cove Wastewater Infrastructure Plan					$350
Long Term Planning Coordination Strategy					$200
Assess Modeling Tools					$40
Water and Wastewater Master Plan §					$950
				Total:	**$2,270**

Ongoing or continuing tasks (started in previous years)

Tasks for 2015/16 (start or continue)

Tasks for 2016/17 or future years (start or continue)

§ This is expected to commence in Q4 of 2015/16 with the majority of the expenditures happening in 2016/17 and finish in 2017/18.

As indicated in Table 6.3, these initial investments represent expenditures of approximately $2,270,000. Long term plans are the norm for Halifax Water and will require

periodic updates (typically undertaken on a five year cycle and coordinated with Regional Plan updates). Efforts to streamline the various 'levels' of planning (e.g. IRP, water and wastewater regional master plans, sewershed-based infrastructure plans, etc.) will be vital to the success and integrity of the process. In addition to the items noted in Table 6.3, the AM Team will be involved in activities aimed at improving the overall long term planning processes for the benefit of both Halifax Water and Halifax municipality. These activities include: building out the modeling program, undertaking infrastructure system modeling (typically in conjunction with a master or infrastructure planning initiative), and enhancing Halifax Water's planning coordination with the Halifax municipality

6.1.2 Five-Year Capital Budget – General Overview

As part of the utility's overall mission, the annual capital budget provides funds for the acquisition, replacement, or rehabilitation of capital assets. Capital assets include all equipment; facilities; and linear infrastructures that have an asset value that exceeds $5,000 and a useful life that exceeds one year. The capital budget funding and subsequent project delivery help ensure that services are provided in a cost-effective and efficient manner with a focus on long-term integrity of systems.

As discussed in Section 6.1.1, the development of the annual and long-term capital budget has its foundation with the Engineering & IS department's core Asset Management program. This program organizes, evaluates, and prioritizes all infrastructures by individual asset class. The core asset-class priorities are reviewed and coordinated with staff from Engineering & IS and Operations departments to identify the highest-priority projects. These projects are further reviewed with technical staff from the municipality's Transportation and Public Works group to review integration opportunities with the proposed Streets Program. A detailed overview of the major projects within the proposed five-year capital budget is provided in Section 6.1.3.

In addition to the core infrastructure projects within the capital budget, employees from all departments define annual capital-equipment requirements to meet their operational mandates. These include equipment classes such as fleet, large tools, computer equipment, and consumption meters.

The capital budget is funded from a variety of sources. The core funding is from capital-asset depreciation accounts and long-term debt. This core funding is enhanced with regional development charges, external grants, and operating surplus, when available. The base funding amount for capital projects from depreciation increases on an annual basis as the underlying capital-asset value increases.

The historical overall level of capital funding is well below requirements relative to current infrastructure deficiencies and projected long-term sustainable requirements. The required increase in capital infrastructure investments is defined in detail within the Integrated Resource Plan (IRP) that was filed with the NSUARB in October 2012. The proposed five

year capital budget shows a transition from historical spending levels towards the level recommended within the IRP. A transitional period allows for the development of institutional capacity to deliver the increased volume of projects, increased funding, and enhanced Asset Management protocols to identify and prioritize specific projects.

With limited available funds for capital projects, the prioritization process focuses on projects with legal and legislative compliance issues, and projects with the largest impact on maintaining defined levels of service with existing customers.

The formal infrastructure projects within the capital budget are delivered by the Project Management Team within Engineering & IS. The group of project managers and their technical staff utilize a standard project management approach to consistently deliver the planning, design, construction, and commissioning phases of each project.

The proposed five year capital budget for 2015/16 to 2019/20 integrates the capital requirements of the Airport/Aerotech water and wastewater system into the overall Halifax Water capital budget consistent with the proposed integration of the rate structure for the Airport/Aerotech customers into the Urban Core rate structure.

The full five-year capital budget for the Urban Core system is shown in Appendix E. The year-one (2015/2016) budget has a total project value of $20,242,000 for water, $33,086,000 for wastewater, and $6,045,000 for stormwater, with a five-year total project value of $97,771,000 for water, $222,926,000 for wastewater, and $41,684,000 for stormwater.

6.1.3 Major Projects

Integrated Capital Projects:

Project: Halifax Water Infrastructure Renewal Integrated with Halifax municipality Street Renewal Program

Asset Class: Water Distribution, Wastewater and Stormwater Collection

Description: This program involves the renewal of water distribution, wastewater collection and stormwater collection infrastructure in an integrated approach with the municipality's annual Street renewal program. Water, wastewater and stormwater pipes and appurtenances are replaced or rehabilitated when approaching or exceeding their useful life cost effectively while the host municipal street is being renewed. The integrated program reduces the total project cost and minimizes the overall disturbance on community neighbourhoods. Halifax Water's planned expenditures on this program are approximately $6M per year.

Water Capital Projects:

Project: Lake Major Dam Replacement

Asset Class: Water – Structures

Description: The project involves the design and construction of a new dam to replace the existing dam. The 2012 Dam Safety Review completed by Meco Engineering identified a number a problems with the existing dam. The recommended remedial action is the replacement of the dam.

Part of the scope of the work will be to carry out a detailed hydraulic and hydrologic study of the Lake Major and East Lake watershed in order to optimize the new dam for the long term needs. The scope will also involve identifying the preferred location, size and type of a dam structure.

MECO Engineering was awarded the conceptual design phase of the project and the work is underway. This is anticipated as a three year project. The design and approvals phase of the work will take approximately 24 months. It is anticipated that construction will begin in 2017.

The estimated cost of the project is $4,100,000. A detailed project cost estimate will be prepared as part of the design phase for this work.

Project: Macdonald Bridge Transmission Main Replacement

Asset Class: Water – Transmission Main

Description: Halifax Harbour Bridges is currently planning for the full replacement of the Macdonald Bridge deck in 2015/16 and 2016/17. The work is planned so that individual structural span sections will be removed and replaced overnight allowing the bridge to be kept open during the day. The projected cost of this work is approximately $150,000,000.

There is an existing 600mm diameter steel transmission main located on the MacDonald Bridge. The planned bridge deck replacement will require the removal and replacement of the existing water transmission main.

The design consultant has determined that the most cost-effective method to complete the water main work is to remove and abandon the old main and reinstall a new main in conjunction with the deck replacement. Approximately 730 metres of the total 1590 metres of pipe will need to be replaced. The rest of the transmission main on the fixed portions of the bridge span and approaches will remain in place.

The estimated cost of the Transmission Main replacement work is $7,500,000. The project costs will be spread over two budget years; 2015/16 and 2016/17. In accordance with the NSUARB ruling on July 24, 2014, Halifax Water is responsible for the full capital cost of the watermain replacement.

Project: Lucasville Road Transmission Main

Asset Class: Water – Transmission Main

Description: Halifax Water is working to construct a new 600 mm diameter transmission main from the Pockwock Transmission Main to the Sackville-Beaverbank area to help address emergency back-up water supply capacity/redundancy issues. This new main would be roughly parallel to the Lucasville Road and extend to the Beaver Bank Road near the railway crossing. It is anticipated that the transmission main will be partially installed through cost sharing/oversizing of mains in new development areas. The overall cost estimate for this project is approximately $11,000,000. Design and construction is underway. The work would extend over approximately 8-10 years as development opportunities progress.

Project: Bedford South Reservoir

Asset Class: Water – Structures

Description: The Bedford South Reservoir was originally identified in the Bedford South Water Master Plan. Subsequent water master plans for the Birch Cove North area and the Bedford West development area are based on the provision of the Bedford South reservoir as well. The Bedford South reservoir is to be located on an existing prepared rock pad located within the Royal Hemlocks development. The construction of the Bedford South Reservoir is funded through the Capital Cost Contribution (CCC) program established for the surrounding development areas.

The plan is to carry out the detailed design in 2016/17 and construct the tank in 2017/18, provided the transmission main connection has been completed along Starboard Drive.

Project: Burnside - Bedford Connector Transmission Main

Asset Class: Water – Transmission Main

Description: Halifax Water is planning for the interconnection of the Pockwock (Bedford/Sackville) system with the Lake Major (Burnside) system in conjunction with the anticipated Highway Connector project and development of the Anderson Lake area. This will help address back-up water supply capacity/redundancy for each system. The planned pipe size for the transmission main is 600mm diameter.

The project scope includes the installation of a new 600mm dia. line along a new corridor between Akerley Drive and Rocky Lake Road. The approximate length of the new transmission main to be constructed is 5 kilometers. The estimated cost of the transmission main project is approximately $7,800,000. The project is still in the concept design stage.

The timing of this project is not clear. It is anticipated that initial contract phases of construction could begin in 2015. It is anticipated that Halifax Water would cost-share with the Nova Scotia Transportation and Infrastructure Renewal (NSTIR) on the blasting/trench rock removal along a future transmission main corridor alignment when the mass earth-works contract proceeds. It is anticipated that the actual design and installation of the transmission main could be deferred for several years subject to budget priority and co-ordination with NSTIR and Halifax municipality for a trail corridor.

Project: J.D. Kline Water Supply Plant

Asset Class: Water – Treatment Facilities

Description: The J.D. Kline Water Supply Plant was commissioned in 1977 to service the City of Halifax, Town of Bedford, and parts of Halifax County. Due to the age of the facility, process equipment is nearing the end of its useful life. As well, certain treatment technologies from 30 years ago no longer meet current standards.

Filter Media Replacement

The J.D. Kline Water Supply Plant has eight granular media filters. The filter columns are comprised of ceramic underdrain tile, gravel, sand and anthracite. During the winter of 2013, the ceramic underdrain for one of the filters failed, which puts the filter out of service until a new underdrain system is installed and new media is placed in the filter.

AECOM consultants recently completed a filtration assessment study for the J D Kline WSP. The study provided recommendations with respect to the replacement strategy for the filter media and under drains. The plan is to replace the eight filters at an estimated cost of $2.1 million, over a five year timeframe in order to spread out the capital costs.

Aluminum Reduction in the Process Wastewater

The process wastewater at the J.D. Kline Water Supply Plant has high levels of aluminum due to the nature of the chemical used for coagulation. Process wastewater from the facility is directed to a series of lagoons behind the facility. The majority of the solids settle out while the liquid portion is discharged and flows overland to Hamilton Pond and ultimately into Little Pockwock Lake. Monitoring at the outlet of Hamilton Pond shows that aluminum levels exceed recommended guidelines and Nova Scotia Environment has requested a plan to deal with the elevated levels of aluminum.

Prior to submitting a plan to Nova Scotia Environment, a concept-level study was undertaken. It was determined that either an engineered wetland or mechanical-separation technology would be suitable to reduce aluminum levels. A pre-design study is

now under way investigating these options. Based on the results of the pre-design study, the best option will be selected for design and construction. It is estimated that a solution will cost in the order of $2,700,000 and the project will be undertaken in 2017/18.

Replace the CO2 Feeders

The existing Carbon Dioxide (CO_2) feeders are original to the plant and hence are over 37 years old. The performance of these CO_2 feeders is deteriorating and replacement parts are getting harder to find due to the age of the equipment. The current feeders are not automatically paced according to the raw water flow and the feeders cannot provide information back to the computer human machine interface (HMI). The project will include carrying out a preliminary and final design by a consultant. The new feeders will be flow-paced for dosing and will also provide feedback to the HMI of the plant. This will result in better process optimization. The estimated cost for this work is approximately $600,000 and it is projected to be completed in 2017/18.

Wastewater Capital Projects:

Project: Aerotech WWTF Upgrade – Design/Construction

Asset Class: Wastewater – Treatment Facility

Description: The Aerotech Wastewater Treatment Facility (AWWTF) treats wastewater from the Halifax Stanfield International Airport (HSIA), Aerotech Business Park, and private septage haulers. The AWWTF also dewaters sludge generated by wastewater treatment facilities operated by Halifax Water.

Sludge and septage comprise two significant side streams being treated by the AWWTF, and the quality and quantity of each are quite variable. The presence of these side streams, and on-going development within HSIA and Aerotech Park, have continued to increase the loads to the AWWTF.

The AAWWTF is experiencing difficulties meeting the stipulated effluent discharge objectives and is near its design capacity. Further growth is projected within HSIA and Aerotech Park. In order to accommodate the anticipated increase in wastewater, the AWWTF will need upgrades to improve performance and increase capacity.

Halifax Water engaged a consultant in 2011 to undertake an Environmental Risk Assessment (ERA) for the AWWTF in accordance with the Canadian Council of Ministers of the Environment (CCME) Municipal Wastewater Effluent Strategy to identify the environmental quality objectives and performance targets that the AWWTF will be required to meet.

In late 2012 Halifax Water engaged an engineering consultant to complete a predesign. The predesign was complete as of September 2014 and the project is now progressing to detailed design. Currently the project cost is estimated to be $21 M and construction is expected to occur in 2015/16 and 2016/17.

Project: Jamieson Street Trunk Sewer Outfall Replacement – Phase 2 Construction

Asset Class: Wastewater – Trunk Sewers

Description: The upgrade of this combined sewer overflow (CSO) was divided into two separate phases. Phase 1 included the replacement of 300 metres of corrugated steel pipe between Windmill Road and a CSO chamber at the bottom of Jamieson Street. This phase was completed in 2007. Phase 2 includes the replacement of the remaining existing corrugated steel pipe and the extension of the CSO outfall into Halifax Harbour. The total project length is approximately 70 metres and includes a 20-metre section beneath the CN right-of-way, which will be cased, and a 50-metre extension. It is anticipated that the pipe will be 1600 mm diameter, high-density polyethylene. The extension of this outfall beyond the tidal zone is required to meet functional and regulatory requirements. It is noted that the permitting and regulatory approval process for Phase 2 was funded in the 2011/12 capital budget and is substantially complete. The construction is proposed for 2015/16 at a total cost of $1.1 M.

Project: Northwest Arm Sewer Rehabilitation

Asset Class: Wastewater – Trunk Sewers

Description: The 1200 mm diameter Northwest Arm trunk sewer is 4500 metres in length and was constructed in the early 1900s. It is generally located between the Northwest Arm and buildings along its eastern shore. This sewer conveys wastewater collected in the Armdale and Spryfield sewersheds to the new pumping station near the Atlantic School of Theology (AST) for further conveyance to the Halifax WWTF. A considerable length of this sewer was constructed of clay blocks that were mortared together. Replacement of this sewer using traditional open-excavation methods is not practical due to its location in narrow easements along the back of residential properties. However, further investigation revealed that this sewer is an excellent candidate for internal structural lining. This practical technology utilizes access to the pipe via existing manholes and avoids the costly and difficult excavation traditional method of trench. In 2006, a condition inspection was undertaken that identified the system needed to be renewed. In 2009, a pilot project was undertaken, and 450 metres were successfully lined at a cost of $1.3 M.

The remainder of the Northwest Arm trunk sewer requires rehabilitation, and to utilize internal structural lining, this work needs to be undertaken before the pipe deteriorates to a point that is not conducive to this technology. Phase 2 of the rehabilitation is planned for 2016/17 to 2018/19 at a cost of $$13.6 M.

Project: Wanda Lane Sanitary Sewer Replacement

Asset Class: Wastewater – Collection System

Description: This capital works project is an integrated project involving the Halifax municipality, local residents, and Halifax Water. The proposed work scope includes street reconstruction, new sidewalk, bridge replacement on Tobin Drive, walkway bridge replacement, Ellenvale Run channel upgrades, new sanitary sewer, conversion of the old sanitary sewer to a clear water or deep storm sewer, and watermain renewal. Construction is expected to take place in 2016/17 and 2017/18 at an estimated cost of $2.2 M.

Project: Gravity Sewer from Maynard Lake to Halifax Harbour

Asset Class: Wastewater – Collection System

Description: The outlet for Maynard Lake is connected to a combined sewer which is pumped to the Dartmouth WWTF via the Old Ferry Road PS. The proposed project would result in the redirection of this flow so that it is conveyed to the Harbour. This would result in a reduction of operating costs associated with the conveyance and treatment of this water. The project would also result in a reduction in the frequency and/or the volume of combined sewer overflows. The project is expected to be undertaken over the three year period from 2016/17 to 2018/19 at an estimated cost of $3.2 M.

Project: Russell Lake PS Upgrade

Asset Class: Wastewater – Structures

Description: This capital works project is being funded through the CCC program for the Russell Lake West area of Dartmouth. The existing pumping station building is at the end of its service life and needs to be replaced. Included in the work scope is the installation of a back-up power system and associated mechanical and electrical equipment. Construction is expected to take place in 2017/18 and 2018/19 at an estimated cost of $2 M.

Project: Mill Cove PS Rehabilitation

Asset Class: Wastewater – Structures

Description: The Pumping Station is located at the Mill Cove Wastewater Treatment Facility site. The station is over 40 years old, and deterioration is particularly evident within the mechanical and electrical components. The majority of the parts in service date back to the original installation. The station requires a complete rehabilitation of these mechanical and electrical components, and related work. Construction is expected to take place in 2015/16 and 2016/17 for a total estimated project cost of $3.0 M.

Project: Belmont WWTF Decommissioning

Asset Class: Wastewater – Treatment Facility

Description: The existing small wastewater treatment facility is at the end of its service life. This proposed capital works project involves the replacement of an existing facility with a new pumping station and forcemain. The new pumping station will transfer the flows to the newly expanded and upgraded Eastern Passage Wastewater Treatment Facility. Construction is expected to begin in 2015/16 and the total project cost is estimated to be $5.4 M.

Stormwater Capital Projects:

Project: Sullivan's Pond Storm Sewer System Replacement

Asset Class: Stormwater – Pipes

Description: The Sullivan's Pond Storm Sewer System is the outlet for Sullivan's Pond/Lake Banook watershed which is some 1500 hectares in area. The system was constructed in the early 1970s and is at the end of its service life. The system is to be designed for the 1 in 100 year storm event and the construction will be very challenging given the anticipated size of the structure to be buried within a highly congested urbanized environment. It is anticipated that the project will be undertaken in two phases. The first phase will be from the Harbour to just above Irishtown Road at a cost estimated to be in the order of $10 M. Construction of this first phase is expected to proceed in 2016/17.

Project: Gravity Sewer from Little Albro Lake to Jamieson Street PS

Asset Class: Wastewater – Collection System

Description: Historically the Little Albro Lake discharged to Halifax Harbour but the outflow from this lake is now diverted into the combined sewer. The proposed project would result in the redirection of this flow so that it is conveyed to the Harbour. This would result in a reduction of operating costs associated with the conveyance and treatment of this water. The project would also result in a reduction in the frequency and/or the volume of combined sewer overflows. Construction is expected to take place in 2016/17 at an estimated cost of $1.9 M.

6.1.4 Integrated Resource Plan

It has been two years since the completion of Halifax Water's first Integrated Resource Plan (IRP) in October of 2012. The IRP was a long-term (30-year), comprehensive planning project that involved collaboration with the NSUARB through their external consulting team (led by the Tellus Institute) and interaction with interested stakeholders. It involved developing a planning framework for future long term planning, and undertaking scenario

analyses to outline and prioritize future capital and operational programs needed to deliver water, wastewater, and stormwater services. The IRP focused on providing the following elements:

- Capital and additional O&M costs to meet the program and project requirements for the 30-year planning period from 2013 to 2043
- Development of an overall planning framework integrating the IRP into Halifax Water's business processes
- Identification of institutional constraints impacting implementation of the IRP recommendations
- Recommendations for additions and refinements of Halifax Water's Levels of Service (LOS) to facilitate the measurement of program success.

The IRP was developed using three strategic drivers: Regulatory Compliance, Asset Renewal, and Growth. Through a series of objectives related to each of these drivers a range of capital investment needs for the water, wastewater, and stormwater infrastructure over the next 30 years was evaluated. Projects and programs were reviewed to allocate the proportion of the benefits to each of the objectives/drivers.

The ***Regulatory Compliance*** driver covered projects/programs needed to address both current compliance issues (i.e. facilities for which Halifax Water is not compliant with current permits to operate or legislation) and future compliance issues (i.e. requirements resulting from emerging legislation).

The ***Asset Renewal*** driver covered projects/programs aimed at a sustainable approach to asset renewal and replacement. Asset Renewal requirements recognized the historical underfunding in some asset classes and evaluated the risk of continuing at the same level of reinvestment in the future.

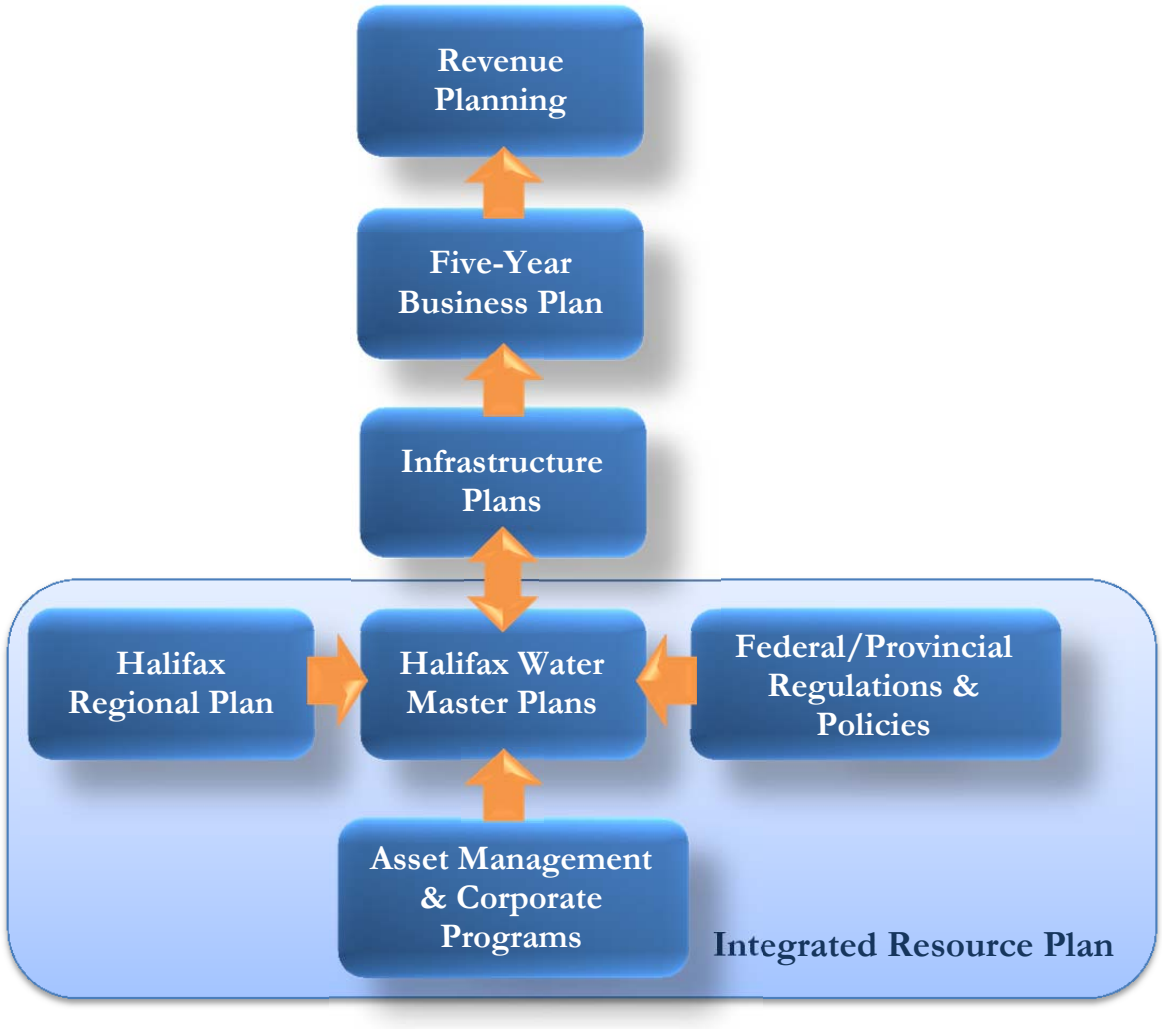
The ***Growth*** driver covered projects/programs aimed at providing regional level infrastructure to support growth and managing flow allocations to optimize system capacity.

The total 30-year net present value (NPV) for the recommended plan inclusive of capital and O&M costs was pegged at $2,579 million. As indicated in Figure 6.1.4 - 1, asset renewal expenditures represent approximately 54% of the overall IRP; growth and regulatory compliance expenditures represent approximately 23% each. Of this $2,579 million, the breakdown by asset class is: $1,855 million for wastewater; $615 million for water; and $108 million for stormwater.

Figure 6.1 – IRP Costs by Driver - Total 30-Year NPV = $2,579 Million

Several programs and projects were identified in the recommended IRP for early implementation. These were initially incorporated into Halifax Water's five-year business, operating, and capital plans. In recognition that the IRP recommended significantly higher levels of investment than historical investment, Halifax Water 'ramped' up the expenditures with a goal of meeting the spending levels by year 3 (2015/16). While some progress has been made to reach the projected IRP funding levels, more time to transition to these higher expenditures is warranted. There remains significant effort to operationalize the recommendations from the IRP. In reviewing Halifax Water's ability to deliver all the existing and proposed programs in relation to organizational capacity, additional resources, processes, and funding are necessary. Many of the foundational programs are outlined in this Five-Year Business Plan (e.g. Wet Weather Management Program, Energy Management Program, Continuous Improvement Program, Capital Program, etc.). Several specific programs/projects within these programs will further inform the financial investment needed over the long term. Section 6.1.1 outlines the AM Program requirements in support of the IRP.

Figure 6.2 – Long Term Planning Framework



Halifax Water has developed a ***Long Term Planning Framework*** to help illustrate how planning activities at Halifax Water will be integrated with other planning activities both internally and externally with Halifax municipality. Figure 6.2 provides a depiction of these interactions as a starting point to initiate discussions with Halifax municipality. The aim is to create a repeatable process for long term planning that is integrated with Halifax's regional plan update process, Halifax Water's development charge policy updates, and periodic updates to the water and wastewater master plans.

The continued success of Halifax Water's long term planning efforts requires sound methodology for population projections. Population projections, in addition to decisions regarding densities and locations for growth, remain the responsibility of the municipality. Halifax Water will use the growth/population projections derived by Halifax municipality to inform the regional infrastructure plan updates (as part of the periodic long term planning process).

Halifax Water also recognizes that the IRP is merely a 'snapshot' in time. An adaptive management approach will be required to respond to changing regulations, realization of projected growth estimates, and new information about asset condition and performance. Therefore, the IRP is considered the foundation piece to an ongoing and evolving process of continuous improvement and strategic long-term planning.

6.2 Five-Year Operating Budgets

Budgets have been developed to cover the period from 2015/16 to 2019/20, as shown in Appendix F. The operating budgets reveal that rate increases will be required to maintain current levels of service, deliver projects already in progress or approved, meet changing environmental requirements, and generate more funding to meet infrastructure investment demands.

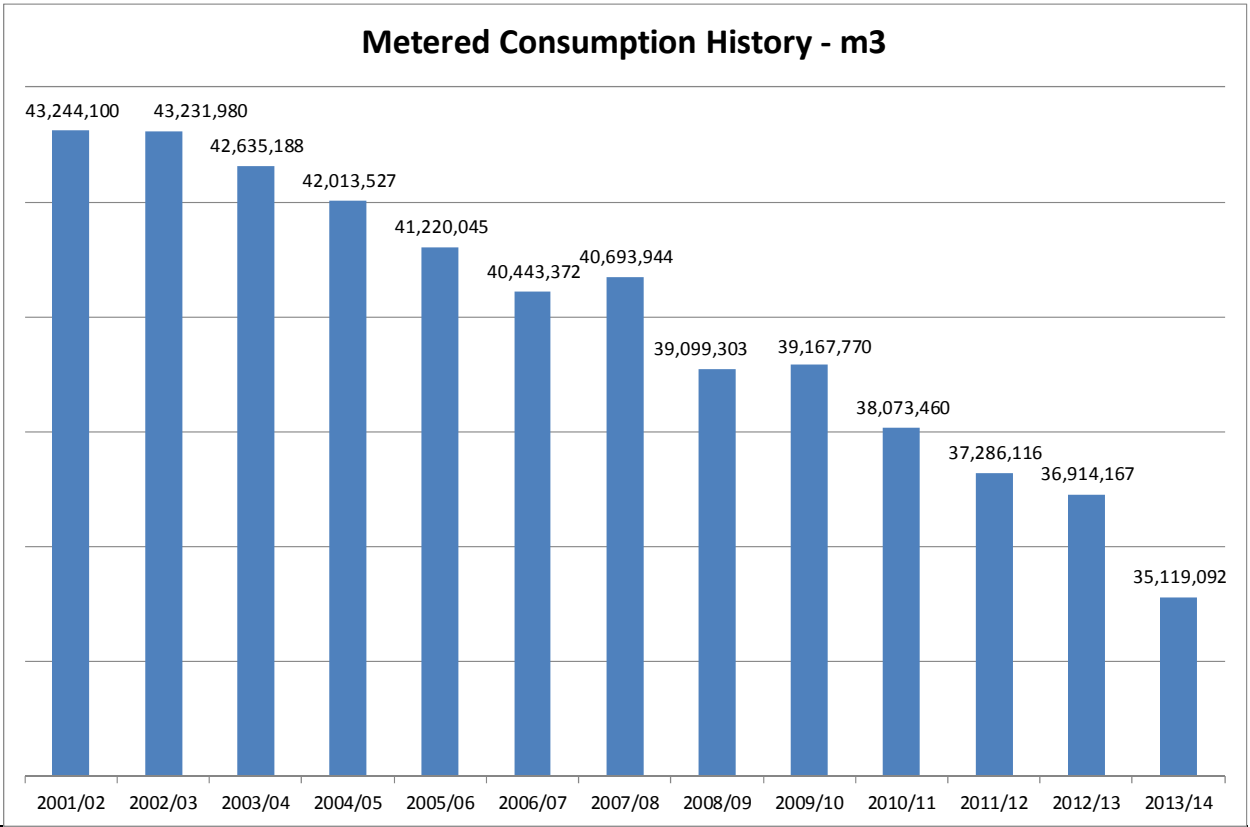
Some of the primary operating budget drivers and assumptions are:

REVENUES

- Consumption will continue to decline related to water and wastewater. Consumption is projected to decrease 3.0% per annum in years 1 and 2, and 2.0% annually in years 3, 4, and 5.

  As illustrated in Figure 6.3, consumption has declined a total of 18.8% over the past 12 years, with an average decrease of 1.6% per annum. Prior budgets typically used a rate of 1.5% annually to forecast declining consumption, however recent trending has indicated the 1.5% rate is no longer relevant. The past 4 years have seen consumption decrease an average of 2.6% per year, and in 2013/14 the decline in consumption from the prior year was 4.9%. This phenomenon is consistent with the experience of other North American water utilities.

Figure 6.3 - Metered Consumption



Twelve Year Historic Average	1.6%		
Total Decrease since 2001/02	18.8%		
Last	Cumulative	Average	
1 Year	4.9%	4.9%	Last Year
2 Years	5.8%	2.9%	Two Year Historic Average
3 Years	7.8%	2.6%	Three Year Historic Average
4 Years	10.3%	2.6%	Four Year Historic Average
5 Years	10.2%	2.0%	Five Year Historic Average

- 700 or roughly 0.8% new customer connections are projected each year, based on the 4 year historic average (2011-2014).
- Revenues from unregulated business activities are increasingly important to mitigate future revenue requirements from rates. These are described in more detail in Section 6.4. Unregulated revenues will be used to fund unregulated expenses and generate additional unregulated revenues for the benefit of the rate base.

EXPENSES

Halifax Water's Five Year Operating Budget is shown on an accrual basis for 2015/16 forward, to provide better information for decision making and be reflective of best practice for budgeting. There is an accrued amount regarding the liability for future employee benefits (pension) as calculated under CICA Handbook Section 3461 that, for rate making purposes, is not currently included in the revenue requirements.

The utility faces pressure associated with growth, asset renewal, and compliance with regulatory requirements, as described in the Integrated Resource Plan.

The largest components of Halifax Water's consolidated operating budgets are salaries & benefits, electricity, debt servicing, depreciation, and chemical costs.

Salaries and Benefits - Reasonable provisions for salary increase have been provided for in the Five Year Plan, based on collective agreements for CUPE Locals 227 and 1431, and market information for non-union compensation. The annual salary increase allowance is 2%, with an additional allowance made to address the impact of step increases within salary bands or reclassification of positions; and increases in benefits.

Electricity – Budgets were established based on an assumption of electricity, fuel, oil and natural gas rate increases in each specific year. The impact of these increases is expected to be partially offset by the formal Energy Management Program initiated in 2011/12 (see Section 7). The projected increases are shown in table 10.2:

- Electricity – 2% in year 1, 7% in year 2 and 2% (~CPI) in years 3, 4, and 5;
- Furnace Oil – 5% in years 1 and 2, then 2% (~CPI) in years 3, 4 and 5;
- Natural Gas – 10% in years 1 and 2, then 2% (~CPI) in years 3, 4 and 5.

Debt Financing – New debt payments are budgeted to support the five-year capital projects. Over the course of the next five years, debt payments are projected to increase significantly. The amount and timing of the increases will be determined by timing of the completion of the projects and the financing rates and options available. It is estimated total debt servicing may increase to $35 M by 2019/20 (see Table 6.5). Halifax Water's capital financing strategy is designed to maintain a debt service ratio of 35% or less; and to use a mixture of infrastructure funding, development related charges (reserves), depreciation; and debt.

Depreciation - As Halifax Water's assets and future capital budgets increase so do depreciation expenses. Depreciation is an integral funding source to support rehabilitation of the existing infrastructure as well as new infrastructure and upgrades to meet future capital requirements necessitated by both servicing demands and changing environmental regulation. Over the course of the next five years, the depreciation expense is projected to increase from $15.8 M in 2013/14 to $24.1 M by 2019/20.

Dividend to the Halifax municipality - The water dividend agreement was renewed in September, 2014 for a 5 year term (April 1, 2015 - March, 2020). The dividend is projected to grow from $4.1 M in 2013/14 to $6.2 M by 2019/20.
Chemical Costs – Chemicals are tendered annually in January for optimal pricing. Chemical cost increases of 5% are anticipated for years 1 and 2, with a 2% increase for years 3, 4 and 5. Long range chemical prices are difficult to predict due to the volatility of the market which is closely linked with energy prices and fluctuations in supply and demand.

Energy and electricity cost assumptions are described in Table 10.2 within Section 10.13 of the Business Plan.

On a consolidated basis, the projected five-year operating budgets are shown in Table 6.4. Over the next five years, operating expenses are projected to increase from $89.7 M in 2013/14 to $114.2 M in 2019/20, or 27%, while operating revenues are projected to have a slight decrease due to declining consumption. Non-operating revenues are projected to decrease by $1.8 M or 60% and non-operating expenses increase by 39% or $11.6 M over 2013/14 levels due to increased debt-servicing costs based on current projections.

Table 6.4 - Pro Forma Income Summary

	Actual	Budget	Budget				
	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20
Operating Revenues	$111,502	$129,853	$127,276	$125,349	$124,366	$123,420	$122,513
Operating Expenditures	$89,737	$99,452	$103,271	$108,439	$108,210	$111,838	$114,263
Operating Profit	**$21,765**	**$30,401**	**$24,006**	**$16,909**	**$16,156**	**$11,583**	**$8,250**
Non-Operating Revenue	**$3,009**	**$3,079**	**$3,077**	**$3,227**	**$3,228**	**$2,230**	**$1,231**
LONG TERM DEBT INTEREST	$8,161	$9,188	$9,380	$9,722	$10,278	$10,910	$11,992
LONG TERM DEBT PRINCIPAL	$17,257	$18,888	$20,427	$21,796	$23,113	$23,868	$22,940
AMORTIZATION DEBT DISCOUNT	$131	$144	$172	$198	$219	$226	$218
DIVIDEND/GRANT IN LIEU OF TAXES	$4,187	$4,340	$4,579	$4,714	$5,245	$5,856	$6,195
Non-Operating Expenditures	**$29,736**	**$32,560**	**$34,558**	**$36,430**	**$38,855**	**$40,861**	**$41,345**
Net Surplus (Deficit)	**($4,963)**	**$920**	**($7,475)**	**($16,293)**	**($19,471)**	**($27,048)**	**($31,864)**
Percentage Increase in Revenue to cover Deficit			*5.9%*				
Incremental Percentage increase in Operating Revenue				*7.1%*	*2.7%*	*6.3%*	*4.1%*

Note: Consolidated numbers reported above include regulated and un-regulated activities of the Urban Core, Satellite and the Airport/AeroTech Systems. Revenue increases required are for illustrative purposes only and do not represent actual revenue requirements of future rate applications for regulated activities.

Rate increases will be required to maintain or enhance the existing level of service and comply with stricter environmental regulations. Based on figures presented in Table 6.4, significant revenue increases are required over the next five years. Halifax Water will not be able to deliver the requirements for growth, asset renewal and compliance identified in the IRP without revenue increases. Notwithstanding this necessity, Halifax Water is developing a rate smoothing strategy that will result in more gradual rate increases.

As of March 31, 2014, Halifax Water had an accumulated operating deficit of $4.0 M, based on audited financial statements. This coupled with forecasted future losses projected in the business plan will cause the cumulative operating deficit to increase significantly unless rates are increased. Projections for 2015/16 and beyond are based on expected normal weather patterns. Should weather patterns deviate from the norm, operating results could be impacted accordingly as significant rain events, prolonged periods of deep cold, or droughts impact operating costs for the utility.

It is important to note that as new and more current information becomes available, five-year projections will change. The five year plan is sensitive to changes in interest rates, availability of external infrastructure funding, any changes in development charges and level of development activity.

6.3 Debt Strategy

On December 17, 2010, the NSUARB rendered a decision on an application by Halifax Water. The application included a capital-debt policy that the NSUARB was not prepared to approve stating it did not accept that the 30/70 debt-to-equity ratio included in the debt policy was necessarily the most efficient. The NSUARB directed Halifax Water to undertake a complete study examining an efficient capital structure, the policies of other utilities, its longer-term capital needs, and opinions that would result in an efficient funding mechanism that is fair to present and future ratepayers.

Halifax Water recognizes the importance of a debt strategy. Debt impacts the operating budget and, therefore, the future rate requirements in several ways:

1. Increased debt payments need to be accommodated through rates.
2. Increased depreciation as the capital program grows needs to be accommodated through rates.
3. Operating costs of new capital needs to be accommodated through rates.
4. Capital requirements not funded by debt will increase the requirement of capital from operating funding through rates.

The terms of reference for the debt study were approved by the NSUARB. They included best-practice research and comparison to public sector and private sector utilities, and were to focus on determining the most efficient capital structure for Halifax Water.

Halifax Water is a unique entity from several perspectives as it is:

- A body corporate utility created under a separate provincial act with all its shares deemed to be owned by Halifax municipality.
- The first and only regulated water, wastewater, and stormwater utility in Canada

- A government business enterprise from an accounting perspective
- The largest water resources utility in Nova Scotia and the second largest utility in Nova Scotia

In recognition of its municipal and provincial relationships, the Municipal Finance Corporation (MFC), Halifax municipality, and Service Nova Scotia Municipal Relations (SNSMR) are important stakeholders in finalizing the debt study and related debt strategy.

The existing *Capital Borrowing Guidelines for Municipal Units in Nova Scotia* state that "a municipality's existing and projected debt service costs (excluding those related to self-supporting utilities) should not exceed 30% of property tax and other own-source revenues." As self-supporting utilities are excluded from these guidelines, there has been no guidance for utilities such as Halifax Water to follow. In August 2011, SNSMR confirmed that a debt-service ratio of 30% would generally be an appropriate measure for a self-supporting utility such as Halifax Water.

In December 2011 the MFC increased the unguaranteed debt cap for Halifax Water from $35 M to $70 M to reflect the fact that the asset base and revenues of the organization have roughly doubled with the addition of wastewater and stormwater services.

On March 11, 2011 the NSUARB approved the Terms of Reference for the Debt Study and Halifax Water engaged the services of Mark Gilbert, Ph.D., to carry out the work.

The study focuses on the four areas identified in the Board Order and concludes with a recommendation for an efficient funding mechanism that is fair to present and future ratepayers. The context for the recommendation is one that applies to a local government enterprise providing water, wastewater, and storm water services in Nova Scotia.

The review of best practice covers eight information sources ranging from professional association manuals, practices, and publications to rating agency methodologies and reports. The information relevant to capital structure and debt limits for water/wastewater utilities and local governments is summarized.

The best practice review suggests "a municipally owned water, wastewater and stormwater utility providing service in its home municipality should select a capital structure and debt limits that reflect a focus on enhancing rate affordability and stability. These enhancements are subject to the factors and constraints, which include senior government legislation and regulation that influence and restrict the municipality's debt policy. The two most appropriate financial criteria used in determining and evaluating capital structure and debt limits for a municipality and its enterprises are ones that measure debt service charges to annual operating revenues and total outstanding debt to either annual revenues or the property tax base. It is also useful to use an indicator that

relates debt to the community's ability to pay and the link between debt and taxable property is a suitable indicator." [2]

Using the final Integrated Resource Plan as approved by the Halifax Water Board on September 28, 2012, several combinations of financing alternatives were examined using a robust financial model developed by the MFC, and modified by Halifax Water staff to be more reflective of the utility's requirements.

The financing alternatives were evaluated using three general principles:

1. Rate stability and affordability
2. Halifax Water long term financial sustainability
3. Intergenerational equity

The debt strategy report concludes that some appropriate ratios for Halifax Water to utilize are:

1. Target Debt Service Ratio of 35%
2. Target Debt/Equity Ratio of 40%/60%

In essence, the two targets will serve as a framework for Halifax Water's strategy when considering future use of debt.

Additionally, the report addresses the issue of affordability and refers to a study conducted by the National Consumer Center for the Water Research Foundation (WRF). The study, while primarily focused on affordability of water charges, also addresses the affordability of wastewater charges. In the report, affordability of user charges is stated to be 2% of average user, median income households each for water and wastewater; i.e. 4% for both utility services (Saunders et al. 1998). The manual also refers to a range of 2.3% to 3% of median household income for combined water – wastewater bills used by the Ohio Public Works Commission in 1999. Notwithstanding these studies, Halifax Water has a goal to keep rates for combined services below 1% of median household income.

Although a rate smoothing strategy will be pursued over the life of this business plan and beyond to limit annual rate increases to single digits, some households on low income may still experience affordability issues. In recognition of the financial burden on households with low income, Halifax Water introduced the Help to Others (H2O) program on April 1, 2011 to mitigate the impact of rising water bills. The H2O program provides dedicated funding for low income households to offset water bills, administered through the Salvation Army, similar to other heating fuel or electricity bill assistance programs. Funds for the program are derived from unregulated activities of the utility with annual base funding of $25,000 and additional utility funds to match employee donations.

[2] Study of an efficient funding mechanism for Halifax Regional Water Commission Mark Gilbert, Ph.D. October 2012

It is important to note that Halifax Water's debt strategy must be acceptable to the Halifax municipality recognizing that the financial performance and outstanding debt of Halifax Water is incorporated in the municipality's financial statements and credit rating. It does not have a material impact on Halifax municipality's cost of borrowing, nonetheless, as all municipal financing is backed by the Province of Nova Scotia.

The Debt Strategy was submitted to the NSUARB in January 2013 and was reviewed as part of the general rate hearing. In the June 24, 2013 NSUARB Decision on the General Rate Application, the NSUARB expressed concern about constraints on Halifax Water's ability to utilize debt.

4.3 Findings

[89] The Board is concerned the results of the Debt Study may have been influenced by "constraints" imposed by other parties. A better process would have been to independently analyze scenarios more reflective of normal commercial constraints to arrive at a recommended debt strategy. However, the Board is aware that HRWC operates in an environment with imposed restrictions.

[90] The Board's main concern with respect to borrowings is that costs are minimized to ratepayers. The argument with respect to the benefit to customers at various levels of debt appears to be highly dependent upon interest and discount rates applied and that these two factors can vary widely over time.

[91] It also appears that there are many assumptions in the scenario analysis, in particular with respect to funding from the RDC and depreciation from contributed assets. The Board notes that HRWC is continuing its stakeholder consultation with regard to the RDC in advance of an application expected to be filed with the Board later this year.

[92] The Board views the Debt Study as a positive step in looking at an efficient funding mechanism for HRWC. The Board accepts the Debt Study as presented. However, given the level of assumptions and uncertainty, the Board is not prepared to approve a particular scenario at this time.

Submission of the Debt Strategy to the NSUARB does not result in any immediate changes to Halifax Water's budget or rates. The Debt Strategy will however be a document that supports future budgets, business plans, and rate applications.

The actual financial strategies that staff will recommend to finance future infrastructure requirements will be consistent with the recommendations from the Debt Strategy, but will be reviewed and updated on an annual basis to reflect changes in key assumptions such as:

1. Interest Rates
2. Availability of Federal/Provincial Infrastructure Funding
3. Approval and implementation of a Regional Development Charge
4. Financial Constraints posed by rates and affordability issues

There are natural constraints in place that restrict the use of debt, such as the ability to absorb operating costs of new capital, annual operating budget pressures caused by increased debt servicing and depreciation, and rate shock sensitivity around increasing rates. The impact of Halifax Water debt on Halifax municipality debt limits and policies as well as the current MFC requirement that the municipality guarantee most of Halifax Water's debt was also a consideration in the development of an efficient capital structure. To that end, on September 23, 2014 Halifax Council approved a blanket guarantee of Halifax Water debt subject to the utility maintaining a debt service ratio of 35% or less.

As noted in Table 6.5, long-term debt is projected to increase from $215 M at March 31, 2014, to $321 M by March 31, 2018. It is estimated total debt servicing will increase from $28.2 M in 2014/15 to $35 M by 2019/20.

Table 6.5 – Projected Debt Levels Under Existing Rates

Halifax Water Debt Projections	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20
Total Debt Service	$ 28,220,000	$ 29,979,000	$ 31,176,000	$ 33,610,000	$ 35,005,000	$ 35,150,000
Total Debt Outstanding	$ 220,612,685	$ 220,973,770	$ 236,701,185	$ 246,281,735	$ 265,319,051	$ 295,468,080
Debt Service Ratio	21.73%	23.55%	24.87%	27.03%	28.36%	28.69%
Projected Operating Revenue*	$ 129,853,000	$ 127,276,000	$ 125,349,000	$ 124,366,000	$ 123,420,000	$ 122,513,000

*based on current rates

Debt Service Ratio = (Total Debt Servicing/Total Operating Revenues)

6.4 Alternative Revenue

Halifax Water has had success generating alternative revenues aside from user fees on both the regulated and unregulated side of the business. On the regulated side, Halifax Water has entered into agreements for the sale of land deemed to be no longer used or useful for utility purposes. These include tracts of land around Geizer Hill in Halifax (outside of the Chain Lake watershed boundary), land near the Larry Uteck Interchange in the Bedford West area, and lands in the Montague area of Dartmouth outside the Lake Major watershed boundary. With the approval of the NSUARB, revenue from these land sales has been used as a source of funds for capital projects related to the delivery of water services in recognition that the land was originally purchased with water-rate base funds. As much of the surplus land has been sold, this will not be a significant source of funds in the future.

Notwithstanding limitations for generating revenue from the regulated side of the business, there has and will continue to be opportunities from the unregulated side. Currently, Halifax Water generates revenue from third-party contracts for water and wastewater treatment.

Halifax Water also generates revenue for the lease of land for telecommunications facilities throughout the municipality in recognition that reservoir sites are located on higher

elevations that afford more direct line of site for telemetry. In conjunction with these leases, Halifax Water installs telecommunications equipment on these facilities for its own needs for the ultimate benefit of the water, wastewater, and stormwater rate base. As Halifax Water continues to expand the Supervisory Control and Data Acquisition (SCADA) system in accordance with its master plan, further opportunities for leases and hosting of Halifax Water equipment will be realized.

In recognition of Halifax Water's expertise in water-loss control, the utility offers a wide range of related services to generate revenue. These range from leak-detection services for Halifax Water customers and other municipalities to consulting services under contract to engineering firms and municipalities. There is great potential to expand these services to generate additional revenue and, at the same time, provide professional development opportunities for staff.

Halifax Water also recognizes that its assets can be leveraged to bring in revenue from energy generation. This includes projects to generate electricity from wind turbines and control chambers where water pressure is reduced. Both of these opportunities have been developed for interface with the Nova Scotia Department of Energy's Community Feed-In Tariff (COMFIT) program, which provides preferential rates to feed electricity into Nova Scotia Power Incorporated (NSPI) distribution grid. Halifax Water has received COMFIT certificates for two wind turbine projects, one of which (Pockwock) will be going into commercial operation this fall. Through efforts of Halifax Water staff, a Ministerial Directive was issued through the Department of Energy (DOE) in 2012 to approve the recovery of renewable energy within water distribution systems at "run-of-the–river" rates. To that end, Halifax Water has received two COMFIT certificates for the installation of hydrokinetic turbines in the Orchard and Lucasville control chambers. The Orchard installation went into commercial operation in October, 2014. The projected net revenues are in the current business plan. These projects are expected to have a positive overall financial impact as unregulated activity and structured to ensure they are compliant with the *Public Utilities Act* with the recognition that regulated activities cannot subsidize the unregulated side of the business.

In partnership with Halifax municipality, Halifax Water has also studied the potential for a green thermal utility whereby energy can be extracted from the heat in sewage and delivered through a local pipe distribution system in the vicinity of treatment facilities. The planned redevelopment of the Cogswell interchange in Halifax will provide an opportunity to advance this concept since the Halifax WWTF is adjacent to the Cogswell interchange. No allowances have been made in the current business plan to realize revenues as the projects are currently in the concept stages.

In an effort to be open and transparent to stakeholders including the NSUARB, Halifax Water disclose revenue and expenses associated with unregulated business separately within the financial statements. It is the intention of Halifax Water that the net gains from these activities would ultimately go to the benefit of the rate base.

Table 6.6 – Projected Unregulated Revenues (Gross)

(000's)	ACTUAL	BUDGET*	PROPOSED BUDGET		BUSINESS PLAN		
DESCRIPTION	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20
REVENUES							
AEROTECH SEPTAGE TIPPING FEES	$633	$800	$800	$825	$908	$998	$1,098
LEACHATE	$322	$366	$379	$393	$400	$408	$417
CONTRACT REVENUE	$91	$86	$86	$86	$86	$86	$86
DEWATERING FACILITY/ SLUDGE LAGOON	$210	$210	$210	$210	$210	$210	$210
AIRLINE EFFLUENT	$75	$80	$78	$78	$78	$78	$78
ENERGY PROJECTS	$0	$38	$115	$198	$198	$198	$198
MISCELLANEOUS	$21	$21	$21	$22	$22	$23	$23
TOTAL	$1,351	$1,601	$1,689	$1,811	$1,902	$2,001	$2,109

The five year budget for unregulated activities, including unregulated expenses is shown in Appendix F.

7. ENERGY MANAGEMENT

7.1 Energy Management Program

Through its Energy Management Program, Halifax Water is committed to creating and ensuring an ongoing focus on sustainability and energy efficiency throughout all operating areas. This program defines the goals, objectives, accountabilities, and structure for activities related to sustainability and responsible energy use.

In support of this program, Halifax Water's *Energy Management Policy* defines longer-term goals and commits Halifax Water to the principles of responsible energy management including reducing dependence on fossil fuels through energy conservation and best practices; identifying and implementing cost-effective energy-reduction initiatives; developing alternative and renewable forms of energy from utility assets; and reducing pollution by increasing the usage of energy supplied from sources that are less greenhouse gas intensive.

Program Structure

The Energy Management Program is coordinated through the Manager of Energy Efficiency reporting to the Energy Management Steering Committee (EMSC). The EMSC comprises the Directors of Engineering & IS, Water Operations and Wastewater/Stormwater Operations, and the Manager, Energy Efficiency. The chair of the EMSC is the Director of Engineering & IS.

Reporting to the EMSC on a monthly basis, the Manager of Energy Efficiency is responsible for the creation and implementation of the corporate Energy Management Action Plan (EMAP) and any other activities defined by the EMSC. Reporting typically consists of progress reports on the energy-related activities of Halifax Water including details of energy consumption, key performance indicators, and progress on energy projects and other related activities.

This program is self-sustaining financially using ongoing savings gained through energy reduction and generation projects to fund operating expenses and program initiatives.

Energy Management Action Plan

The EMAP includes details of energy-management activities that will be developed and undertaken by Halifax Water each year. Key activities contained in the action plan include:

- Delegation of the responsibility for achieving energy goals;
- Assignment of team members as required to meet goals;
- Development of an employee-awareness strategy to facilitate energy savings at work and home;
- Establishment of an energy accounting system that allows for collection, monitoring, and reporting of all data on energy-consuming assets, energy consumption, energy costs, energy savings, and key performance indicators;
- Preparation of energy audits on all facilities on a priority basis;
- Implementation of identified energy projects based on sound financial principles;
- Benchmarking of Halifax Water's facilities and establishment of annual energy-reduction targets;
- Identification of funding requirements for the EMAP;
- Refinement of contract and purchasing policies to incorporate energy-efficient practices; and
- Development of renewable energy generation projects.

One of the main tools used in any energy-management program is the energy audit. This can range from a quick, low-level scoping audit, to a complex, detailed investment-level audit. To date, mid-level audits have been completed for the three Harbour Solutions WWTFs, and the Pockwock WSP, Lake Major WSP, and Bennery Lake WSP. From these mid-level audits, a significant number of energy-reduction opportunities have been identified. These opportunities have the potential to generate significant energy and financial savings in the future.

Future energy audits are also planned for the Mill Cove WWTF, Lakeside Timberlea WWTF and Aerotech WWTF, the Aerotech Bio-solids Processing Facility, larger wastewater pumping stations, and a number of larger PRV, metering and pumping chambers.

Energy management opportunities are also being identified through the integration and coordination of facility condition assessments via the Asset Management Program.

7.2 Renewable-Energy Generation

In April 2010, the Government of Nova Scotia released its Renewable Electricity Plan to support and encourage increased development of renewable energy resources for electricity generation. The plan sets out a detailed path for the province to gradually move away from traditional energy sources to sources that are more local, clean, secure and sustainable.

Halifax Water has also identified renewable energy as an important way of offsetting energy costs and increasing revenue that will move the utility closer towards net-zero energy consumption and significantly contribute to greenhouse gas reductions in the region.

To date, two key project areas have been identified: renewable energy and energy recovery from both water and wastewater systems.

7.2.1 Wind Energy

Halifax Water's land assets, namely the Pockwock and Lake Major Watershed areas, have good wind profiles that can be used as a renewable energy source. Halifax Water intends to leverage its available assets to reduce operating expenses and provide greater value to its stakeholders and customers. As such, Halifax Water has completed a lease for a wind development near the Pockwock WSP and is exploring further wind-energy development opportunities in the Lake Major Watershed area.

The Pockwock watershed comprises 5,661 hectares of land surrounding Pockwock Lake and has a significant wind regime. Through a land lease arrangement with Pockwock Wind GP, Ltd., five, 2.0MW wind turbines were installed in 2014 and are scheduled to commence commercial operation in November of 2014.

The Lake Major watershed comprises 6,944 hectares of land surrounding Lake Major and Long Lake. The projects identified for this area consists of two initiatives: one comprising five, 2.3 MW wind turbines and sited west of Lake Major on watershed lands and another comprising one 2.3 MW wind turbine sited east of Long Lake on watershed lands. Work continues to further the development of these two projects.

Other opportunities are being explored for additional small wind (<100 kW) developments on Halifax Water owned lands. Opportunities being considered fall under either the COMFIT or Net Metering programs currently sponsored through the NS Department of Energy (DOE).

7.2.2 Hydrokinetic Turbines

An opportunity has been identified to use inline turbines to recover energy from the water supply system in place of pressure-reducing valves (PRVs), widely used by water utilities to reduce pressure more suitable for downstream distribution systems. While PRVs release energy to reduce pressure, they do not perform any useful work with that energy. Inline hydrokinetic turbines can be used to reduce line pressure, and recover energy and convert it to electrical energy.

Halifax Water has investigated two potential projects for the installation of inline hydrokinetic turbines – one at the Orchard Control Chamber in Bedford, and one at the Lucasville PRV Chamber in Middle Sackville. These projects have the potential to generate an estimated 325 MWh of electrical energy on an annual basis. In financial terms, under the existing COMFIT program, these projects could generate an estimated $45,000 in annual electrical energy revenue over the +20 year life of the projects. Halifax Water has requested and received approval from DOE to allow these types of projects to be considered equivalent to run-of-river hydro under the provincial COMFIT program. Subsequently, Halifax Water submitted COMFIT applications for these projects and has received COMFIT certificates for both.

Both projects are considered research and development projects for this relatively new and innovative application of an existing technology. As such, the Orchard project has received funding from the WRF's Tailored Collaboration Program, a program which enables WRF utility subscribers to partner with the WRF on research, and funding from Nova Scotia Department of Environment. The Lucasville project involves the development and application of a smaller, "plug & play" style system, utilizing technology that is being developed in partnership with Rentricity Inc., a New York based developer of small hydrokinetic turbine systems, and Xylem, a global leader in the development of water and wastewater pumps and pump control systems.

The Orchard project was completed and commenced commercial operation in October of 2014. The Lucasville project is expected to be completed in 2015/16.

7.3 Energy Recovery

Energy recovery from process or waste streams is recognized as one of the biggest opportunities available to society. Recoverable energy is everywhere – in solid municipal/residential waste streams, industrial by-products, and water and wastewater streams. Halifax Water has significant recoverable energy resources available in both its water and wastewater streams. Specifically, as noted in the previous section, inline hydrokinetic turbines can be used in place of pressure reducing valves (PRVs) to recover energy from water distribution systems. In the wastewater system, energy can be recovered from the waste sludge produced by wastewater treatment facilities, heat exchangers and highly efficient industrial heat pumps can be used to transfer energy from one system to another, energy that can be supplied for heating or removed for cooling, and bio-gas can be produced to fuel a combined heat and power (CHP) system to generate electrical energy and heat from the combustion process that can then be used for treatment process or building heat.

7.3.1 Energy from Biosolids

Halifax Water currently supplies over 35,000 tonnes per year of partially de-watered sewage sludge to its Aerotech Bio-Solids Processing Facility (BPF). Currently, this sludge is turned into a soil amendment that can be used as fertilizer for topsoil manufacturing, sod growing, horticulture, and land reclamation.

In accordance with corporate policy, Halifax Water is focused on energy conservation, efficiency improvement, and renewable energy generation strategies to meet its long term energy, environmental and financial goals. Energy from biosolids is one type of renewable and sustainable energy that is readily available from Halifax Water's wastewater treatment facilities, as well as other municipalities. This approach also aligns with the "Canada Wide Approach for the Management of Wastewater Biosolids" approved by the CCME in October, 2012.

Halifax Water continues to explore opportunities and options for the alternative re-use of biosolids as an available energy source which can contribute to overall GHG reductions and offset annual energy costs.

7.3.2 Wastewater Effluent Heat Recovery

The volume of wastewater effluent flowing out of wastewater treatment facilities is immense. The capacity of water to store energy in the form of heat is also immense. This combination presents a real and readily available resource for an efficient, cost-effective heat sync that can be used, at a minimum, to provide or remove energy to and from wastewater treatment facilities, or to the local community at large.

The potential exists to dramatically reduce the amount of energy purchased and used for heating in at least three of the largest wastewater treatment facilities belonging to Halifax Water. The power available and cost savings potential is summarized in Table 7.1.

Table 7.1 – Wastewater Effluent Heat-Recovery Potential

Facility	Annual Flow (m^3/yr.)	Available Power Capacity (1) (MW)	Required Heat Energy (2) (MW)	% of Available Capacity	Annual Heating Costs (2) ($)
Halifax WWTF	36,825,000	59.7	0.6	1.0%	$95,000
Dartmouth WWTF	22,100,000	35.3	0.4	1.1%	$85,000
Herring Cove WWTF	4,630,000	7.4	0.3	4.1%	$150,000
Totals	**63,555,000**	**102.4**	**1.3**	**6.2%**	**$330,000**

1) Total available power based on an average effluent temperature of 12°C.
2) Based on 2013/14 usage and cost data.

Halifax Water has completed studies at the three Harbour Solutions plants to determine and understand the technical and financial challenges associated with these types of energy-recovery systems, and then implement the projects that make sense from an energy efficiency and financial perspective. The current Halifax municipality study to assess the development potential for the Cogswell Street Interchange area will also provide a real opportunity for a green thermal utility in partnership with the municipality.

As a first step, and to optimize heat recovery opportunities, ventilation air heat recovery projects are first being implemented at each of the HHSP's. Once complete, effluent heat recovery projects will be evaluated based on sound financial analysis and performance metrics, and implemented as part of the annual capital project planning process.

7.3.3 Bio-Gas CHP Energy Utilization

Halifax Water's Mill Cove WWTF is classed as a secondary treatment plant that utilizes a mesophilic anaerobic bio-digestion process to reduce sludge volumes and generate bio-gas in the form of methane that is then burned to provide process heat to support the digestion process and space heating for facility buildings. On average, this process generates over 650 m^3/day of methane gas. Currently, and on an annual basis, roughly 55% of this gas is used for process and building heat and 45% is sent to a flare stack to be burned.

The opportunity exists to optimize and maximize gas production levels at the Mill Cove plant and install a Combined Heat and Power (CHP) system to utilize this renewable energy to produce both electricity and heat. It is envisioned this system will burn 100% of the bio-gas produced to generate electricity and capture heat from the exhaust gases to provide the required process and building heat throughout the year. It is possible that enough electrical and heat energy can be generated on-site to provide 100% of the electrical and heat demand of the Mill Cove facility.

Halifax Water has begun the process to determine and understand the technical and financial challenges associated with this system and determine project feasibility from an energy-efficiency and financial perspective. The utility will be making an application under the Nova Scotia COMFIT Program in the fall of 2014 to obtain approval for this project.

8. CONTINUOUS IMPROVEMENT

8.1 Organizational Cultural Change

Mergers and acquisitions have always created opportunities and challenges for organizations, and Halifax Water is no different. With the water, wastewater, and stormwater merger of 2007, Halifax Water brought staff together with different values, work practices, and demographics. It is the utility's obligation to nurture and foster a renewed culture of accountability, innovation, teamwork, and collective purpose. Many activities have commenced or have been completed to reinforce this objective including preparation of a revised mission, vision, and corporate balanced scorecard (see Appendix A); consolidation of policies; negotiation of new collective agreements; implementation of a formal continuous-improvement program; and consolidation of administration and operational facilities.

It should be recognized that Halifax Water, like other employers, operates with staff from four distinct demographic groups: Veterans; Baby Boomers; Generation X; and Generation Y. In recognition that these groups bring varied values to the organization, different approaches are necessary to motivate staff to pursue corporate objectives. It is also recognized that employment of visible minorities and immigrants brings diversity to the organization reflecting the communities served by the utility, and efforts have been successful to attract these individuals to consider a career with Halifax Water.

Recognizing that measurement of performance can drive improvement, Halifax Water continues to track performance through a Corporate Balanced Scorecard which is updated on an annual basis. In an effort to take this to the next step, Halifax Water joined the National Water and Wastewater Benchmarking Initiative (NWWBI) facilitated through AECOM in 2012. The NWWBI began in 1997 and now includes over 50 Canadian utilities who take a very structured approach to metric and process benchmarking. The NWWBI approach has garnered international recognition as a best practice and Halifax Water

believes it will foster a stronger continuous improvement culture within the utility. The 2015/16 and 2016/17 operations budgets contain an annual expense of $65,000 to participate in the national program.

As part of the continuous improvement process, Halifax Water has several initiatives under way with a goal of enhancing customer services. Those initiatives include new call centre technology, and improved business processes around wastewater and stormwater inquiries; a responsibility which is shared with the municipality. Technology initiatives like CMMS and Advanced Metering Infrastructure (AMI) will help make Halifax Water more responsive and accountable to customers.

8.2 Water Quality Master Plan

On April 1, 2012, Halifax Water renewed its research partnership agreement with Dalhousie University who in turn, were able to renew their Halifax Water/Natural Sciences and Engineering Research Council of Canada (NSERC) Research Chair for an additional 5 year term. Under the Chair, NSERC matches dollar for dollar the research funds provided by Halifax Water to Dalhousie University to conduct its water quality research. In 2012, Halifax Water revised its Water Quality Master Plan (WQMP) and issued WQMP v2. WQMP v2 marked a turning point in the partnership with Dalhousie University wherein, having identified some fundamental issues in the initial term of the Chair, the research focus shifted from broad fundamental knowledge to conducting research that has a more direct impact on day to day management of water quality and plant operations.

In the 24 months since WQMP v2 was published and implemented, a significant number of events have occurred on the water quality landscape which will further inform and shape our research focus. The most significant of these include:

- The first occurrence of geosmin in the Pockwock water system in October of 2012, after 35 years of operation and its reoccurrence in 2013 and 2014. Knowledge gained through recent studies and input from customers indicates that geosmin is an issue that needs to be addressed.

- The decision to end, in April of 2013, the practice of pre-chlorination at the J. Douglas Kline (Pockwock) plant resulted in a 40% reduction in trihalomethanes as well as small reductions in haloacetic acids (HAA's). Other positive outcomes from the process change include improved plant operability and a $25,000 per year saving in operating cost. This outcome reduced the need (geosmin aside) to achieve near term process improvements at this facility, allowing a shift in research focus to improving process and water quality at Bennery Lake and Lake Major.

- Process optimization studies completed at Bennery Lake and Pockwock have assisted the development of capital improvement plans. An optimization study of

Lake Major, anticipated to be completed by June 2015, will result in a capital plan as well. Necessary upgrades noted in these studies are aimed at achieving water quality and operational improvements. As these plans are implemented, there will be a need to pilot test proposed process changes. This will be facilitated through use of the pilot plant at Pockwock and resources gained through the partnership with the Dalhousie Research Chair.

- Several projects completed under the Chair, including participation in a study of national importance led by Dr. Michelle Prevost at Ecole Polytechnique in Montreal, have highlighted that the replacement of lead service lines (LSL) is a much more complex issue than previously understood. As a result, the LSL replacement policy has been amended to encourage complete lateral replacement instead of partial replacement. The utility has also developed a comprehensive monitoring and communications program for customers considering LSL replacement.

These developments have mandated the need to review research goals and adjust the research plan to provide the necessary support to capital spending decisions and policy development. Accordingly, WQMP v2.1 has been developed and is included in this business plan as Appendix G. While the WQMP will continue with its efforts to improve operating performance, it will be adjusted to take into account these recent events.

Of particular note is the ongoing study of geosmin in the Pockwock system. In the summer of 2014, AECOM completed a study which identified technically and operationally feasible options for treating geosmin. Three viable options were identified for further study, however all options come with significant increases in operating costs. As a result, the pilot plant at the Pockwock facility and the research team will play crucial roles in confirming feasibility, operating costs and dosing parameters, prior to considering investing in a treatment option.

In May of 2013, the American Water Works Association opened up its successful utility quality program, the Partnership for Safe Water, to utilities in English Canada and shortly thereafter, Halifax Water joined the program. This program which has existed in the US since 1995 currently has members representing over 500 treatment facilities. This program is for utilities, by utilities and is designed to optimize treatment plant and distribution system performance through a benchmarking and self-assessment process. Utilities who have achieved all four phases of the partnership have achieved treated water quality 60% better than regulatory benchmarks and are certified by the Partnership as having achieved the highest level of operation performance. Halifax Water has just initiated a multi- year journey to achieving Partnership recognition. This staff driven effort will work in a complimentary way with the ongoing research and path to achieve water quality goals.

The past two years have required our research partnership to be flexible to adjust to environmental factors, like geosmin, or changing conditions in plants such that research efforts can be directed to support Halifax Water's objective to provide high quality water at

the best price to customers. This approach has proven to be a very effective strategy for water quality improvement.

8.3 Wastewater Treatment Facilities Compliance Plan

The discharge of wastewater effluents have been undergoing significant changes all across the country. Halifax Water has stayed ahead of the curve in terms of addressing the requirements of the CCME strategy and the pursuant Wastewater System Effluent Regulations (WSER). Halifax Water has completed several strategic initiatives such as the Regional Wastewater Functional Plan, Integrated Resource Plan and most recently a Wet Weather Management Plan. In addition Halifax Water has developed a Wastewater Treatment Facility Compliance Plan, attached as Appendix H, which describes the current compliance status of all WWTFs and the objectives to meet the requirements of the WSER. The implementation of the Compliance Plan is well underway and planned project funding is identified in the capital budgets over several years.

8.4 Environmental Management System Expansion

ISO 14001 is an international standard for environmental management systems (EMS). The benefit of implementing an EMS is that it drives a process of continual improvement towards meeting defined environmental goals and objectives. Minimizing environmental impacts becomes one of the defined primary goals, and standard processes are put in place to identify issues and direct improvements through documented standard operating procedures.

Water Services have an EMS program in place and have registered the Pockwock Lake, Lake Major, and Bennery Lake facilities to ISO 14001. Halifax Water is expanding the EMS program to initially include wastewater services and eventually include all aspects of corporate operations such as fleet and building management, purchasing, contract services, and Occupational Health & Safety.

As a first step in implementing ISO 14001 for wastewater, Halifax Water will begin with the Herring Cove Wastewater Treatment Facility. During the 2012/13 fiscal year, the Intelex software package for EMS management was selected and purchased. Such software allows tracking of all EMS-related documents, and all required actions and follow-ups including assignment of due dates and responsibilities. Halifax Water engaged the services of Duerden & Keane Environmental Ltd. to assist with the design and creation of the internal components of the Wastewater EMS program, drawing on the experience gained from the Water Services program. The consultant assisted in completing the initial EMS stages such as defining the scope, identifying the environmental aspects of the operation, determining the goals and specific objectives, and providing guidance on writing the standard operating procedures required to achieve the defined objectives.

The corporate Core Manual for EMS was originally developed for the first water system registered, and had been expanded over time to include additional facilities. As a result, the Core Manual contained a large amount of facility-specific material. A decision has been made to develop separate EMS Manuals for each facility, together with a high-level corporate Core Manual, containing general EMS policies. This effort is in progress, and will be completed before seeking ISO registration for the Herring Cove WWTF (anticipated in 2015/16), and before implementation of the Intelex ISO software.

Additional resources within Environmental Services will be required to implement and manage the corporate ISO program with an EMS Coordinator proposed for the 2015/16 fiscal year. Over time, additional wastewater treatment facilities and collection system elements such as sewers, pumping stations, storage facilities and others may be incorporated until all wastewater facilities are included and registered.

8.5 Wet Weather Management

Wet weather flows are the most serious regulatory and operational problem in Halifax Water's wastewater system. These flows cause a multitude of problems for the natural environment, Halifax Water customers and the general public, during and after rainfall events:

- Wastewater overflows into freshwater and marine water bodies. There are approximately 100 wet weather overflow locations related to the wastewater and combined sewer collection system, mostly at CSOs and pumping stations but some at manholes.

- Impacts on wastewater treatment facilities. High wet weather flows cause washout of the treatment process at some facilities, resulting in under-treatment of the wastewater. Also, at some treatment facilities, portions of the high flows are required to bypass some or all of the treatment processes. Both of these conditions result in increased risk to public health, greater impacts on the receiving environment, and regulatory violations. Further, at some facilities, the impact and the type of treatment process is such that it can take weeks for the bacteria and the process to re-establish itself, so that the facility is able to return to its normal operational status.

- Surcharging of the wastewater collection system, resulting in wastewater back-ups into buildings, especially basements. These back-ups are a burden for property owners in various ways: risk to their health; cleanup costs; inconvenience; possible increased insurance rates; and possible inability to get insurance coverage.

- Usurping of valuable system capacity which was intended to be used for growth and development.

- Increased operational costs. One significant cost is related to power for the 175 pumping stations and 15 wastewater treatment facilities for which Halifax Water is responsible. Another is staff costs, including overtime, related to responding to various aspects of wet weather events, including wastewater overflows, treatment facility impacts, system upgrades to accommodate wet weather flows, environmental compliance, customer complaints, insurance claims, and others.

It should be noted that the extent and severity of the problems listed above are typically greater for the more severe rainfall events, and less so for minor events.

To provide some context to the magnitude of the wet weather flow problem, during typical storm events, peak flows can increase in the order of forty times the normal flow, and occasionally more. Also, Halifax Water staff have analyzed flow patterns within the sewersheds with separate sewers (as compared to combined sewers, which were designed to accept stormwater), and determined that on average, approximately 35% of the total flow in the wastewater system is stormwater. The actual number may be greater than this, in that the analysis does not account for all the volumes of overflow, some of which are not currently being measured. Capital budgets have and will continue to contain funds for flow monitoring to ensure better system understanding.

The sources of high wet weather flow in a wastewater system are derived from infiltration and inflow (I&I), which is the entry of stormwater, including groundwater and illegal connections, into the wastewater system. There are two fundamental approaches to managing wet weather flows to reduce or eliminate the negative impacts described above. One is to eliminate I&I at the source before it enters the wastewater system. The second is to manage the wet weather flow in the system by constructing larger infrastructure and by developing and utilizing operational improvements.

There are advantages and disadvantages to each approach. Reducing I&I at source is a very difficult and time-consuming process. It can be a short term solution in small sewersheds, but in most sewersheds, it is a long term solution. However, this approach tends to be more sustainable in that the life-cycle costs may be lower, and the wastewater system does not have to handle the high wet weather flows through the various components of the system – pipes, pumping stations, storage facilities and wastewater treatment facilities.

The second approach can be implemented more quickly and with more certainty of success, but the costs – capital and operating – tend to be greater. Larger infrastructure is required to transport, store and treat the large wet weather flows, and because the flows are not reduced, the operating costs are also greater.

Halifax Water currently considers both approaches noted above when addressing wet weather flow problems in individual sewersheds. One or the other approach, or both, may be utilized. Knowing how much I&I is entering the wastewater system, and the source of this I&I, is critical to success in all elements of a wet weather flow management program.

Comprehensive sewershed evaluation studies (SSES) are conducted by Halifax Water to gather the necessary information to make informed decisions on where to direct I&I reduction strategies. Halifax Water uses a number of tools and tactics to assist in this front-end part of the program: flow measuring (both temporary and permanent); smoke testing; closed-circuit television inspection; dye testing; age and type of sewer system; pump station run times information; and visual inspection. Also, a network of rain gauges is being installed to capture better rainfall information to correlate rainfall intensity and duration with wastewater overflow events.

There are two basic categories of I&I, each requiring a different solution-set. One is I&I directly into the wastewater collection system through defects in the pipes, manholes and other system components. This category of I&I tends to be a problem in older systems which have not been maintained as they have aged and is the direct responsibility of Halifax Water to resolve. Sometimes the approach is to repair identified sources of I&I on an operational basis, by sealing manholes, repairing pipes and joints, and possibly replacing shorter sections of pipe. However, at some point, older systems have deteriorated to the point that operational repairs are no longer feasible or cost-effective. In this case, the system must be rehabilitated as a capital project.

The second category is I&I directed into the system by private property owners. The discharge of stormwater and groundwater into the wastewater system is prohibited by the Halifax Regional Municipality Charter and is regulated by the Rules and Regulations of Halifax Water. Halifax Water has developed a program, called the Stormwater Inflow Reduction (SIR) Program, to locate such discharges, and to administer and enforce the legislation and regulations with respect to such discharges. Pursuant to the Rules and Regulations, the cost to rectify such discharges is the full responsibility of the customer.

The program started at Halifax Water in 2009, with the initial focus being residential sewersheds. In 2012, the SIR Program shifted primary focus from residential properties to industrial, commercial and institutional (ICI) properties. The ICI properties are often large and have significant areas of hard surfaces (e.g. rooftops, driveways and parking lots) generating high stormwater runoff. One ICI property can sometimes generate stormwater I&I into the wastewater system equal to hundreds of residential properties.

The long term success of the SIR program may depend on the ability to get customers to dispose of stormwater correctly without the intervention of Halifax Water. Educating property owners, contractors, real estate agents, home inspectors and other stakeholders in the proper methods of handling stormwater and wastewater is critical. Efforts to educate and inform customers regarding the correct way to dispose of stormwater will continue, in partnership with the Halifax municipality, the Insurance Bureau of Canada, and local NGOs.

Areas within the municipality which tend to have high contributions of I&I from private properties are those which have no deep storm sewer. The most sustainable manner of draining private properties is by gravity, which for homes with basements requires a deep storm sewer. The development standards in some areas of Halifax municipality in the

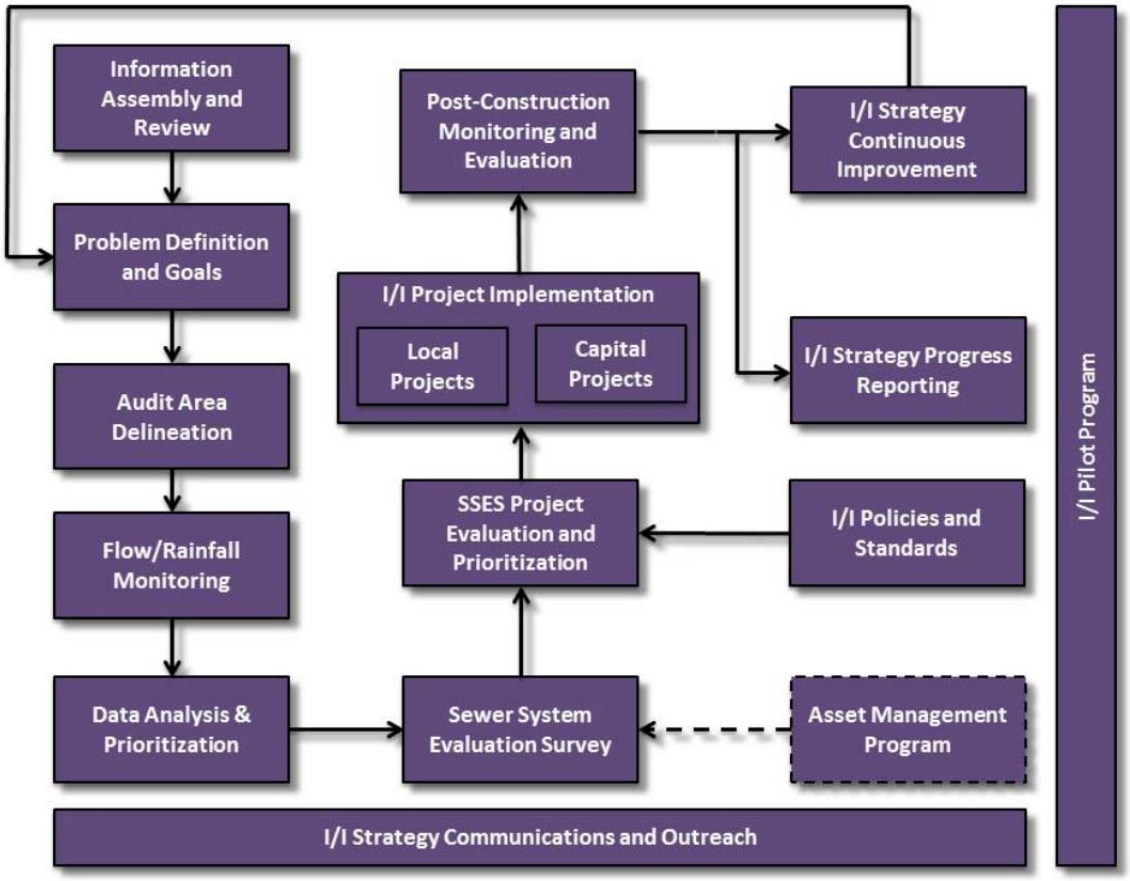
1960s, 70s and early 80s did not require a deep storm sewer, and it is those areas where high rates of I&I are common. With this in mind, Halifax Water developed a policy in 2009 to install such storm sewers on an equal cost share basis with the municipality and the local property owners. The policy was approved by the Halifax Water Board and forwarded to the municipality for their review. Halifax municipality has not approved the policy to date, but have adopted interim solutions on a case by case basis. Municipality and Halifax Water staff are continuing to work jointly on a stormwater management policy recognizing a shared responsibility. Any cost sharing from Halifax Water for deep storm sewers is also subject to the approval of the NSUARB.

Halifax Water's annual Capital Budget typically contains projects which either directly or indirectly provide for improved wet weather flow management. For example, any facility expansion or upgrade will be designed and constructed so as to reduce wet weather overflows and reduce impacts on wastewater treatment facilities. Further, replacement of wastewater sewers due to age will have the effect of reducing I&I into the system.

The wet weather flow problems experienced by Halifax Water are not unique. In fact, such problems are common across North America, especially in older cities with aging infrastructure. A number of jurisdictions in Canada and the USA have embarked on 20 and 30 year wet weather flow reduction programs.

In fall 2013 Halifax Water focused its efforts on developing a strategic wet weather management program to systematically prioritize the sewer service boundary and develop a framework to manage wet weather flows within the collection system. Halifax Water developed this program with the support of consultants and determined a short term action plan. The short term action plan, attached as Appendix I, identified 4 pilot projects and a number of key objectives to help develop a long term WWMP for Halifax Water. The primary focus of this exercise was to review the best practices and develop a holistic strategy for wet weather management. The following graphic describes the Halifax Water Strategy which was based on best practice review.

Figure 8.1 - I/I Strategy Overview



Halifax Water's Wet Weather Management Program is currently running 3 pilot projects; Stuart Harris, Crescent Avenue and Cow Bay Road Deep Storm Sewer Project. These three pilot basins were chosen intentionally to enable Halifax Water to validate what Rainfall Derived I&I (RDII) reduction can be accomplished via various reduction strategies. Industry data indicates that approximately 50% of RDII is generated from public infrastructure and 50% is generated from private infrastructure. Specific strategies must be employed to each portion of the sewershed to address RDII globally in the catchment.

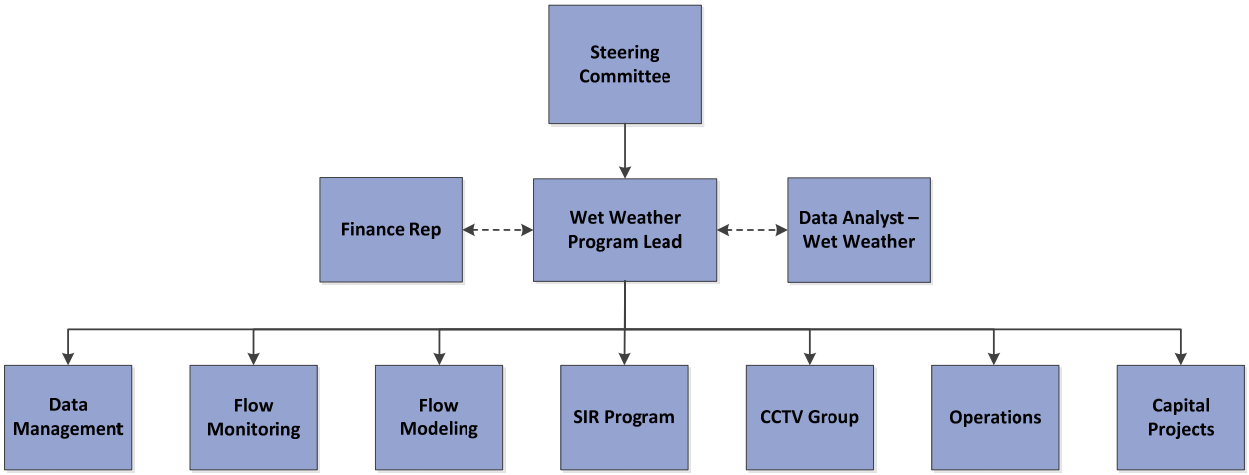
Sewershed evaluations use a variety of tools to gather pertinent information to make informed decisions on wet weather management actions. CCTV pipe condition inspections and flow monitoring are two very important tools in that regard. Accordingly, Halifax Water engaged Redzone Robotics in a pilot project to determine the suitability of autonomous CCTV cameras in the sewer system. The pilot included a number of challenging pipe inspections and the equipment proved it is capable of gathering the required video. Video is being reviewed in the desktop environment by Redzone Robotics and will be delivered to Halifax Water as an industry standard condition rating report as developed by the National Association of Sewer Service Companies (NASSCO).

Halifax Water has utilized multiple flow monitoring technologies to determine what technologies are best suited to sewer infrastructure to ensure flow data is available to support the WWMP. Pilots are ongoing and information gathered will be used to implement both long term and short term flow monitoring for Halifax Water's sewershed monitoring program.

Pipe inspection and trenchless rehabilitation are core components to a Wet Weather Management Program. Depending on the magnitude of the project these services could be obtained by an external service provider or by in house resources. Recognizing this, Halifax Water intends to form a Trenchless Group within the Wastewater and Stormwater services department. Under the direction of a new Trenchless Supervisor the program will deliver mainline, manhole, and lateral condition inspections as well as rehabilitate sewer laterals by trenchless techniques. Over the next five years the plan is to build out trenchless technology capabilities to include mainline and manhole rehabilitations.

As described above, Halifax Water has programs and practices in place to address I&I problems and to improve the management of wet weather flows within the wastewater system. Collectively a great deal of expertise exists within Halifax Water and can be found within various departments of the organization. A Wet Weather Steering Committee (WWSC) has been put in place, comprised of senior staff of three key departments – Wastewater and Stormwater Services, Environmental Services, and Engineering and IS. This committee will work very closely with the Wet Weather Action Committee (WWAC) to ensure Halifax Water's wet weather objectives are realized. The overall organization structure of Halifax Water's WWMP is shown in the figure below.

Figure 8.2 - Organization Structure - Wet Weather Management Program



Some specific activities that are being considered or will be implemented are:

- Search for world-class expertise to assist in developing a Wet Weather Flow Management Strategy. Halifax Water has performed a literature review of two of North Americas most successful Wet Weather Management Programs; King County, Washington and York Region, Ontario. In addition to these reviews, key staff have participated in international workshops to get perspective on wet weather management.

- The WWAC is prioritizing the wastewater service boundary based largely on the RDII. RDII is used to measure the success of wet weather management as it directly represents the extraneous flows resulting from wet weather events. The prioritized sewershed matrix is based on many attributes (pipe material, age of infrastructure, etc.) however RDII has the highest weighting in this ranking. RDII is determined by flow monitoring where available. In absence of flow monitoring pump station runtimes may be used as a surrogate to determine the sewer response to wet weather events.

- The prioritized sewershed matrix will be reviewed by the WWSC and specific sewersheds identified for the WWAC. The WWAC will then employ the appropriate strategies and tactics to most efficiently deal with wet weather impacts in that sewershed.

- The application of trenchless technologies is a mechanism which could help in carrying out timely repairs of old, leaking wastewater mains and laterals. The local marketplace has not historically had enough projects to attract contractors for this line of work, but Halifax Water will be identifying candidate projects to attract contractors to apply this technology to I&I reduction efforts. To that end, the Crescent Ave project is expected to be completed in 2015/16.

- Halifax Water will implement a trenchless group within its stormwater/wastewater operations group to rehabilitate components of the sewershed where magnitude and complexity are appropriate.

- Expansion of the permanent flow monitoring network and acquisition of additional portable flow measuring equipment will be achieved through the capital budget. Approximately 50 permanent flow measuring stations will be constructed at key locations in the wastewater system and these stations will be linked to the PI data historian and accessible via a desktop computer. The goal is to have the entire 50 stations fully operational within five years. One new permanent staff engineer position will be required early in 2015 and will be dedicated full time to this project. Additional monitoring points will be installed at key pumping stations over time and connected to the PI data historian. The use of technology such as wireless download and the connection of additional monitoring points to PI will increase efficiency in identifying problem areas while enhancing the safety of staff.

- Leaking laterals contribute a significant portion of infiltration into the collection system. Linking compliance testing to the sale of a property may be an effective and sustainable way to eliminate illegal (stormwater) connections from the wastewater system. Property owners are motivated to have their property comply, plus have access to financing to pay for repairs if needed. A program will be investigated to have compliance testing done in conjunction with the sale of a property or the creation of a new service account.

- Measuring of wastewater overflows, consistent with the CCME municipal wastewater effluent strategy and related regulations.

8.6 National Water and Wastewater Benchmarking Initiative (NWWBI)

The Corporate Balanced Scorecard (CBS) has been a performance measurement framework for Halifax Water since 2000. The CBS was updated in 2007 after the merger of Wastewater and Stormwater Services with Water Services to include several performance indicators to represent all three services. After investigating several other similar programs administered by various organizations such as AWWA, WEF etc., Halifax Water joined the National Water and Wastewater Benchmarking Initiative (NWWBI), facilitated through AECOM.

The NWWBI began in 1997 and was developed in response to a demand for Canadian municipal water and wastewater utilities to measure, track, and report their utilities performance. While fundamentally a high level metric benchmarking process, it has developed into a network and information database for Canada's most progressive municipal utilities. At present, there are 55 municipalities of various populations that participate in this project. The program focuses on wastewater collection and treatment systems, water treatment and distribution systems, and stormwater management systems with the ultimate goal to continuously improve quality and performance. This program embarks on standardized data collection and verification methodology along with a standardized Utility Management Model. The data is collected annually and results are discussed at an annual workshop which provides a great opportunity for continuous improvement through exchange of ideas with similar organizations with similar issues. Apart from the annual workshops, there are several focus task groups that interact throughout the year via web conferences etc., to improve service delivery.

The data collection and validation is a significant effort considering the NWWBI collects data for 7 broad categories with over 150 performance measures for all three services, as indicated in the figure below:

Figure 8.3 - NWWBI Performance Framework

8.7 Succession Planning

The success of an organization depends on its people, particularly those in senior leadership roles. Over the next five years succession planning will continue to be an important and challenging strategic initiative at Halifax Water considering the number of impending and potential retirements in key positions over that period. A well thought out succession plan will help recognize and develop internal talent and identify and bridge talent gaps.

A formal succession planning process began in 2009 to ensure continuity of leadership and identify qualified successors for key positions within the workplace. The initial steps included a review of Halifax Water's senior management positions that included the general manager, director, superintendent, and manager positions.

In 2013 Halifax Water developed and launched a comprehensive program and systematic approach to identify and develop successors from its internal talent pool.

The first step in this process was to establish a Succession Planning Review Committee comprised of the members of the Executive Committee. The role of this committee is to, a) become better acquainted with internal talent, b) determine the performance criteria and leadership competencies required in each job role, c) assess the performance and leadership potential of employees, d) determine an employee's ability to step into a more

senior role when vacated, e) develop training and experiential learning plans to prepare future leaders, f) identify talent gaps and plan on how to overcome them, and g) meet on a semi-annual basis to review progress and re-calibrate plans and strategies.

The committee recognized the need to develop the leadership competencies of its first-line supervisors as a strategy to prepare its future leaders. In the last two fiscal periods a total of 40 supervisors have participated in *Performance Matters,* a year-long multi-workshop supervisory competencies training program aimed at developing key supervisory competencies needed to lead and manage work teams more efficiently and effectively.

To facilitate the task of the Succession Planning Review Committee a new annual performance assessment program was developed to determine job performance and leadership potential in line with the succession strategy. This new program was rolled out to employees at the director level for the Fiscal 2013/14 performance assessment reviews and will be cascaded throughout the organization in the next two years.

To date, Halifax Water has made great strides with its succession planning program and is well on its way, within this evolutionary process, to meeting its long-term objective.

9. SAFETY & SECURITY

9.1 Occupational Health & Safety Programs

Halifax Water's Occupational Health and Safety Program is based on the Internal Responsibility System (IRS), which is the foundation of the Nova Scotia Occupational Health and Safety Act. The IRS is an internal system that provides for direct responsibility for health and safety for all staff in an organization.

The Safety and Security Division of Environmental Services has principal duties and responsibilities as part of the IRS as follows:

- Assist in formulating and supervising the execution of the utility's Occupational Health and Safety Program, and assist management to fulfill, to the greatest degree possible, its responsibilities for safety.
- Co-ordinate and/or provide safety training to staff in an effort to prevent accidents, minimize losses, increase productivity and efficiency, and ensure compliance with safety legislation and policies.
- Conduct safety audits in the workplace to identify safety hazards and recommend control measures.
- Assist in the development and maintenance of a system of accident investigation, reporting, and follow-up.

- Provide program education for job safety.
- Act as a resource to the Joint Occupational Health and Safety Committee (JOHSC).
- Maintain liaison with federal, provincial, and local safety organizations by taking part in the activities and services of these groups.

Halifax Water has established and maintains an Occupational Health and Safety Program in consultation with the Joint Occupational Health and Safety Committees. Our program continues to mature with updates and improvements occurring annually. Environmental Services will see the addition of one full time employee in the Safety and Security division to assist with the execution of these critical business functions. The Safety and Security division has identified the following policies and initiatives that require updating and will work with the JOHSC's and the organization at the departmental level in implementing these over the next five years.

Incident Reporting System

Halifax Water has purchased software called Intelex that will be utilized by the Safety and Security Division to track safety incidents. This software will ensure that corrective actions are undertaken in response to incidents, and facilitate the timely provision of reports and statistics.

Corporate Safety Training Policy

Halifax Water is ensuring all staff receive appropriate and effective safety-related training. The Safety and Security division is working with Human Resources in identifying training related to health and safety. A more comprehensive training program has been developed, and better tracking and scheduling will be instituted using the Intelex software.

Respiratory-Protection Policy

This policy is related to equipment such as self-contained breathing apparatus, supplied air respirators, and half-mask chemical and dust respirators. A number of activities are contemplated: the current program manual will be updated; equipment will be standardized, inspected, and certified; and all users of the equipment will be fit-tested.

Hearing-Conservation Policy

The procedures will be updated, hearing-protection equipment will be standardized across the organization, annual testing will be made available to all employees, and all noise hazards will be identified and labeled at all Halifax Water facilities.

Contractor-Safety Policy

Halifax Water uses the services of contractors on many different fronts when conducting business. This policy has been updated to ensure contractors understand their responsibilities when conducting work for Halifax Water. It includes a pre-qualification process, monitoring guidelines, and associated documentation. This program ensures that not only our employees are working safely, but also all contractors and their employees that work for Halifax Water.

The Department of Labour and Advanced Education in Nova Scotia is in the process of consolidating and updating its many regulations that pertain to the Nova Scotia Occupational Health and Safety Act. This review and update will require that we continuously monitor the changes and update Halifax Water's program manual as required. A communications plan will be created to ensure that all staff are aware of these changes to entrench a strong safety culture.

9.2 Corporate Security Program

Halifax Water's Security Program is based on enterprise assets protection and is designed to protect three types of assets: people, property, and information. It also considers intangible assets such as the organization's reputation, relationships, and creditworthiness. The program has been developed to take an all-hazards approach, be it from natural, intentional, or accidental hazards, when reviewing risks to the organization.

Halifax Water uses the three basic elements of a physical security system to protect its assets to ensure it accomplishes its mission.

> ***Protection:*** The protection element is the physical barrier that delays the determined adversary and the opportunist in accomplishing their goals. Halifax Water uses barriers such as building fabric, fences, doors, door hardware, and containers to protect its assets.
>
> ***Detection:*** The detection element indicates and may also verify an actual or attempted overt or covert penetration. Halifax Water uses intrusion alarms, access control systems, CCTV, guards, and patrols to protect its assets.
>
> ***Response:*** This element is the reaction to an attempted or actual penetration. Halifax Water uses guard forces and police forces to protect its assets.

Halifax Water uses two sources of information it gathers through use of consultants when designing an effective security system that assists the organization in completing its mission, as described below.

Vulnerability Assessments

In 2003, Halifax Water completed a risk assessment for Water Services using the Risk Assessment Methodology for Water (RAM-W) developed by Sandia National Laboratories. The outcome of this project assisted the organization in developing a list of critical assets for water, and directing resources to improve security readiness and meet mission objectives.

In 2009, the same methodology (RAM-W) was used to define critical assets in Wastewater and Stormwater Services and provide a roadmap for security improvements. Halifax Water employed the services of security consultants to review each facility identified in the RAM-W Vulnerability Assessments. The security consultants evaluated the administrative and organizational security, personnel security, physical security, and technical security measures followed by each facility, and determined if they met comparable institutional standards and were commensurate with current threats. The consultants also identified practices and procedures that improve the security of each facility and recommended cost-effective corrective measures to provide an acceptable level of security based on the three basic elements of a physical security system: protection, detection, and response.

In 2014, Halifax Water partnered with Public Safety Canada to conduct risk assessments at two major water and wastewater treatment facilities as part of a national pilot program. Public Safety Canada utilized a methodology that Argonne National Laboratory developed for U.S. Department of Homeland Security (DHS), which is designed to measure a facility's resilience from all hazards. Public Safety Canada will be completing additional assessments of Halifax Water's facilities in 2015 and 2016.

Operational and capital funding is required for a range of security-related initiatives and upgrades. The Safety and Security Division of Environmental Services is proposing annual capital budget expenditures of $50,000 for water and $200,000 for wastewater and stormwater for the next five years, to continue to upgrade and expand Halifax Water's corporate security program. Due to the sensitive and confidential nature of these projects, details are not provided in this document.

Emergency Response Planning

Safe and reliable drinking water, sanitation and environmental protection are vital to the sustainability of communities within Halifax municipality. In recognition of this, Halifax Water maintains an Emergency Response Plan (ERP), as required by the provincial Emergency Management Act.

The purpose of the ERP is to establish an organizational structure and procedures for response to water and wastewater/stormwater incidents. It assigns roles and responsibilities for the activation and implementation of the plan during an emergency, using the Incident Command System (ICS). The preparation and exercising of an ERP can

save lives, reduce risk to public health, enhance system security, minimize property damage, and lessen liability.

Halifax Water continues to train employees involved in emergency response and maintains readiness by exercising the ICS principles when responding to minor and major incidents. Staff also conduct internal response exercises and participate in regional exercises with other municipal, provincial and federal agencies, all on a regular basis.

10. BUSINESS RISKS & MITIGATION STRATEGIES

There are many challenges and opportunities in front of Halifax Water as society becomes more aware of the importance of preserving the environment. In recognition of this reality, Halifax Water intentionally elevated the environment to the same level as the customer in its service delivery and entrenched this approach in its mission statement. The path to sustainability for wastewater and stormwater is, however, a difficult journey. The level of investment will require significant increases in funding levels that can only come from external funding programs (federal or provincial) and/or the rate base. With external programs being unpredictable and indeterminate, base funding is more appropriately secured through the rate structure.

To that end, Halifax Water will be submitting a rate application for the Urban Core/Satellite systems in November 2014 to cover the 2015/16 and 2016/17 fiscal years using the Cost of Service methodology, approved by the NSUARB. As recently directed by the NSUARB, Halifax Water will include the Airport/Aerotech system in the rate application. The rate application is necessary to secure funding to cover projected operating costs and continue to address the utility's infrastructure deficit and increase capacity for growth. The latter is particularly true for the Airport/Aerotech wastewater system, which must be expanded to service the growth of the Halifax Stanfield International Airport. The utility is also completing a major capital project to facilitate growth with the transfer of wastewater from the Beechville/Lakeside/Timberlea sewershed to the Halifax sewershed. The associated rate increases will need to be balanced with fair allocation across the rate base and the ability of the customer to adjust to the new reality of full cost recovery for renewal of infrastructure and protection of the environment. It is recognized that not all customers view protection of the environment as important and Halifax Water will have to increase communication and education to customers on this topic.

Halifax Water's current fiscal health as measured by traditional financial ratios is stable; however, four consecutive years of operating losses have eroded the accumulated operating surpluses of the past and are cause for concern. Several risk mitigation strategies are currently being employed for the fiscal and operational health of the utility, and more are planned during the period of the Five-Year Business Plan. The following section outlines some key risks and strategies to mitigate their impact.

10.1 Declining Water Consumption

Halifax Water will continue to promote water conservation as it is a sustainable practice that will benefit the utility, customers, and the environment in the long run. The promotion of water conservation will be carried out through direct education and partnerships with Halifax Municipality and other non-governmental organizations (NGOs), which have proven successful in the past. The environmental stewardship benefits of conservation do, however, have a financial side effect for the utility.

Halifax Water is limited in participation in conservation initiatives, as they cannot be funded from the rate base unless there is a demonstrated financial benefit for the customers through operating cost savings or avoidance of future capital costs.

Halifax Water has recorded steady decreases in water consumption and expect the trend to continue for quite some time. As detailed in Section 6.2, a projected decrease of 3.0% in consumption per year for the next two years, and 2% thereafter is incorporated in the Five-Year Business Plan. The continued downward trend is attributed to customers responding to increasing water and wastewater rates, incorporation of water-efficient fixtures and appliances, and a general environmental awareness. If conservation results in a greater decrease in metered sales, the operational revenue projected in the business plan will not be achieved.

In an effort to mitigate financial impacts from conservation effects, Halifax Water has established a wastewater rate structure similar to its water rate structure. In this manner, a base charge is tied to customer meter size to recover fixed costs, and a second charge is based on consumption to reflect variable costs. Additionally, the introduction of a separate storm water charge based on impervious area versus water consumption will help further mitigate the financial impacts from conservation.

10.2 Nova Scotia Environment (NSE) Regulatory Compliance

Wastewater

A compliance plan (Appendix I) has been developed and updated for all Halifax Water wastewater treatment facilities (WWTFs). The plan outlines the recent performance of each facility in relation to current Nova Scotia Environment (NSE) discharge limits and WSER requirements. The plan also identifies enhancements or upgrades required for each non-compliant facility, with estimated timeframes. Further work will be required to define the required capital, operating changes, or upgrades to the various facilities, and to develop accurate cost estimates for the required work, which will become part of future capital budgets.

Halifax Water meets and communicates regularly with NSE staff, with the objective of achieving consensus on priorities. Regulatory compliance plans are being updated on a continual basis through consultation with NSE.

Funding of capital improvements for a number of the wastewater treatment facilities has already been approved, or included in the Five-Year Capital Budget, namely: Aerotech (upgrade and expansion), Belmont (decommissioning), Eastern Passage (upgrade and expansion completed in 2014), Beechville-Lakeside-Timberlea (upgrade), Lockview-MacPherson (optimization), and Wellington (replacement WWTF constructed and commissioned). Upgrade of the Frame WWTF is currently included within years 6 to 10 of the Capital Budget but will be brought into compliance over the next two years.

Halifax Water is currently planning to utilize operational improvements to maintain compliance for three other facilities – Halifax, Dartmouth and North Preston.

Water

With the recent construction of membrane filtration facilities for three small water systems - Collins Park, Middle Musquodoboit, and Bomont - Halifax Water will remain in compliance with current provincial drinking-water regulations. In recognition that all water treatment facilities comply with provincial regulations, maintenance of existing programs and execution of the Water Quality Master Plan will ensure continued compliance. As such, the primary focus for the combined utility will be to upgrade and enhance wastewater facilities to ensure environmental compliance.

System Assessments

Halifax Water is committed to supplying safe and clean water, and effective wastewater collection and treatment. In support of these goals, Halifax Water undertakes assessments of all water and wastewater systems, in conformance with NS Environment (NSE) regulations.

It is a regulatory requirement that Water System Assessments be completed every five years with the latest reports submitted to NSE in 2013. Assessments of municipal drinking water systems are conducted to evaluate the capability of the system to consistently and reliably deliver an adequate quantity of safe drinking water; to verify compliance with regulatory requirements; and provide preliminary costs and timelines to address any identified deficiencies and/or concerns. Corrective Action Plans are in place where required by NSE, as follow-up to the Water System Assessments.

Wastewater Systems Assessments (similar to water system assessments) are currently not a regulatory requirement. However, Halifax Water regularly reports to NSE on the performance of some components of the wastewater system for conformance with regulatory requirements. Additionally, Halifax Water conducts wet weather flow studies on

parts of the wastewater system. These studies are similar to system assessments, but are not as comprehensive.

10.3 Climate Change

Climate change has been a documented global phenomenon for a number of years. Climate data indicate a warming progression since the beginning of the industrial era. The Intergovernmental Panel on Climate Change projects continued warming with global increases of between 2-4 degrees Celsius or more by the end of this century. Changes will be gradual, progressive, and will impact communities and natural systems well before the end of the century. Climate change may have a number of effects on the water cycle and natural water systems, with resulting impacts on water, wastewater and stormwater operations and infrastructure:

Climate Change Effects

- Greater weather variability (more extreme wet-weather events and more dry-weather periods)
- Greater intensity of precipitation during extreme events
- Greater risk of hurricanes in the Maritimes
- Increased risk of flooding
- Sea level rise (up to 1 metre by 2100)
- Increased stormwater runoff
- Decreased water supplies during dry weather
- Changes in ecology of nuisance or disease-causing organisms

Climate Change Impacts on Utilities

- Increased stormwater flows during extreme events
- Increased risk of erosion
- Increased flows within combined systems during extreme events
- Increased flows during snow melt events
- Increased risk of inflow/infiltration and overflows for wastewater systems
- Increased water demand and storage requirements during dry summer weather
- Increased uncertainty regarding water supply, reservoir replenishment and groundwater recharge, due to uncertainty of local annual precipitation patterns
- Infrastructure impacts due to sea-level rise
- Increased risk of power failures during extreme weather events

These effects and impacts of climate change will require that water and wastewater/stormwater utilities be proactive in planning for contingencies and emergencies. Halifax Water has an Emergency Response Plan in place to deal with extreme events. The Halifax Harbour Solutions Project wastewater facilities in Halifax, Dartmouth and Herring Cove were designed to accommodate a possible 1-metre rise in sea level projected for this century as a result of climate change.

However, additional planning for longer-term climate change impacts will be appropriate. As an example, the US EPA has provided an Adaptive Response Framework for Drinking Water and Wastewater Utilities (EPA, 2012). This framework advocates the following steps and considerations in preparing to deal with climate change:

- Awareness
- Adaptation
- Mitigation
- Policies
- Community
- Partnerships

An important aspect of the framework is to maintain communications with regulatory agencies, community groups, research organizations and the general public. Proactive planning for short and long term events and trends will be required.

This EPA Framework is one example of many sources of advice and resources available to utilities in dealing with climate change.

The Halifax municipality has several climate change initiatives. Under the Regional Plan, the municipality has developed a corporate Greenhouse Gas Emissions Reduction Functional Plan and the Climate SMART (Sustainable Mitigation and Adaptation Risk Toolkit) program.

The province of Nova Scotia has also released a Climate Change Action Plan, and has programs for Flood Assessments, and Greenhouse Gas Reductions.

The Canadian Water Network is supporting a project by Dr. Slobodan P. Simonovic of the Civil and Environmental Engineering Department, Western University, in developing a Computerized Tool for the Development of Intensity-Duration-Frequency-Curves under Climate Change.

The proposed project will respond to the needs of municipalities by achieving the following objectives:

- Improvement of the procedure for updating IDF curves (integration of climate information, sophisticated downscaling mechanism and observed precipitation);

- Development of a completely computerized tool for the implementation of the IDF updating procedure;

- Documenting the tool; and

- Distributing the tool and providing the necessary training to maximize application and uptake of knowledge.

Halifax Water will be monitoring the progress and outcomes of this project, and will utilize these in its development of planning and mitigation initiatives related to climate change.

10.4 CCME Wastewater Strategy and WSER Regulations

On February 14, 2009, the Canadian Council of Ministers of the Environment (CCME) adopted a national strategy for the management of municipal wastewater. The strategy advocates a risk-based approach to management of wastewater effluent whereby requirements are based on environmental and health-risk assessments that are to be carried out for all treatment facilities. However, the strategy also includes a prescriptive approach with a requirement for a uniform minimum standard for all effluent equivalent to secondary treatment. Halifax Water's inland treatment facilities that discharge to fresh water already provide secondary or better treatment, as does the Mill Cove facility in Bedford and the Eastern Passage facility. However, the three Halifax Harbour Solutions Project (HHSP) facilities are advanced-primary. Upgrading to secondary level is required for the HHSP facilities under the WSER, with estimated capital costs in the order of $425 M. As outlined in Section 5 of this Business Plan (Wastewater System Effluent Regulations), the upgrade deadlines could be up to 30 years for Halifax and Dartmouth WWTFs under Transitional Authorizations sought under the WSER, due to high-risk CSOs. The Herring Cove WWTF currently is able to meet the WSER discharge limits since it is well under capacity, although it is an advanced-primary facility. As growth in the Herring Cove sewershed brings the facility closer to its rated capacity, effluent quality may come closer to exceeding WSER limits. In this case, advance planning for an upgrade will be required so that the facility remains compliant.

A more immediate operational/regulatory issue with Halifax Water's wastewater system is wet weather flow and resultant overflows into the environment as detailed in Section 8.5. Many of the sewers in the municipality are combined, built many decades ago with many greater than 100 years in age. Combined sewers have not been permitted since the early sixties, but even the older, separate sanitary sewers experience very significant I&I problems.

Of the approximately 175 wastewater pumping stations owned by Halifax Water, some 30-40 experience regular overflows. Many of these overflows go to inland receiving waters and, as such, represent higher environmental and health risks than marine discharge of primary treated effluent. As an initial step, a program is underway to provide sensors to detect overflow conditions and estimate volumes for the sanitary sewer overflows. Eighteen such installations are complete, with approximately another dozen to be constructed over the next two years (by the end of 2015/16).

Much of the capital and operating budgets have been allocated to mitigate these wet weather flow problems based on a priority-ranking process. It is preferred that resources be allocated based on risk and assessed priority, rather than on the basis of a national standard (the CCME/WSER) that does not consider local conditions. Identification of funding mechanisms and cost-sharing arrangements with senior levels of government will be critical now that the WSER regulations are in force.

10.5 Pension Fund

The Halifax Water Commission Employees' Pension Plan originated in 1972, has 361 participating members, and is a defined-benefit pension plan. After amalgamation of the municipal water utilities in 1996, the Halifax Water Commission pension plan was amended and restated effective June 1, 1998. In the intervening years from 1998 to 2008, eight amendments were made to the plan to maintain and/or improve benefits or to meet regulatory requirements. The plan text has been consolidated as of January 1, 2011, to include these amendments, and the consolidated plan rules were approved by the Halifax Water Board in June of 2011.

The Halifax Water Employees' Pension Plan and Nova Scotia *Pension Benefits Act* require that an actuarial valuation is carried out every three years. An actuarial evaluation was conducted as at January 1, 2014 (See Table 10.1) and confirms deterioration in the plan's financial position, as anticipated with the going concern deficit increasing from $14.4 M to $27.1 M. There have been improvements in investment performance since the last valuation; however, two key changes in assumptions have resulted in increased cost and funding requirements for the plan. The two major changes are related to a lower discount rate and the fact that Canadians are living longer.

With the most recent valuation, the actuary has recommended a decrease in the discount rate from 6.00% to 5.50% to reflect lower expectations for investment returns in the future. The method used to calculate discount rates is prescribed by Actuarial guidelines. There has been a trend amongst public pension plans in recent years to ensure discount rates are conservative and reflective of projected future conditions. This is being driven by Actuarial guidelines.

New mortality tables were published in early 2014 in recognition that Canadians are living longer. The new mortality tables are expected to increase liabilities between 5 – 8% for most defined benefit pension plans.

Consequently, the Halifax Water Board approved an increase in the contribution rate effective July 1, 2014, from 10.47% to 12.95%, and the required minimum annual special payments will increase from $1,528,500 to $2,952,200.

Pension Plan redesign has been identified as a priority and discussions are underway in conjunction with collective bargaining to redesign the pension plan. The funding required to maintain the pension plan will ultimately impact funding available for wage increases or other benefit enhancements. A joint working group including members of the Pension and Benefit Committee, the CUPE 227 and 1431 Union Presidents, and non-Union representatives has been formed to work on Pension Sustainability.

On a positive note, the pension plan does not have a solvency deficiency, as there is a surplus of $4,698,300 from a solvency perspective, based on a calculation that includes the present value of the increased going concern special payments. Although Halifax Water does not currently require it, the utility applied for a solvency exemption in spring of 2013. Approval for a solvency exemption has not yet been received but is expected this year.

Regardless of the status of bargaining or any pending plan redesign, the Plan Administrator has an obligation to work within the existing Plan Rules, with a fiduciary responsibility to administer the plan in the best interest of the sponsor and plan members. The following table summarizes the findings of the actuarial evaluation and impact on Halifax Water's payroll.

Table 10.1 – Pension Plan Actuarial Results

	Jan. 1, 2014	**Jan. 1, 2011**
Going Concern Surplus/(Deficit)	($27,110,200)	($14,387,000)
Solvency Surplus/(Deficit)	$4,698,300	$3,342,800
Minimum Total Additional Special Payments	$2,952,200	$1,528,500
Employee Contribution Rate	12.95%	10.47%
Total Employer Contribution (including current service cost & special payments)	27.40% of payroll or $5,873,600	20.26% of payroll, or $3,352,800

10.6 Regional Plan

The Halifax municipality recently approved an update to the 2006 Regional Plan (Regional Municipal Planning Strategy - RMPS). Halifax Water staff were involved in the review of the proposed planning policies to ensure alignment with the provision of water, wastewater and stormwater services including coordination with growth projections and the impact to utility infrastructure.

Growth projections from the Regional Plan were used in the development of the Regional Wastewater Functional Plan (RWWFP) and the subsequent Regional Development Charge (RDC). With the implementation and development of infrastructure plans, Halifax Water will continue to work with Regional Planning staff to ensure growth projections and development opportunity sites are captured accurately, ensuring both the infrastructure and RDC are sized appropriately.

As well, of particular interest, Halifax planning staff included mapping of source water protection areas in the RMPS. This will assist land developers and planning staff in their understanding of the sensitive areas relating to source water on lands not owned by Halifax Water. Policies were also included to enable Council to consider adopting Land Use Bylaw amendments to protect water supplies on both publically and privately held lands.

Halifax Water will continue to be involved with future updates to the Regional Plan, as growth projections and development opportunity sites evolve.

10.7 Development Pressures and Obligations

Halifax Water staff continue to process building permit and subdivision applications submitted through Halifax Planning Services.

This past year has seen a slowdown in new single unit residential and multiple unit dwellings. Large scale developments such as Parks of West Bedford, Kings Wharf, Harbour Isle and Bedford South, continue to occupy staff's time. A Land Suitability Analysis has begun for the next Master Planned Community, Port Wallace, and staff have been participating on the Steering Committee to assist in the development of the overall Area Master Plan for the provision of water and wastewater services.

With the Halifax Regional Plan, there is a continued objective to increase density within the Regional Centre. Halifax Water staff have raised concerns with possible wastewater capacity limitations in some of the identified opportunity sites to Halifax planning staff. Halifax Water has agreed to manage a study, funded by the municipality, to determine the existing capacity within the sewersheds for the respective opportunity sites and investigate possible density increases and associated costs. Halifax Water continues to work closely with Halifax Planning and Development staff to ensure applications are

addressed in a timely fashion while giving consideration to the impact the new development has on utility infrastructure.

Halifax Water continues to provide technical support as Halifax Regional Planning explores the provision of central services to areas outside the Urban Core. The recent Decision from the NSUARB on the RDC ensures that the rate base will not be burdened with costs from growth driven developments, inside or outside the Urban Core.

10.8 Biosolids

Biosolids are produced from sludge received from Halifax Water's wastewater treatment facilities. The Harbour Solutions facilities have onsite dewatering; the sludge is dewatered and transported to the Biosolids Processing Facility (BPF) at the Aerotech Park. The upgrade of Eastern Passage WWTF facility has facilitated on-site dewatering of sludge which has provided an opportunity to strengthen overall sludge dewatering capability. In an effort to reduce Ammonia loading on the Aerotech WWTF, some of the sludge from Mill Cove WWTF is currently being dewatered at Herring Cove WWTF and Dartmouth WWTF. This operational practice is also cost efficient because it avoids trucking high water content sludge to Aerotech. The Mill Cove WWTF is currently in the process of implementing an on-site dewatering solution on a trial basis which could enable it to dewater all of its sludge. If the trial is successful; the equipment will be incorporated into the plant permanently. This initiative will divert sludge from the Aerotech WWTF which contributes 60% of the dewatering volume at Aerotech. The sludge from the remainder of the facilities is transported in liquid/slurry form to a central dewatering facility that is a part of the Aerotech wastewater treatment operation. Once dewatered, this sludge is transferred to the BPF. The sludge dewatering will undergo some further changes once the Eastern Passage WWTF achieves Total Completion and the results of the Mill Cove trial are known. The final intent is to divert all external sludge from Aerotech.

The BPF is operated by a private contractor, Walker Environment Group who is the new license holder of N-Viro Systems Canada LP, with overall responsibility for operating the facility to produce a soil amendment in conformance with Canadian Food Inspection Agency (CFIA) regulations and marketing the product for beneficial reuse. The sludge from Harbour Solutions facilities are transported by Seaboard Liquid Carriers Limited using specialty trailers, whereas the sludge from all other facilities are transported by Halifax Water resources. The contract agreements with Walker and Seaboard are in effect until November 2019 and October 2016, respectively. The contracts allow for fee adjustments based on a formula that takes into account various input costs to operate the BPF. Both of these services will be reviewed as the contracts expire. Different delivery methods will be considered along with the current practice.

The BPF is a highly mechanized facility that operates in very tough environmental conditions with high concentrations of dust, humidity and ammonia. The facility is about 8

years old, thus the components are showing signs of excessive wear. Although some critical parts have been procured and stocked at the facility over the last few years, this facility will require capital upgrades to the equipment over the next two years. With the improvement in performance of treatment plants; the WWTFs are producing an increased quantity of sludge. The BPF is approaching its design capacity thus staff will be reviewing the operation to gain some efficiency through operational optimization with an objective to delay a capacity upgrade.

Transportation Contract

There are minimal business risks with this contract since there are several other trucking companies that can provide this service as Halifax Water will own the specialty trailers at the end of the current contact. The trailers will be over 10 years old at the end of the current contract. This equipment may need major upgrades if the utility decides to continue with the current model.

Biosolids Regulations

The beneficial use of biosolids has been a controversial issue for decades in the province of Nova Scotia and around the world. There are unsubstantiated claims from various sources that land application of biosolids is unsafe. However, the scientific research has proven that land application is safe and biosolids are a resource that should not be wasted.

The *Guidelines for Land Application and Storage of Municipal Biosolids in Nova Scotia* from Nova Scotia Environment govern Halifax Water operations. However, Halifax Water is faced with the risk of federal, provincial, or municipal authorities either changing the guidelines under public pressure or recommending other alternative technologies to dispose of biosolids. The Canadian Council of Ministers of the Environment (CCME) has also completed a review of the use of biosolids. The CCME approved the *Canada-wide Approach for the Management of Wastewater Biosolids* on October 11, 2012. The *Approach* encourages the beneficial use and sound management of biosolids. Beneficial uses include high-temperature lime-stabilization of biosolids for land application, such as the N-Viro process currently used by Halifax Water. Nothing in the CCME *Approach* suggests that any change will be required in current biosolids management practices in Nova Scotia, which emphasizes beneficial use. The acceptance of the product by the public and the agricultural community continues to be a monitored but recent stability in product uptake indicates the agriculture community is gaining comfort with land application.

Since the facility operation contract is up for renewal in 2019, Halifax Water will have to decide towards the later years of this business plan whether to operate the facility utilizing its own resources, or to continue operation through a private contractor. Halifax Water has undertaken several steps to ensure the continued safe practice of land application of biosolids:

- Halifax Water completed an independent peer review of its operations and practices in 2011. This review concluded that the practice is safe and the BPF is being operated in a professional manner.

- Halifax Water will enhance monitoring controls and promote industry best practices for land application during the span of this business plan.

- The operating contractor has employed a trained agronomist to liaise with farmers to provide them with information and guidance for land application of biosolids.

- Halifax Water has developed information brochures and provides regular information through its website and workshops to educate stakeholders.

- Halifax Water works closely with Walker, Halifax municipality and Nova Scotia Environment to educate members of the public.

- Halifax Water will continue to stay abreast of emerging research and technology to further enhance the beneficial use of biosolids. Halifax Water is affiliated with several organizations conducting research through the Canadian Water Network on substances of emerging concern.

10.9 Leachate Treatment

Treatment of Otter Lake landfill leachate at Mill Cove emanated from the original agreement between Mirror Nova Scotia and the Halifax municipality that contractually bound the municipality to assume responsibility for treating leachates from the landfill. Mill Cove, the largest facility at the time, was the logical choice for receiving and treating the liquid. The Beechville-Lakeside-Timberlea WWTF was approved by the NSE as an alternate location for the first few years.

Leachate production at the landfill is affected by the application of daily cover, rainfall, establishment of new cells, etc. Accordingly, deliveries of leachate are directly proportional to rainfall amounts and can sometimes be 24 hrs./day for multiple days resulting in overtime costs for plant coverage. Deliveries arrive via 9000-gallon tanker trucks; leachate is deposited directly into a manhole on site that flows by gravity to the onsite pump station where it is mixed with wastewater from Bedford before being conveyed to the plant. Costs are recovered on a quarterly basis at a rate of 2.88 cents per gallon.

Occasionally (once or twice a year) an unknown component of the leachate causes a cloudiness in the effluent resulting in periods of higher-than-normal fecal counts. This issue typically does not cause the plant to be out of compliance but decreases the plant buffer should there be any other issues that may impact the effluent quality.

The Otter Lake leachate imparts color to plant effluent that causes a decrease in transmittance and, accordingly, an increase in the UV light output required to achieve disinfection. It is difficult to quantify, but it is safe to assume there is an increase in power consumption related to leachate treatment. A replacement of the current UV system will be required within the next three years and the color issue may have an impact on the size and cost of the new system.

The organic strength of the liquid leachate ranges from 149-706 mg/L BOD with the bulk of the samples being in the lower part of that range. Assuming a median value of 300, the population equivalent of the material based on current volumes equates to a population of 610 people.

Receipt of the leachate during rainfall events results in increased truck traffic and traffic at all hours of the night in a residential area. The number of noise complaints is increasing and may continue considering the dense development in the immediate vicinity of the plant.

The above issues will remain as long as Halifax Water continues to receive and treat the leachate. Possible mitigation measures available are:

- Halifax Water could advise Halifax municipality that we will no longer be offering the service and that they will need to make alternative arrangements; this may have implications on the municipal contract with the landfill contract operator.

- Halifax Solid Waste is currently holding public information sessions to use the Leachate Treatment Facilities at the Highway 101 Landfill to treat off-site leachate. This facility is owned by Halifax municipality and operated by Halifax Water and is the preferred approach for treatment of Otter Lake landfill leachate. Halifax Water will work cooperatively with Halifax municipality with a target of successful diversion within the timeframe of this business plan. The expanded capacity at EPWWTF could be an alternate to treat this leachate. The potential opportunity could be explored further when Halifax Water takes control of plant operations on February 1, 2015.

10.10 Halifax Harbour Solutions Project (HHSP) Facilities

The HHSP facilities are very compact. This compact footprint was achieved by utilizing more complex mechanical equipment. The facilities are about 8 years old and thus the repair and maintenance of the equipment has been increasing. Halifax Water's Asset Management Program is underway and includes asset condition assessments which will assist in better planning of equipment replacement. These facilities will require robust asset management plans considering the equipment cost in these facilities is about 50% of the initial capital cost. Halifax Water has undertaken several optimization efforts to

efficiently operate these plants with documented success. These efforts will continue with a focus on energy and chemical optimization.

10.11 Aerotech Wastewater Treatment Facility

The existing Aerotech WWTF has a nominal average hydraulic capacity of 1,360 m3/day and a maximum capacity of 2,080 m3/day. The plant is approaching its design limit during dry weather and is challenged in handling peak wet weather flows. It is estimated that plant overflows occurred about once or twice per month on average in 2013-14. The recent optimization results have been encouraging where the overflow frequency has reduced to once per year and the plant is marginally non-compliant. Halifax Water staff have recently taken action to reduce extraneous effluent loading including treatment of Mill Cove sludge at Herring Cove and treatment of Eastern Passage sludge at Dartmouth to improve overall plant performance. New regulations under the Fisheries Act will require more stringent effluent quality standards in the near future, which will further exacerbate plant performance. An environmental risk assessment of the receiving waters is completed in preparation for a future upgrade and expansion.

The Aerotech Servicing Study completed in July 2008 provided growth projections for the Airport and Aerotech Park serviced area over a 25-year planning horizon. The anticipated wastewater production from the tributary area was estimated to average 3,000 m3/day by 2033. The report identified potential expansion and upgrading options for the WWTF capable of meeting existing and anticipated more stringent effluent requirements. The upgrade to the Aerotech WWTF is currently proposed for 2015/16 and 2016/17 at a concept level cost estimate of $21M. The final project cost will be developed in conjunction with the project design. External funding opportunities are being pursued through the Building Canada Fund which will mitigate the total net cost to Halifax Water and impact on the rate structure.

In addition to regular capital project requirements within the wastewater system, a major lagoon dredging and sludge dewatering operations project was proposed for 2013/14 but later amended. A more practical approach was utilized to dewater the lagoon slowly and dredge the lagoon using traditional excavation equipment resulting in significant cost savings.

The Aerotech WWTF receives over 50% of the flow from the Halifax Stanfield International Airport (HSIA) which is owned and operated by Halifax International Airport Authority (HIAA). The related collection system was in poor condition and a significant contributor of I&I. HIAA has been active in 2011, 2012, and 2013 to renew wastewater collection assets and Halifax Water will continue to work with HIAA to improve system performance. The plant also serves the Aerotech Business Park owned by Halifax municipality. The municipality has committed to limit additional development to mitigate further compliance problems until the Aerotech plant is upgraded and expanded.

As recommended in a consultant report, the side streams that contribute to the Aerotech WWTF are being investigated with options to divert them to alternative locations to reduce the loading on the plant. A comprehensive accounting of the side streams was performed in 2012/13 and a significant effort was made to decrease side streams by diverting sludge normally dewatered at the Aerotech WWTF to Harbour Solutions WWTFs. In May of 2012, Halifax Water informed septage haulers that their discharge volumes were capped at 2011/12 levels until a more permanent solution could be found for treatment of additional volumes. In 2013, a pilot program was initiated to allow septage haulers to discharge in the Urban Core system. This pilot was successful, and with NSE approval over 60% of the septage was diverted into the Urban Core system in 2014.

Staff have investigated various strategies to optimize operations to bring the facility into compliance in the short term until such time as the treatment plant can be expanded. The Aerotech Lagoon has been utilized to further equalize flows and thus reduce peak hydraulic loading on the plant which has curtailed the discharge of untreated overflows to the receiving water. This effort ensured that the plant receives consistent flows thus enabling the treatment of effluent in a steady state which helps improve compliance. Staff are also paying special attention to ammonia reduction at this facility to enable it to perform up to its design capacity. This optimization exercise will complement an efficient upgrade and expansion strategy.

The plant will be undergoing a major upgrade with construction scheduled to begin in 2015. The preliminary design has been completed with final design subject to approval of funding from the Building Canada Fund.

10.12 Small Wastewater Treatment Facilities

Lockview MacPherson WWTF

The Lockview MacPherson WWTF is located in Fall River and was constructed in 1994. It has a treatment capacity of 454 m^3/ day and serves both residential and commercial customers. The existing treatment plant processes include grit removal, extended aeration, secondary clarification, filtration, and ultraviolet disinfection.

The treatment facility currently experiences problems with the biological process due to excessive flow after heavy rainfall events and suspected toxic shock loading. Washout and process upset presents as elevated TSS in the effluent. Halifax Water has engaged Environmental Services to investigate the toxic shock loading and develop a plan to deal with the suspected occurrences.

There are also ongoing operational and maintenance issues related to the surge tank configuration, the extended aeration process and its ability to address organic loading, and

surcharging of the ultraviolet disinfection system during heavy storm events. An assessment was conducted in 2012 that included specific recommendations to address these ongoing issues at this facility. The solids handling system was upgraded in 2014 and the facility now has automated control over sludge recirculation and wasting. Operationally the process will be optimized to best utilize the recent upgrade and increase the level of treatment. Halifax Water staff, with the assistance of an expert consultant, will continue to optimize this facility over the next year. The objective is to bring this facility fully into compliance, without the need for a major upgrade, by the end of 2014/15.

Beechville Lakeside Timberlea WWTF

This sewershed is undergoing major reconfiguration, the most significant being the diversion of flows to the Halifax system. This diversion will reduce the flow to this facility by approximately 34% with the construction of the trunk sewer through the Chain of Lakes Trail, scheduled for completion in 2015. The current facility suffers some compliance challenges; not only from a hydraulic and process capacity perspective but also related to equipment reliability. In the past few years, some major maintenance has been undertaken to keep the facility operating at a reasonable level. A comprehensive review of this facility will be undertaken in the next two years to develop options for optimization and upgrades. Planned improvements (subject to available budget) could include flow equalization, an additional bank of rotating biological contactors, UV disinfection, and a finer bar screen.

Frame WWTF

An Environmental Risk Assessment (ERA) was recently completed for this facility. The design/construction of the facility replacement was initially proposed to proceed in 2014/15 and 2015/16 at an estimated cost of $3.3M. However, upon further investigation and optimization, the plant is performing well although not fully compliant. Staff will continue to further their optimization activities with a target to improve the biological process and bring the plant into compliance. Once the process optimization is complete; it is anticipated that some components of the plant will have to be replaced or upgraded. A total plant replacement may not be required which may result in significant cost savings.

Springfield Lake WWTF

A capital works project was carried out which saw the twinning of a section of force main to alleviate wet weather surcharges which necessitated ongoing intervention by wastewater collections staff during storm events. Further efforts will be made to reduce wet weather I&I to improve conveyance with implementation of the SIR program to reduce extraneous stormwater. Long term plans envision a future connection to the Sackville trunk sewer, subject to system improvements to reduce I&I in the Sackville System.

Wellington WWTF

The replacement of the Wellington WWTF was completed in 2013 and the plant is treating effluent to the new regulations associated with the CCME Strategy. There is no other planned capital work for this facility during the next five years.

North Preston WWTF

The North Preston facility was originally constructed in 1988 as a rotating biological contactor (RBC) plant. In 2007, the facility was upgraded and expanded, with a change to sequence batch reactor (SBR) technology complete with UV disinfection and tertiary wetland treatment. In 2010, a new headworks building was added to provide screening of the influent flow. The facility has worked very well but still has a few challenges. They are listed below along with the mitigation strategies:

The facility is required under its permit to attain a minimum pH of 6.5 in the effluent. In the past, it was difficult to consistently meet this requirement as the facility design did not incorporate any means of pH control. Equipment for pH control was installed recently by Halifax Water staff and results to date are very promising.

Design average daily flow at the North Preston facility is 680 m^3/day, and plant records for 2013-14 indicate an average daily flow of 866 m^3/day. The data suggests that I&I is the source of excess flows. Staff have focused on optimizing this plant as well. Recent results have shown the plant is fully compliant with all of its permit parameters. The optimization efforts will continue to maintain compliance. Plant performance data is relatively good given the high flows but would be better if influent flow rates were brought more in line with plant design.

The North Preston WWTF catchment rates as a high priority on the wet weather management prioritization matrix and will be presented to the WWSC as a candidate area for improvement. Depending on the results of the preliminary investigations the sewershed may be selected as a focus area within the WWMP.

10.13 Energy Costs

Through its Energy Management Program, Halifax Water has committed to an ongoing focus on sustainability and energy efficiency throughout the utility, including Water and Wastewater operations. This program serves to define the goals, objectives, accountabilities, and structure for activities related to responsible energy use.

The Water and Wastewater/Stormwater departments operating budgets are significantly impacted by energy costs which are expected to increase over the life of this business plan and beyond.

Table 10.2 provides projected energy costs over the next five years:

Table 10.2 - Projected Energy Cost Increases & Budget Impacts

Year	Electricity	Fuel Oil	Natural Gas	Water Budget Impact ($)	Wastewater Budget Impact ($)	Total Budget Impact ($)
2015/16	2%	5%	10%	$55,000	$125,000	$180,000
2016/17	7%	5%	10%	$170,000	$355,000	$525,000
2017/18	2%	2%	2%	$60,000	$140,000	$200,000
2018/19	2%	2%	2%	$60,000	$145,000	$205,000
2019/20	2%	2%	2%	$60,000	$150,000	$210,000

The Energy Management Action Plan identifies energy reduction targets for Water and Wastewater Operations over a five-year planning period. Targets will be reviewed each year and adjusted for future years based on the previous year's performance, future year's operating and capital budget allocations, and anticipated energy price increases.

Water and Wastewater Operation's energy-reduction targets over the next five years are outlined in Table 10.3:

Table 10.3 - Energy Reduction Targets

Year	Water Operations Projected Savings		Wastewater Operations Projected Savings	
	Energy Reduction Target	Energy Savings (kWh_e)	Energy Reduction Target	Energy Savings (kWh_e)
2015/16	2.0%	435,000	2.0%	860,000
2016/17	2.0%	425,000	2.0%	845,000
2017/18	2.0%	415,000	2.0%	825,000
2018/19	2.0%	410,000	2.0%	810,000
2019/20	2.0%	400,000	2.0%	795,000

As a result of Halifax Water's Energy Management Action Plan, presented with the last general rate application, Halifax Water was able to reduce revenue requirements associated with energy by 2%. Presently the Five-Year Business Plan operating budgets do not incorporate the energy reduction targets outlined in Table 10.3. As future electricity rates become known with greater certainty and the energy savings of various initiatives are

measured, budgets will be adjusted on an annual basis. The projected savings shown above are also contingent on the availability of human and capital resources as approved in the annual operating and capital budgets. As capital budgets are approved or amended, actual energy savings may need to be adjusted on an annual basis.

To date, a number of potential energy-management opportunities (EMOs) have been identified through low to mid-level energy audits in a number of facilities.

For Water Operations, EMOs include HVAC system upgrades; retro-commissioning of PRV-station HVAC systems; lighting retrofits; reactive power correction; variable frequency-drive upgrades; pumping system performance upgrades; and new construction design review for energy efficiency.

For Wastewater Operations, EMOs include effluent stream and ventilation system heat recovery; retro-commissioning of pumping station HVAC systems; UV disinfection system upgrades; UV system channel isolation; odour control system upgrades; lighting retrofits; reactive power correction; variable frequency drive upgrades; and new construction design review for energy efficiency.

A number of these EMOs have been successfully implemented, and some have been partially funded through Efficiency Nova Scotia's various programs.

A number of new construction projects are also being evaluated for energy efficiency improvements. Projects include the new Aerotech Wastewater Treatment Facility, the Bedford West Trunk Sewer and Pumping Station Upgrade (pump system efficiency improvements, area classification/HVAC improvements, lighting, VFDs, motors, etc.), and the Lakeside/Bayers Lake PS Upgrade (pump system efficiency improvements, area classification/HVAC improvements, lighting, VFDs, motors, etc.). Energy efficiency is now an integral part of the overall project evaluation and design process, ensuring improvements are incorporated prior to the construction phase of a given project. This formal approach was adopted for the recent upgrade and expansion of the Eastern Passage WWTF, whereby $7.7 million in energy savings are anticipated over the next 25 years.

A number of Halifax Water's standard design specifications have also been reviewed to ensure energy efficiency is taken into account in any future new construction activities (e.g., wastewater pumping stations, booster stations, treatment plants).

10.14 Chemical Costs

Chemical costs for water treatment make up approximately 10% of the cost of operating the drinking water system and 7 % of the cost of operating the wastewater system.

Historically chemicals have gone through periods of price volatility with factors such as the economy in general, competing demand for raw products from other sectors and market consolidation. In some years, price increases/decreases of as much as 30% have been experienced.

Chemicals are currently in a period of market stability that has not been experienced in the previous two decades, with price increases being in single digits and in some cases prices being held from year to year.

Halifax Water has adopted a strategy of annual tendering, with an option of renewal for two subsequent years at market supported price adjustment as the optimal strategy for achieving price certainty.

Wastewater services uses polymers that are seeing some price reductions recently due to local market conditions and optimization efforts by staff. This has facilitated use of polymers from different suppliers, leading to increased competition in the market.

10.15 Geosmin

As indicated in Section 8.2, in the fall of 2012, Halifax Water experienced a taste and odour episode for the first time in the 35 year history of operating the Pockwock system. Geosmin has reoccurred in 2013 and 2014.

Halifax Water is continuing to study the occurrence of geosmin, however, conclusions to date are that it will continue to reoccur in Pockwock Lake and the most likely causes for its appearance are climate change related. In response, Halifax Water has increased its source water monitoring for geosmin. Results indicate its presence in source waters supplying Middle Musquodoboit, Collins Park and Bomont. Based on limited observations to date, the nanofiltration units in Collins Park and Middle Musquodoboit appear to be effective in removing geosmin. As the Bomont system was in the process of commissioning, samples were not taken for geosmin testing. It is expected that samples will be taken in the near future to determine presence or absence of geosmin. Since little is known about its occurrence, Halifax Water will plan for geosmin to occur at higher levels, for a longer duration or in other sources in the future.

While geosmin is an aesthetic parameter unregulated globally, many people find the related taste and odour unpleasant and associate it with poor water quality.

Since the first occurrence in 2012, Halifax Water has informed customers that they should anticipate at least 3 to 5 years for a treatment solution. In the first year the nature and occurrence of geosmin in Pockwock Lake was studied. In year two, a consultant was hired to determine which unit processes could feasibly be added to the Pockwock plant and the approximate capital and operating costs.

In the summer of 2014, the engineering consultant, AECOM reviewed 6 technically feasible geosmin treatment options. They are recommending that three of those; ozone and two variations of granular activated carbon be considered pilot study. Capital costs for these options range from $3 - $10 million with annual operating costs ranging from $300,000 to $1.6 million. Should Halifax Water elect to implement a geosmin treatment option, the solution may be implemented in the 2017-18 fiscal year.

10.16 External Funding

In 2012 the federal government announced plans to develop a new long term infrastructure fund which would bring all its infrastructure funds together under one umbrella and streamline the application criteria and processes. The new Building Canada Fund was announced in Budget 2013, after a year of consultation with provinces, municipalities and other stakeholders. It will deliver $53.3 billion over 10 years to public infrastructure that supports the federal priorities of productivity, economic growth and job creation. There are several program streams within the Fund, including the Provincial/Territorial Component, a National Infrastructure Fund, and the Gas Tax Fund. Eligibility criteria and application processes for these funds were announced on March 28, 2014, and the programs are now accepting applications.

In anticipation of the new Building Canada Fund accepting applications, Halifax Council identified three priority areas for federal/provincial infrastructure funding in June 2013:

- Water and wastewater
- Transportation
- Urban core investments

These areas were selected based on Council priorities and funding needs in the municipality's ten year capital plan. The three infrastructure priorities were shared with the federal and provincial governments, as well as the Federation of Canadian Municipalities, Union of Nova Scotia Municipalities, and all provincial party caucuses.

On August 5, 2014, Council approved a list of Halifax Water projects for Building Canada Fund applications. The projects were developed based on Halifax Water's Integrated Resource Plan which lays out infrastructure requirements for the next 30 years. Overall, $2.6 billion is needed to meet the three cost drivers of compliance ($595 million), growth ($598 million), and asset renewal ($1.385 billion). The federal wastewater regulations are a significant cost driver for wastewater asset renewal. Despite numerous discussions between the federal government and the FCM, no cost-sharing strategy to assist specifically with the wastewater regulations has been developed. The Building Canada Fund appears to be the only source of federal assistance for wastewater infrastructure.

Halifax Water has identified a number of priority projects which would be eligible for federal funding, and which would have the greatest economic and environmental impact over the next ten years. These are grouped by asset class below:

WASTEWATER

- **Aerotech Wastewater Treatment Facility (WWTF) Expansion ($21 million)**
  The WWTF for the airport and Aerotech Park is nearing capacity and is experiencing difficulty in meeting the stipulated effluent discharge objectives. Further growth is planned for both the airport and Aerotech Park; however, expanded wastewater treatment capacity is necessary to enable further development to occur.

  A preliminary design for an expanded facility was being completed in 2014, and construction could begin as early as 2015 pending project funding approval. This is Halifax Water's top priority project given its impact on economic growth for the airport, industry in the area, and impact to the rate base.

- **Northwest Arm Sewer Rehabilitation ($15.4 million)**
  The 4.5 km Northwest Arm trunk sewer is over a century old. It is only 1200 mm in diameter and a large part of the line is constructed of clay blocks mortared together. This line needs to be structurally renewed and expanded to extend its service life, prevent leakage and overflows into Northwest Arm, increase its capacity and bring it into line with modern environmental standards. This project is proposed to be undertaken in two stages: the first from 2015-16 to 2016-17 at a cost of $4.4 million, and the second after 2016-17 at an estimated cost of $11 million.

- **Bedford Sackville Trunk Sewer Storage Facility ($20 million)**
  This project is the design and construction of a large underground wastewater storage facility to hold peak flows in the wastewater system resulting from stormwater inflow and infiltration. The storage facility will provide wastewater system capacity and reduce sanitary sewer overflows and improve regulatory compliance.

STORMWATER

- **Deep Storm Sewer Program ($5.5 million)**
  There are many areas throughout Halifax municipality with no formal stormwater system. In these areas a significant amount of stormwater is introduced to the wastewater system through illegal connections from abutting homes. This project would construct new deep storm sewers to properly drain house foundations and

remove the extraneous flow from the wastewater system thus improving wastewater system operations and improving regulatory compliance.

- **Sullivan's Pond Storm Sewer Renewal ($8 million)**
  The existing storm sewer between Sullivan's Pond and Halifax Harbour has reached the end of its service life. A new 580 meter line is being designed in 2014, with phased construction beginning in 2015.

WATER

- **Lake Major Dam Replacement ($2.1 million)**
  A dam is required to impound water within Lake Major to provide water supply to Dartmouth and Cole Harbour. A new dam is required to replace the existing gravity timber and earthen structure which has reached the end of its service life. Design work is proposed for 2014-15, with construction to begin in 2017.

- **Water Transmission Main Renewal/Redundancy ($15.2 million for three projects)**
  - **Bedford Connector ($2.2 million)**
    Replacement/rehabilitation of the transmission main along Hammonds Plains Road and the Highway 102 corridor. This main is the primary supply main to Bedford and Sackville. The existing pipe is under very high pressure and has had a number of leaks and failures in recent years.
  - **Port Wallace area ($6 million)**
    Twinning of the existing water transmission main to provide increased system redundancy and additional capacity to the expanding development in Burnside Industrial Park and Port Wallace area.
  - **Lucasville ($7 million)**
    Construction of a new transmission main from Pockwock to Sackville-Beaverbank, to help address emergency water supply capacity, system redundancy and meet new development requirements. Construction is expected to begin in 2014 and extend over approximately 8 years as development opportunities progress.

In addition to the IRP based priority projects above, Halifax Council recently added two others to the list: Fall River Water Service Extension, and Herring Cover Water and Sewer Phase IV.

10.17 Flood Plain Delineation

Throughout the municipality there are many existing and proposed commercial and residential developments that are adjacent to or within the natural flood plain of existing water courses. Existing flood plain mapping is out of date and not fully reflective of the potential impacts of floods on adjacent lands. New, updated flood plain mapping, reflective of the potential impacts of climate change, are critical for the management and protection of development activity.

Halifax Water has a mitigative strategy to obtain enhanced information in a collaborative effort with the other levels of government within this region. The Federal Government recently released a ***Final Report on the National Floodplain Mapping Assessment***. A proposed collaborative approach will work on important next steps that include, establishing priorities, field data collection, funding models and enhanced technical standards for mapping.

11. RECOMMENDATIONS FOR RATE APPLICATIONS

11.1 Urban Core, Airport/Aerotech, and Satellite Systems

In recognition that Halifax Water incurred an operating loss in 2013/14 and is projecting a loss in 2015/16 and 2016/17, a two year rate application will be filed with the NSUARB in November 2014 to address the following objectives.

1) Provide sufficient operating revenue for the 2015/16 and 2016/17 fiscal years to cover the operating and non-operating costs for water and wastewater. No adjustment of stormwater rates will be requested at this time.

2) Provide sufficient operating revenue to accommodate increasing depreciation and debt servicing.

3) Provide rate stability to continue delivery of the Integrated Resource Plan to address the infrastructure deficit and regulatory compliance issues facing the utility.

The Business Plan and rate application include an annual increase in customer base of 700 customer connections divided between domestic, industrial, commercial, multi-residential and institutional based on the average increase over the past four years. The increase in customers results in additional consumption which only partially mitigates the 3% reduction in the annual volume of water sold.

No rate adjustment for stormwater services is contemplated for 2015 as the revenue requirement has not dramatically increased, and staff are still working through

implementation of the new rate structure and considering ways to improve and refine it. Additionally, unlike water and wastewater service where consumption is decreasing annually, impervious area (the basis for the stormwater charges) is increasing due to development.

The proposed application will be the second made under the new cost of service/ rate design, and will be for a consolidated system that includes the Aerotech/Airport, Urban Core & Satellite Systems.

Recommendations for the proposed Rate Application will be presented to the Halifax Water Board in November 2014.

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Appendix A

Mission, Vision & Corporate Balanced Scorecard

Halifax Water

Our Mission:

"To provide world class services
for our customers and our environment"

Our Vision:

- *We will provide our customers with high quality water, wastewater, and stormwater services.*
- *Through adoption of best practices, we will place the highest value on public health, customer service, fiscal responsibility, workplace safety and security, asset management, regulatory compliance, and stewardship of the environment.*
- *We will fully engage employees through teamwork, innovation, and professional development.*

Halifax Water

Measuring Performance through a Corporate Balanced Scorecard

Providing world-class services for our customers and our environment

Background of Corporate Balanced Scorecard

- HRWC embarked on a Continuous Improvement Program in 1999
- In 2000, HRWC looking for methodology to measure organizational performance that was meaningful
- Introduced to concept of Corporate Balanced Scorecard [CBS] through association with Bridgeport Hydraulics, Connecticut
- HRWC Board approved CBS in 2001 and Organizational Award Program on March 28, 2002
- CBS ensured all employees focused on strategic outcomes
- After the wastewater merger on August 1/07, recognition that CBS should be expanded to include wastewater/stormwater performance measures and opportunity to recalibrate water measures

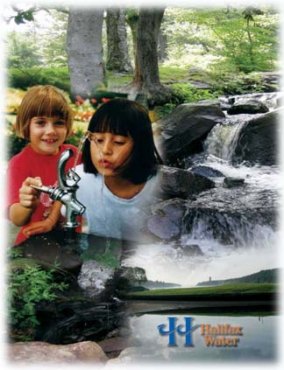
The Process

- In late fall 2007, struck a steering committee and selected a group of forty employees to review the utility mission, vision and develop expanded scorecard
- Good cross section of employees representing all departments, all levels, union and management [front line to General Manager]
- Three steering committee meetings and two staff workshops held with facilitation by an outside consultant, Jack Duffy

The Process

- Developed a new mission statement which had to change as a result of the merger in 2007
- Identified critical success factors [CSFs] in support of the new mission
- Developed organizational indicators [OIs] to measure performance
- Received approval of the revised CBS from the Halifax Water Board and a revised organizational award program on March 6, 2008

The Mission of Halifax Water



"To provide world class services for our customers and our environment"

Halifax Water

The Vision of Halifax Water

- **We will provide our customers with high quality water, wastewater, and stormwater services.**
- **Through adoption of best practices, we will place the highest value on public health, customer service, fiscal responsibility, workplace safety and security, asset management, regulatory compliance, and stewardship of the environment.**
- **We will fully engage employees through teamwork, innovation, and professional development.**

Halifax Water

Critical Success Factors

- High Quality Drinking Water
- Service Excellence
- Responsible Financial Management
- Effective Asset Management
- Workplace Safety and Security
- Regulatory Compliance
- Environmental Stewardship
- Motivated and Satisfied Employees

Organizational Indicators

- Organizational Indicators (OI's) are the measures of our performance within each CSF and provide the definition and detail to best understand them. The OI's are organizational, not individual measures.
- The OI's provide both a detailed clarification of the CSF and allow a target or goal for performance to be established and tracked.

Organizational Performance Award Program

- Based on a subset [12] of our strategic OI's which are the most objective.
- Program pays for itself by meeting operating expense to revenue ratio target; ratio is reduced from approved budget to accommodate the award program potential.
- It is not a given; a threshold of 7.0 in scoring must be reached in a given year.
- To be eligible for the award, employees must work a minimum of nine months during the fiscal year [April 1st to March 31st]

The CBS Targets for 2014/15 Fiscal Year

- Organizational Indicators with a star ★ are tied to the Award Program

CSF: High Quality Drinking Water

- **Organizational Indicators:**
  - Adherence with 5 objectives from the Water Quality Master Plan for all water systems; we must own system for one year to include results [target of 90% adherence] ★
  - Bacteriological tests [Monthly target of 99.3% free of Total Coliform]
  - Customer satisfaction about water quality [Target of 85% rating water quality as good to excellent] ★

CSF: Service Excellence

- **Organizational Indicators:**
  - External customer survey about service [Target of 90% satisfied or very satisfied with service] ★
  - Service outages of water [Target of 200 connection hours / 1000 customers]
  - Service outages of wastewater [Target of10 connection hours / 1000 customers]. (N.B. the clock starts after we know it is our system)
  - Average call wait time over the year [Target of 70 seconds]

CSF: Responsible Financial Management

- **Organizational Indicators:**
  - Operating Expense/Revenue ratio; target of 0.733 ★
  - Annual Cost per customer connection [$ per connection-Water]; target of $439
  - Annual Cost per customer connection [$ per connection-Wastewater]; target of $637
  - Annual Cost per customer property [$ per property - Stormwater]; target to be established in 2015/16 after base year results

CSF: Effective Asset Management

- **Organizational Indicators:**
  - Water Loss Control; target leakage allowance of 165 litres per service connection per day [IWA performance measure] ★
  - Inflow and Infiltration [I&I] Reduction; Target of 250 inspections of private property in relation to discharge of stormwater into the wastewater system [SIR Program] ★
  - % of water, wastewater and stormwater network available on GIS [Target of 78.8%] ★ Note: Current coverage at 71.8%

CSF: Workplace Safety & Security

- **Organizational Indicators:**
  - # of incidents with written compliance orders received from NS L*abour* and Advanced Education [Target of zero with maximum of 2 per year]
  - lost time accidents [# of accidents resulting in lost time per 100 employees [Target of 4 with a maximum of 5 per 100 employees]. Gateway Target of no more than 6 per 100 employees ★
  - # of traffic accidents per 1,000,000 km [Target of 4 with maximum of 5] ★
  - Employees are retrained or recertified before due date [Target maximum of 100% with minimum of 90%]
  - Supervisors complete weekly or bi-weekly Safety Talks [Target maximum of 95% with minimum of 85%]

Halifax Water

CSF: Regulatory Compliance

- **Organizational Indicators:**
  - # of public health and environmental regulatory infractions resulting in an Environmental Warning Report, Summary Offence Ticket, Ministerial Order or prosecution. [Target of zero with maximum of 2 per year]
  - % of WWTFs complying with NSE approval permits for all reporting periods. Note: does not include Belmont WWTF which is scheduled to be taken out of service in 2015/16. [Target of 85% compliance] ★
  - % of water supply plants meeting product regulations of their permits; we must own system for one year to include as a measure. [Target of 100% compliance]

Halifax Water

Environmental Stewardship

- **Organizational Indicators**
  - Target of 400 ICI properties in HRM inspected by Pollution Prevention [P2] section
  - Energy management [kwh]; Target of 3.0% energy reduction associated with capital projects. ★
  - Bio-solid residuals handling; % of sludge meeting solids concentration target [Target of 96 % of samples meet a minimum solids concentration of: HHSP 25%, Aerotech Dewatering Facility 18%] ★

CSF: Motivated and Satisfied Employees

- **Organizational Indicators:**
  - # of arbitrations divided by total # of grievances. [Target of 0 Arbitrations]
  - % of jobs filled from within HW (excluding entry level jobs). [Target of 80%]
  - Employee satisfaction survey [Target of A- rating from internal survey; benchmark of B established in 2009].
  - Average number of days of absenteeism. [Target of < 7 days]

2014/15 Organizational Award

Based on a subset of 12 OIs which are the most objective:

- Water Quality Master Plan Objectives
- Customer Water Quality Survey Results
- Customer Service Survey Results
- Operating Expense/Revenue Ratio *[Gateway Indicator]*
- Water Loss Control
- Inflow & Infiltration Reduction
- Percentage of Network on GIS
- Number of Lost Time Accidents per 100 employees *[Gateway Indicator]*
- Number of Traffic Accidents per 1,000,000 km
- Percentage of WWTFs Compliant with NS Environment Permits
- Energy Management
- Biosolid Residual Handling

Halifax Water

Employees Organizational Award

The highest possible score is 12.0 [1.0 for each OI]. If HRWC performs well, then everyone should be rewarded as follows:

Total OI Score	OP Award Amount
≥11.0	$1,000
10.0	$900
9.0	$800
8.0	$700
7.0	$600
< 7.0	$0

These values will be pro-rated if a score falls between them.

***Example*: For the total OP Award score of 8.5, each employee will get an organizational award of $750.**

Halifax Water

Summary

- **The track record of the CBS at Halifax Water has been very positive; it has made us a better utility.**
- **The CBS process continues to be an inclusive and consensus building exercise for employees.**
- **Staff obtains Board approval of the Organizational Award Program on an annual basis**
- **Organizational Award Program funding is available by meeting the Operating Expense to Revenue Ratio Target.**
- **The Organizational Award Program is not a given; the organization must score at least 7.0 to have an award.**
- **Financial targets are consistent with approved annual operating budget.**

Appendix B

Organizational Chart

Halifax Water

HALIFAX WATER

COMMISSIONER
Ray Ritcey

COMMISSIONER
David Hendsbee

COMMISSIONER
Richard Butts

COMMISSIONER
Mayor Mike Savage

CHAIR
Ken Meech

VICE CHAIR
Russell Walker

COMMISSIONER
Barry Dalrymple

COMMISSIONER
Don Mason

COMMUNICATIONS & PR COORDINATOR
James Campbell
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GENERAL MANAGER
Carl Yates
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ADMIN ASSISTANT II
Sandy Hood
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DIRECTOR
ENVIRONMENTAL SERVICES
Kenda MacKenzie
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ADMIN ASSISTANT
Jeannie Fraser
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MANAGER REGULATORY COMPLIANCE
Tony Blouin
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MANAGER ENVIRONMENTAL ENGINEERING & POLLUTION PREVENTION
Charles Lloyd
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MANAGER SAFETY AND SECURITY
Pat Bellemare
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OFFICE ASSISTANT
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DIRECTOR
ENGINEERING & INFORMATION SERVICES
Jamie Hannam
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ADMIN ASSISTANT
Nola Button
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Tom Gorman
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MANAGER, WASTEWATER/ STORMWATER INFRASTRUCTURE ENGINEERING
WEST/CENTRAL
David Ellis
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MANAGER ASSET MANAGEMENT WASTEWATER/ STORMWATER
Val Williams
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MANAGER, WASTEWATER/ STORMWATER INFRASTRUCTURE ENGINEERING
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Ian Guppy
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MANAGER, ENGINEERING APPROVALS
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ENGINEERING INFORMATION MANAGER
Harold MacNeil
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INFORMATION SERVICES MANAGER
Dayalan Pillay
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MANAGER ENERGY EFFICIENCY
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DIRECTOR
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WEST REGION SUPERINTENDENT
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EAST REGION SUPERINTENDENT
Sheldon Parsons
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CENTRAL REGION SUPERINTENDENT
Danny Patey
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FLEET MAINTENANCE & BUILDINGS SUPERVISOR
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TREATMENT FACILITIES SUPERINTENDENT
Rick Reid
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ADMIN ASSISTANT
Carol White
902-832-8631

HALIFAX HARBOUR SOLUTIONS FACILITIES SUPERINTENDENT
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Updated: November 2014
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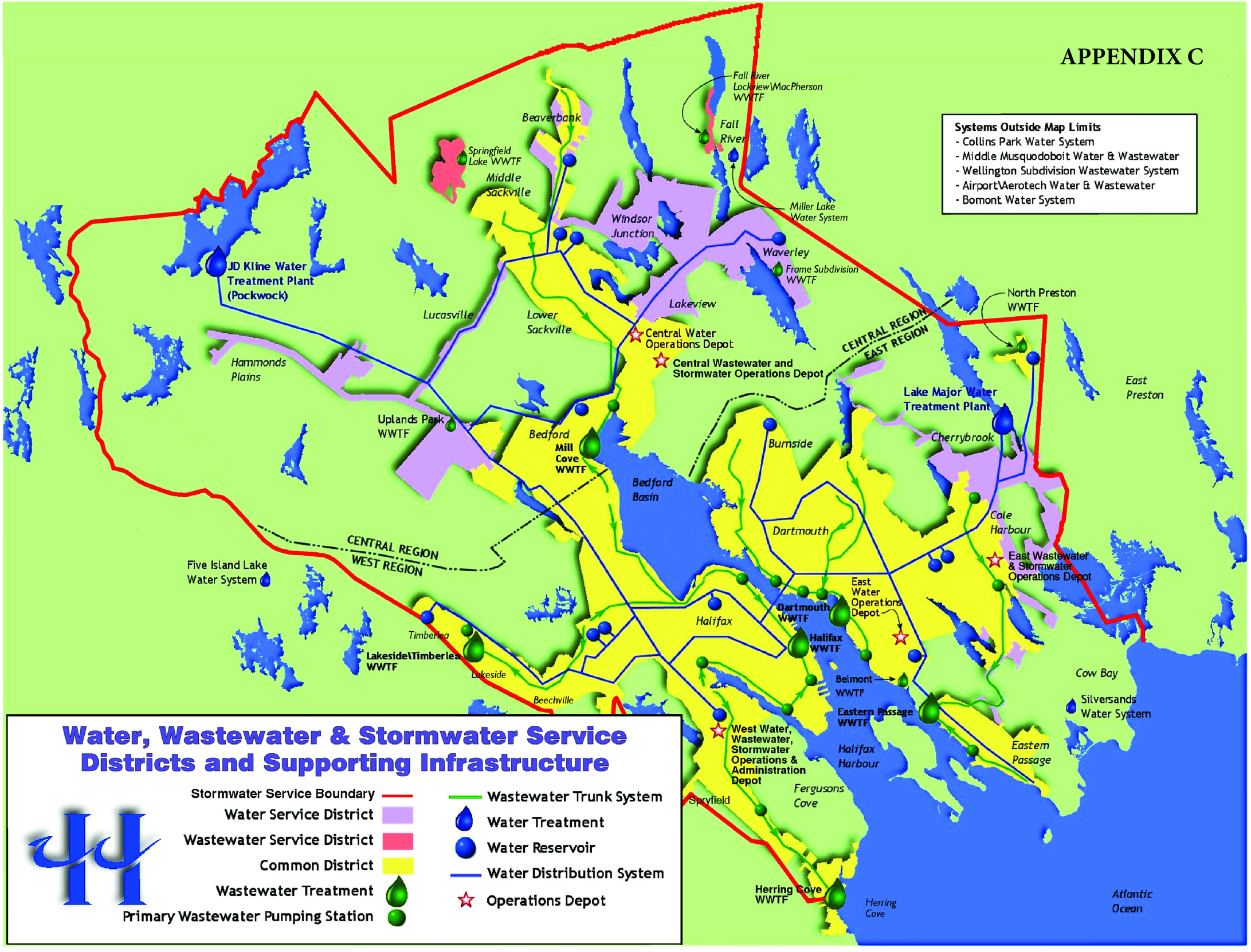
Appendix C

Water, Wastewater & Stormwater

Service Districts and Supporting Infrastructure

Halifax Water

APPENDIX C


Systems Outside Map Limits
- Collins Park Water System
- Middle Musquodoboit Water & Wastewater
- Wellington Subdivision Wastewater System
- Airport\Aerotech Water & Wastewater
- Bomont Water System
Fall River Lockview\MacPherson WWTF
Fall River
Miller Lake Water System
Beaverbank
Springfield Lake WWTF
Middle Sackville
Windsor Junction
Waverley
Frame Subdivision WWTF
Lakeview
North Preston WWTF
East Preston
JD Kline Water Treatment Plant (Pockwock)
Lucasville
Lower Sackville
Central Water Operations Depot
Central Wastewater and Stormwater Operations Depot
CENTRAL REGION
EAST REGION
Hammonds Plains
Uplands Park WWTF
Bedford
Mill Cove WWTF
Bedford Basin
Burnside
Lake Major Water Treatment Plant
Cherrybrook
Cole Harbour
East Wastewater & Stormwater Operations Depot
Dartmouth
East Water Operations Depot
Dartmouth WWTF
Halifax
Halifax WWTF
Belmont WWTF
Eastern Passage WWTF
Cow Bay
Silversands Water System
Eastern Passage
West Water, Wastewater, Stormwater Operations & Administration Depot
Halifax Harbour
Fergusons Cove
Spryfield
CENTRAL REGION
WEST REGION
Five Island Lake Water System
Timberlea
Lakeside\Timberlea WWTF
Lakeside
Beechville
Herring Cove WWTF
Herring Cove
Atlantic Ocean
Water, Wastewater & Stormwater Service Districts and Supporting Infrastructure
Stormwater Service Boundary
Water Service District
Wastewater Service District
Common District
Wastewater Treatment
Primary Wastewater Pumping Station
Wastewater Trunk System
Water Treatment
Water Reservoir
Water Distribution System
Operations Depot

Appendix D

Approved Capital Budget

2014/15

Halifax Water

HALIFAX WATER

Capital Budget 2014/15

Urban Core System

Summary

Asset Category	Project Costs
Water - Land -- T O T A L	$110,000
Water - Transmission -- T O T A L	$12,025,000
Water - Distribution -- T O T A L	$5,837,000
Water - Structures -- T O T A L	$925,000
Water - Treatment Facilities -- T O T A L	$769,000
Water - Energy -- T O T A L	$260,000
Water - Security -- T O T A L	$50,000
Water - Equipment -- T O T A L	$98,000
Water - Corporate Projects - T O T A L	$2,566,000
TOTAL - Water	**$22,640,000**

Wastewater - Trunk Sewers -- T O T A L	$11,483,000
Wastewater - Collection System -- T O T A L	$7,880,000
Wastewater - Forcemains -- T O T A L	$1,126,000
Wastewater Structures -- T O T A L	$1,650,000
Wastewater - Treatment Facility -- T O T A L	$2,503,000
Wastewater - Energy -- T O T A L	$552,200
Wastewater - Security -- T O T A L	$200,000
Wastewater - Equipment -- T O T A L	$137,000
Wastewater - Corporate Projects -- T O T A L	$3,024,600
TOTAL - Wastewater	**$28,555,800**

HALIFAX WATER

Capital Budget 2014/15

Urban Core System

Summary

Asset Category	Project Costs
Stormwater - Pipes -- T O T A L	$6,854,000
Stormwater - Culverts -- T O T A L	$1,024,000
Stormwater - Structures -- T O T A L	$1,034,000
Stormwater - Corporate Projects -- T O T A L	$737,400
TOTAL - Stormwater	**$9,649,400**
G R A N D T O T A L	**$60,845,200**

HALIFAX WATER

Capital Budget 2014/15

Urban Core System

Water

Project Number	Project Name	Project Cost
	Water - Land	
3.033	Watershed Land Acquisition	$100,000
3.214	Forest Road Bridge Replacement - Tomahawk Lake Watershed lands	$10,000
	Water - Land -- T O T A L	**$110,000**
	Water - Transmission	
3.012	Pockwock Transmission Main Replacement, Phase 2 - Bluewater Valve Chamber to Hammonds Plains Road	$11,500,000
3.175	Macdonald Bridge Transmission Main Replacement	$354,000
3.179	Spruce Hill Transmission Main Access Road Improvements	$49,000
	Benefit to Existing Customers - Development Area Capital Cost Contribution Projects:	
3.043	- Bedford South	$87,000
3.045	- Bedford West	$30,000
3.113	- Northgate	$5,000
	Water - Transmission -- T O T A L	**$12,025,000**
	Water - Distribution	
3.022	Water Distribution - Main Renewal Program	$4,000,000
3.035	Customer Meter Replacement Program	$1,150,000
3.067	Distribution System Valve Replacement Program	$125,000
3.068	Hydrant Replacement Program	$75,000
3.069	Service Line Renewal Program	$240,000
3.168	Central Region Zone Meter Replacement	$34,000
3.209	Main Road 400 mm Renewal - Design	$100,000
3.187	Automated Flushing Station	$16,000
3.177	Rechlorination Station Upgrades	$22,000
3.217	Water Quality Model	$75,000
	Water - Distribution -- T O T A L	**$5,837,000**
	Water - Structures	
3.189	Beaver Bank Booster Station Driveway Reconfiguration	$38,000

HALIFAX WATER

Capital Budget 2014/15

Urban Core System

Water

Project Number	Project Name	Project Cost
3.184	Highway #7 Booster Station Upgrades	$114,000
3.169, 3.170, 3.171	Confined Space Entry Retrofits - various locations	$119,000
3.178	Sackville Drive PRV Upgrade	$15,000
3.152	PRV Chamber Oceanview Drive - Bedford South	$156,000
3.188	Atholea Drive PRV Replacement	$170,000
3.182	Waverley Road PRV Chamber Decommissioning	$10,000
3.190	Bulk Fill Stations - New Card Readers and Terminals	$103,000
3.173	Lake Major Dam Replacement - Design Phase	$200,000
	Water - Structures -- T O T A L	**$925,000**
	Water - Treatment Facilities	
	J D Kline Water Supply Plant:	
3.139	- Replacement program for Filter Valve Actuators	$45,000
3.141	- Replace Valve Actuators at Pumping Station	$95,000
3.155	- Improved Ventilation at Pumping Station	$15,000
3.157	- Filter Media Replacement	$300,000
	Lake Major Water Supply Plant:	
3.158	- HVAC at Low Lift Pumping Station	$30,000
3.159	- Replace Contactors in Motor Control Centre	$24,000
3.162	- Butterfly Valve Replacement Program	$30,000
3.163	- Process Waste Handling Study	$50,000
3.201	- Process Optimization Study	$110,000
3.203	- Fire Alarm System Upgrade	$11,000
3.164	Bo-Mont Water Supply Plant- Study to Review Pre-Treatment Options for Colour Control	$30,000
3.211	Chlorine Analyzers	$18,000
3.212	Chemical Feed Pumps - Rechlorination Stations	$11,000
	Water - Treatment Facilities -- T O T A L	**$769,000**
	Water - Energy	
3.109	JD Kline - Industrial Process Pumps Upgrade	$110,000

HALIFAX WATER

Capital Budget 2014/15

Urban Core System

Water

Project Number	Project Name	Project Cost
3.200	Water Supply Plant Energy Management Information System - Phase 1	$150,000
	Water - Energy -- T O T A L	**$260,000**
	Water - Security	
4.009	Security Upgrade Program	$50,000
	Water - Security -- T O T A L	**$50,000**
	Water - Equipment	
3.101	Miscellaneous Equipment Replacement	$30,000
3.174	Leak Detection Equipment - West Region	$10,000
3.176	Pipe Locator Equipment - West Region	$10,000
3.181	Trav-L Vac Unit - West Region	$21,000
3.191	Asphalt Cutting Service Trailer - East Region	$15,000
3.180	Storage Containers for Facility Yard – East Region	$12,000
	Water - Equipment -- T O T A L	**$98,000**
	Water - Corporate Projects - T O T A L	**$2,566,000**
	GRAND TOTAL - WATER	**$22,640,000**

HALIFAX WATER

Capital Budget 2014/15

Urban Core System

Wastewater

Project Number	Project Name	Project Cost
	Wastewater - Trunk Sewers	
2.035	CN Quinpool Bridge Structure - Replacement of 450mm Combined Sewer	$100,000
2.010	Lakeside Pumping Station Diversion Project	$11,228,000
2.067	Northwest Arm Sewer Rehabilitation - Design	$155,000
	Wastewater - Trunk Sewers - -- T O T A L	**$11,483,000**
	Wastewater - Collection System	
2.331	Condition Assessment - Zoom Camera Inspection	$233,000
2.332	Condition Assessment - Closed Circuit Television Inspection	$91,000
2.333	Condition Assessment - Data Mining	$204,000
2.357	Manhole Renewals	$27,000
2.358	Lateral Replacements	$1,428,000
4.021	Collection System Renewal Projects Integrated with HRM Street Renewal Projects	$1,750,000
2.043	Corporate Flow Monitoring Program	$549,000
2.117	Sewer Lining - Trenchless Pilot Project - Crescent Avenue Sewershed	$1,014,000
2.157	Alder Crescent Collection System Replacement - Design	$10,000
2.223	Wet Weather Management Planning Program	$250,000
2.195	Gravity sewer from Little Albro Lake to Jamieson St Pumping Station - Design	$200,000
	Benefit to Existing Customers - Development Area Capital Cost Contribution Projects:	
2.074	- Bedford West Collection System	$1,390,000
2.073	- Portland Hills Collection System	$5,000
	- Russel Lake Collection System	$5,000
2.359	Halifax - Herring Cove Sewersheds Master Plan	$499,000
2.360	Mill Cove Sewershed Master Plan	$225,000
	Wastewater - Collection System -- T O T A L	**$7,880,000**

HALIFAX WATER

Capital Budget 2014/15

Urban Core System

Wastewater

Project Number	Project Name	Project Cost
	Wastewater - Forcemains	
2.032	Shore Drive - Forcemain Replacement and Twinning	$626,000
2.022	Fish Hatchery Park Pumping Station - Forcemain Condition Assessment	$500,000
	Wastewater - Forcemains -- T O T A L	**$1,126,000**
	Wastewater - Structures	
2.046	Wastewater Pumping Station Upgrade Program - Various Locations	$550,000
2.039	Belmont Wastewater Treatment Facility Decommissioning - Design	$150,000
2.091	Bedford Pumping Station Rehabilitation - Design	$300,000
2.361	Eastern Passage Pumping Station - Efficiency/Pump Control	$650,000
	Wastewater Structures -- T O T A L	**$1,650,000**
	Wastewater - Treatment Facility	
2.050	Wastewater Treatment Facilities Upgrades (Various Locations)	$250,000
	Halifax Wastewater Treatment Facility Upgrade Program:	
2.346	- Fixed Monorail for Extraction/Recir Pumps	$40,000
2.347	- Fine Screen Upgrade	$73,000
2.345	- Densadeg Inlet Penstocks	$39,000
	Dartmouth Wastewater Treatment Facility Upgrade Program:	
2.342	- Basement emergency sump pump and pipework	$43,000
2.343	- Fine Bar screen upgrade	$66,000
2.344	- Upgrade Type M controller for UV system	$135,000
2.340	- Permanent access ladder to roof	$18,000
2.341	- UV system local isolators	$22,000
	Herring Cove Wastewater Treatment Facility Upgrade Program:	
2.349	- Sludge Holding tank mixers upgrade	$38,000
2.350	- Public Address System	$19,000
	Mill Cove Wastewater Treatment Facility Upgrade Program:	
2.266	- Emergency Overflow Outfall Pipe Replacement	$860,000
2.124	- UV Upgrade	$75,000

HALIFAX WATER

Capital Budget 2014/15

Urban Core System

Wastewater

Project Number	Project Name	Project Cost
2.330	Beechville Lakeside Timberlea Wastewater Treatment Facility - Upgrades Design	$400,000
2.164	HRM - Sludge Management Study	$150,000
2.126	Biosolids Processing Facility - Upgrade Program	$150,000
2.056	Plant Optimization Audit Program	$125,000
	Wastewater - Treatment Facility -- T O T A L	**$2,503,000**
	Wastewater - Energy	
2.265	Wastewater Treatment Facility Energy Management Information System - Phase 1	$150,000
	Dartmouth Wastewater Treatment Facility Upgrades:	
2.250	- Variable-Frequency Drive Upgrades	$80,000
2.251	- Domestic Hot Water Heat Pump	$7,000
	Halifax Wastewater Treatment Facility Upgrades:	
2.256	- UV Channel Isolation (Phase 1) & UVT Monitoring & Control (Phase 2)	$50,000
2.257	- Variable-Frequency Drive Upgrades	$83,000
2.248	- Heat Recovery Phase 1 - Ventilation Air	$140,000
2.259	- Domestic Hot Water Heat Pump	$7,200
2.260	- Variable-Frequency Drive Upgrades	$35,000
	Wastewater - Energy -- T O T A L	**$552,200**
	Wastewater - Security	
4.008	Security Upgrade Program	$200,000
	Wastewater - Security -- T O T A L	**$200,000**
	Wastewater - Equipment	
2.161	SIR Program Flow Meters and Related Equipment	$75,000
2.338	Lateral Lining Equipment	$50,000
2.337	Lifting Davit	$12,000
	Wastewater - Equipment -- T O T A L	**$137,000**
	Wastewater - Corporate Projects -- T O T A L	**$3,024,600**
	GRAND TOTAL - WASTEWATER	**$28,555,800**

HALIFAX WATER

Capital Budget 2014/15

Urban Core System

Stormwater

Project Number	Project Name	Project Cost
	Stormwater - Pipes	
1.089	Infiltration and Inflow Reduction Program	$400,000
1.038	Stormwater System Renewal Projects Integrated with HRM Street Renewal Projects	$575,000
1.019	Drainage Remediation Program Surveys/Studies	$50,000
1.051	Sackville Cross Road Stormwater System Renewal - Design	$110,000
1.098	Cow Bay Road Deep Storm Sewer Installation	$4,560,000
1.097	Metropolitan Avenue - Stormwater Improvements	$586,000
1.043	Sullivan's Pond Storm Sewer System Replacement - Design	$250,000
1.068	Acadia Mill Drive/Salmon River Terrace Storm Sewer Rehabilitation	$125,000
1.102	Manhole Renewals	$24,000
1.103	Catchbasin Renewals	$24,000
1.105	Grafton and Argyle Streets - Sewer Separation	$150,000
	Stormwater - Pipes -- T O T A L	**$6,854,000**
	Stormwater - Culverts/Ditches	
1.104	Driveway Culvert Replacements	$427,000
1.009	183 Lakeview Avenue - Twin Culvert Replacement	$220,000
1.061	1250 Sackville Drive - Cross Culvert Replacement	$220,000
1.101	Glendale Drive (near Pinehill Drive) Cross Culvert Replacement	$157,000
	Stormwater - Culverts/Ditches -- T O T A L	**$1,024,000**
	Stormwater - Structures	
1.006	Clement Street Berm - Rehabilitation of Stormwater Control System	$325,000
1.107	Ellenvale Run - Condition Assessment	$209,000
1.106	Ellenvale Run (Permanent repair to 2013 collapse)	$500,000
	Stormwater - Structures -- T O T A L	**$1,034,000**
	Stormwater - Corporate Projects -- T O T A L	**$737,400**
	GRAND TOTAL - STORMWATER	**$9,649,400**

HALIFAX WATER

Capital Budget 2014/15

Aerotech / Airport System

Aerotech / Airport - Water – T O T A L	**$96,000**
Aerotech / Airport - Wastewater – T O T A L	**$500,000**
TOTAL - Aerotech / Airport	**$596,000**

Project Number	Project Name	Project Cost
	Water	
3.165	Bennery Lake Boat Launch	$17,000
3.208	Bennery Lake Plant Isolation Valve	$10,000
3.213	Bennery Lake Chemical Feed Pumps and Flow Meter	$9,000
3.192	Bennery Lake Oxygenation	$45,000
3.215	Bennery Lake Filter Valve Replacements	$15,000
	Water – T O T A L	**$96,000**
	Wastewater	
2.024	Aerotech WWTF Upgrade - Design/Construction	$500,000
	Wastewater – T O T A L	**$500,000**
	GRAND TOTAL - AEROTECH / AIRPORT	**$596,000**

HALIFAX WATER

Capital Budget 2014/15

Urban Core System

Corporate Projects

Project Number	Project Name	Project Cost
	Land	
4.022	Land acquisition & Management Program	$30,000
	Land -- T O T A L	**$30,000**
	Transmission & Distribution	
4.020	Asset Management Roadmap Implementation Program	$190,000
4.023	Asset Registry	$248,000
	Transmission & Distribution -- T O T A L	**$438,000**
	Information Technology	
4.004	SCADA Control System Enhancements from IRP (Allocated 50 W / 50 WW)	$200,000
4.016	SCADA Master Plan Implementation (Allocated 50 W/ 50 WW)	$700,000
4.017	GIS Data Program - Bedford Main Area	$300,000
4.028	GIS Data Program - Dartmouth Old (North)	$350,000
4.029	GIS Data Program - Dartmouth Old (South)	$350,000
4.030	Drawing Index Database Application	$50,000
4.011	Desktop Computer Replacement Program	$160,000
4.012	Network Infrastructure Upgrades	$200,000
4.019	Computerized Maintenance Management System	$800,000
4.015	Multimedia Devices	$100,000
4.013	Document Management System	$200,000
4.024	Sharepoint Implementation	$400,000
4.025	Uninterruptable Power Supply	$220,000
4.010	Lateral Card Database Conversion Project (Allocated 50 WW/ 50 SW)	$250,000
4.027	Asset Accounting in SAP	$100,000
	Information Technology -- T O T A L	**$4,380,000**

	Fleet	
4.006	Water Fleet	$254,000
4.006	Wastewater Fleet	$960,000
4.006	Stormwater Fleet	$240,000
	Fleet -- T O T A L	**$1,454,000**
	Equipment	
3.21	Survey Equipment - Robotic GPS Total Station	$26,000
	Equipment -- T O T A L	**$26,000**
	GRAND TOTAL - Corporate Projects	**$6,328,000**

ALLOCATION BREAKDOWN:	
Water - Corporate Projects - T O T A L	$2,566,000
Wastewater - Corporate Projects -- T O T A L	$3,024,600
Stormwater - Corporate Projects -- T O T A L	$737,400
GRAND TOTAL - Corporate Projects	**$6,328,000**

Note: All corporate projects are allocated as follows:

50% Water

40% Wastewater

10% Stormwater

(unless otherwise noted)

Appendix E

Projected Capital Budgets for 2015/16 to 2019/20

Halifax Water

2015 -16 to 2019 - 20 Capital Expenditure Program	TOTALS					
	All $ in 000's					
	Y1	Y2	Y3	Y4	Y5	Y1 to Y5
	2015-2016	2016-2017	2017-2018	2018-2019	2019-2020	Totals
Water/Wastewater/Stormwater Budget Summary						
Water - Land	$731	$71	$100	$100	$100	$1,102
Water - Transmission	$5,297	$4,897	$3,185	$3,891	$7,963	$25,233
Water - Distribution	$4,978	$5,006	$5,090	$5,190	$5,290	$25,554
Water - Structures	$608	$4,315	$615	$400	$350	$6,288
Water - Treatment Facilities	$2,412	$1,334	$1,661	$5,191	$1,288	$11,886
Water - Energy	$700	$400	$400	$400	$400	$2,300
Water - Security	$50	$50	$50	$50	$50	$250
Water - Equipment	$112	$59	$50	$50	$50	$321
Water - Corporate Projects	$5,354	$5,775	$6,587	$4,244	$2,878	$24,837
Sub Total - Water	$20,242	$21,907	$17,738	$19,516	$18,369	$97,771
Wastewater - Trunk Sewers	$1,100	$0	$0	$10,358	$8,304	$19,762
Wastewater - Collection System	$7,945	$12,782	$13,945	$15,132	$18,853	$68,657
Wastewater - Forcemains	$700	$1,125	$3,033	$3,298	$3,000	$11,156
Wastewater - Structures	$5,070	$4,869	$8,170	$8,664	$15,878	$42,651
Wastewater - Treatment Facilities	$10,500	$19,450	$7,407	$4,687	$4,935	$46,979
Wastewater - Energy	$1,285	$500	$585	$400	$400	$3,170
Wastewater - Security	$200	$200	$200	$200	$200	$1,000
Wastewater - Equipment	$625	$375	$125	$125	$125	$1,375
Wastewater - Corporate Projects	$5,661	$5,670	$6,046	$7,327	$3,472	$28,175
Sub Total - Wastewater	$33,086	$44,971	$39,511	$50,191	$55,167	$222,926
Stormwater - Pipes	$2,927	$9,645	$3,600	$2,550	$5,200	$23,922
Stormwater - Culverts/Ditches	$2,038	$797	$3,603	$2,427	$2,427	$11,292
Stormwater - Structures	$0	$500	$500	$500	$500	$2,000
Stormwater - Security	$0	$0	$0	$0	$0	$0
Stormwater - Equipment	$0	$0	$0	$0	$0	$0
Stormwater - Corporate Projects	$1,080	$746	$845	$1,219	$581	$4,470
Sub Total - Stormwater	$6,045	$11,688	$8,548	$6,696	$8,708	$41,684

TOTALS - Water/Wastewater/Stormwater	$59,372	$78,565	$65,796	$76,403	$82,244	$362,380

	Five Year Capital Budget- Water								
Project ID	Project Name	Region	All $ in 000's						
			Y1	Y2	Y3	Y4	Y5	Total Y1 to Y5	Future Years
			2015-2016	2016-2017	2017-2018	2018-2019	2019-2020		
	Water - Land								
3.033	Watershed Land Acquisition	HRM	$650		$100	$100	$100	$950	
3.214	Forest Road Bridge Replacement - Tomahawk Lake Watershed Lands	Central	$10					$10	
3.241	JD Kline Watershed Access Road Bridge Replacements below Pockwock Dam	West/Central	$71	$71				$142	
	Water - Land – T O T A L S		**$731**	**$71**	**$100**	**$100**	**$100**	**$1,102**	
	Water - Transmission								
3.042	Critical Valve Replacement Program	HRM	$250	$500	$500	$500	$500	$2,250	
3.250	Critical Valve Replacement Program - Gottingen Street 2015	West	$250					$250	
3.220	Transmission Main Asset Renewal Program	HRM			$2,000			$2,000	
3.175	Macdonald Bridge Transmission Main Replacement	East	$3,750	$3,750				$7,500	
3.245	Chain Control Transmission Main Realignment	West	$455					$455	
3.231	Governor's Brook Transmission Main Oversizing	West	$197					$197	
3.232	MacIntosh Run Estates Phase 1 Transmission Main Oversizing	West	$96					$96	
3.259	Gaston Road - Circumferential Transmission Main Tie-in	East	$120					$120	
3.021	Burnside - Bedford Connector Transmission Main	East		$400			$7,463	$7,863	
3.234	Windsor Junction Transmission Main Oversizing	Central			$325			$325	
3.020	Lucasville Road Transmission Main - Phase 2	Central				$3,371		$3,371	
3.246	Water Transmission Main Condition Assessment Program	HRM	$60	$125				$185	
3.043	Bedford South Capital Cost Contribution	Central	$87		$330			$417	
3.045	Bedford West Capital Cost Contribution - Various Phases	Central	$30	$100	$30	$20		$180	$150
3.260	Morris (Russell) Lake Estates Capital Cost Contribution	East		$15				$15	
3.261	Lakeside Timberlea Capital Cost Contribution	West	$2	$2				$4	
3.113	Northgate Capital Cost Contribution	Central		$5				$5	
	Water - Transmission – T O T A L S		**$5,297**	**$4,897**	**$3,185**	**$3,891**	**$7,963**	**$25,233**	
	Water - Distribution								
3.022	Water Distribution - Main Renewal Program	HRM	$4,200	$4,300	$4,400	$4,500	$4,600	$22,000	
3.067	Distribution System Valve Replacement Program	HRM	$125	$125	$125	$125	$125	$625	
3.068	Hydrant Replacement Program	HRM	$75	$75	$75	$75	$75	$375	
3.069	Service Line Renewal Program	HRM	$190	$190	$190	$190	$190	$950	
3.066	Cathodic Protection Program	HRM	$300	$300	$300	$300	$300	$1,500	
3.243	Cowie Reservoir Meter Replacement	West	$22					$22	
3.240	Robie Control Chamber High Service Meter	West	$12					$12	
3.256	M2 Hydrant Replacement Program	West	$54					$54	
3.233	Automated Flushing Station - Burnside	East		$16				$16	
	Water - Distribution – T O T A L S		**$4,978**	**$5,006**	**$5,090**	**$5,190**	**$5,290**	**$25,554**	

Project ID	Project Name	Region	All $ in 000's						
			Y1	Y2	Y3	Y4	Y5	Total Y1 to Y5	Future Years
			2015-2016	2016-2017	2017-2018	2018-2019	2019-2020		
	Water - Structures								
3.262	Chambers and Pumping Stations Program	HRM		$250	$250	$250	$250	$1,000	
3.263	DMA Program	HRM		$100	$100	$100	$100	$400	
3.248	Water Pressure Control/Flow Meter Chambers Condition Assessment Program	HRM	$30	$295				$325	
3.247	Water Booster Stations Condition Assessment Program	HRM	$20	$125				$145	
3.173	Lake Major Dam Replacement	East	$400	$3,500				$3,900	
3.249	Confined Space Entry Retrofit - Titus and Evans Chamber	West	$65					$65	
3.244	Lake Major Entrance Road Culvert Replacements	East	$76					$76	
3.239	Renfrew Street PRV Decommissioning	East	$17					$17	
3.227	Lucasville Meter Chamber – CT Equipment Upgrade	Central		$20				$20	
3.116	Bedford South Reservoir Capital Cost Contribution	West		$25	$250			$275	
3.115	Herring Cove Reservoir Capital Cost Contribution	West			$15	$50		$65	
	Water - Structures – T O T A L S		**$608**	**$4,315**	**$615**	**$400**	**$350**	**$6,288**	

Project ID	Project Name	Region	All $ in 000's						
			Y1	Y2	Y3	Y4	Y5	Total Y1 to Y5	Future Years
			2015-2016	2016-2017	2017-2018	2018-2019	2019-2020		
	Water - Treatment Facilities								
3.264	JD Kline WSP Upgrade Program	W/C			$300	$300	$300	$900	
3.139	J D Kline WSP Replacement Program for Filter Valve Actuators	W/C	$45	$45				$90	
3.157	J D Kline WSP Filter Media Replacement	W/C	$300	$600	$600	$600		$2,100	
3.140	J D Kline WSP Chemical Feed Pump Replacement Program	W/C	$120	$120				$240	
3.143	J D Kline WSP Entrance Road Paving Renewal	W/C	$85					$85	
3.135	J D Kline WSP Parking Lot Resurfacing	W/C	$170					$170	
3.156	J D Kline WSP Backwash Butterfly Valve Actuators	W/C	$30					$30	
3.236	JD KlineWSP Ampgard III to Vacuum Contactor Conversion	W/C	$40	$40	$40	$40		$160	
3.134	JD Kline WSP – Wastewater Aluminum Removal	W/C				$2,700		$2,700	
3.242	JD Kline WSP Replace CO2 Feeders	W/C			$50	$550		$600	
3.265	Lake Major WSP Upgrade program	East			$100	$600	$600	$1,300	
3.159	Lake Major WSP - Replace Contactors in the MCC	East	$26	$26	$26	$26	$13	$117	
3.162	Lake Major WSP - Butterfly valve replacement program	East	$40	$40	$40			$120	
3.201	Lake Major WSP - Process Optimization Study	East	$110					$110	
3.204	Lake Major WSP - Lighting in Filter Gallery	East	$5					$5	
3.205	Lake Major WSP - Catwalk in the Filter Gallery	East	$15					$15	
3.206	Lake Major WSP - Chemical Feed Pumps	East	$20					$20	
3.161	Lake Major WSP - Replace the Lime Feed and Delivery System	East	$100					$100	
3.144	Lake Major WSP - New Diesel Generator	East	$713					$713	
3.228	Lake Major WSP - Finished Water Chlorine Analyzer & Sample Pump	East	$12					$12	
3.229	Lake Major WSP - Storage Containers	East	$16					$16	
3.258	Lake Major WSP Chlorine Vacuum Regulator	East	$21					$21	
3.160	Lake Major WSP - Upgrade the PLC	East	$30	$30	$30			$90	
3.237	Lake Major WSP Recirculating Pumps for the Heating System	East	$8	$8				$16	
3.207	Lake Major WSP - Isolating the Treatment Trains	East		$50				$50	
3.266	Non-Urban Core WSP Upgrade program	HRM		$150	$150	$150	$150	$600	
3.226	Collins Park WSP Waste Water Tank Retrofit	East/Central	$11					$11	
3.235	Geosmin Mitigation Study	West	$65					$65	
3.267	Bennery Lake WSP - Upgrade Program	Bennery		$225	$225	$225	$225	$900	
3.166	Bennery Lake WSP Channel Improvements - Water Supply Plant	Bennery	$125					$125	
3.167	Bennery Lake WSP Plate Settlers - Water Supply Plant	Bennery	$233					$233	
3.238	Bennery Lake WSP Zeta Potential Meter	Bennery	$72					$72	
3.121	Water Quality Master Plan Updates	HRM			$100			$100	
	Water - Treatment Facilities – T O T A L S		**$2,412**	**$1,334**	**$1,661**	**$5,191**	**$1,288**	**$11,886**	

Project ID	Project Name	Region	All $ in 000's						
			Y1	Y2	Y3	Y4	Y5	Total Y1 to Y5	Future Years
			2015-2016	2016-2017	2017-2018	2018-2019	2019-2020		
	Water - Energy								
3.268	JD Kline - Heat Recovery Study Upgrade	W/C	$700					$700	
3.221	Energy Management Capital Program	HRM		$400	$400	$400	$400	$1,600	
	Water - Energy -- T O T A L S		**$700**	**$400**	**$400**	**$400**	**$400**	**$2,300**	
	Water - Security								
4.009	Security Upgrade Program (water)	HRM	$50	$50	$50	$50	$50	$250	
	Water - Security -- T O T A L S		**$50**	**$50**	**$50**	**$50**	**$50**	**$250**	
	Water - Equipment								
3.101	Miscellaneous Equipment Replacement	HRM			$50	$50	$50	$150	
3.230	Truck Mounted Valve Exercising Machine	East	$30					$30	
3.253	Leak Detection Equipment	West	$16					$16	
3.252	Upgrade to Correlator	Central	$22					$22	
3.255	GPS/Total Station for Water Services	HRM	$28					$28	
3.270	Diesel Plate Compactor	HRM	$16					$16	
3.104	Large Tapping Machine with electric operator	HRM		$34				$34	
3.271	Small Hydro Vac for valve box maintenance	HRM		$25				$25	
	Water - Equipment -- T O T A L S		**$112**	**$59**	**$50**	**$50**	**$50**	**$321**	
	TOTALS - Water		**$14,888**	**$16,132**	**$11,151**	**$15,272**	**$15,491**	**$72,934**	

	Five Year Capital Budget- Wastewater								
Project ID	Project Name	Region	All $ in 000's						
			Y1	Y2	Y3	Y4	Y5	Total Y1 to Y5	Future Years
			2015-2016	2016-2017	2017-2018	2018-2019	2019-2020		
	Wastewater - Trunk Sewers								
2.069	Jamieson Street Trunk Sewer Outfall Replacement - Phase 2 - Construction	East	$1,100					$1,100	
2.067	Northwest Arm Sewer Rehabilitation	West				$8,635	$5,000	$13,635	
2.384	Bedford Sackville Trunk Sewer improvements	Central				$1,723	$1,723	$3,446	$13,784
2.433	Wastewater Diversion Program (Trunk Sewers) - West Region	West					$1,581	$1,581	$14,230
	Wastewater - Trunk Sewers – T O T A L S		**$1,100**	**$0**	**$0**	**$10,358**	**$8,304**	**$19,762**	

Project ID	Project Name	Region	All $ in 000's						
			Y1	Y2	Y3	Y4	Y5	Total Y1 to Y5	Future Years
			2015-2016	2016-2017	2017-2018	2018-2019	2019-2020		
	Wastewater - Collection System								
2.223	Wet Weather Management Program	HRM	$500	$500	$500	$500	$500	$2,500	
2.435	Inflow/Infiltration Reduction Pilot Projects	HRM	$200					$200	
2.436	Inflow/Infiltration Reduction Program	HRM		$2,600	$2,800	$3,000	$3,500	$11,900	
2.331	Wastewater Sewers - Condition Assessment - Zoom Camera	HRM	$470	$500	$500	$500		$1,970	
2.332	Wastewater Sewers - Condition Assessment - CCTV	HRM	$155	$200	$200	$200		$755	
2.333	Wastewater Sewers - Condition Assessment - Data Acquisition	HRM	$25					$25	
2.357	Manhole Renewals	HRM	$29	$32	$35	$39	$42	$177	
2.358	Lateral Replacements	HRM	$1,490	$1,640	$1,805	$1,985	$2,090	$9,010	
2.052	Integrated Wastewater Projects - Program	HRM	$1,300	$1,500	$1,500	$1,500	$1,500	$7,300	
2.043	Corporate Flow Monitoring Program	HRM	$710	$1,390	$1,105	$1,105	$1,105	$5,415	
2.168	Sewer Lining Program	HRM	$1,000	$1,000	$2,000	$2,000	$2,000	$8,000	
2.157	Alder Crescent Collection System Replacement	Central	$635					$635	
2.437	Hines Road Rider Sewer Extension	East	$300					$300	
2.370	Main Street Sewer Renewal - Hartlen Street to Gordon Avenue	East	$253					$253	
2.417	Inglis Street Sewer - Hydraulic Analysis	West	$33					$33	
2.013	Wanda Lane Sanitary Sewer Replacement	East		$1,000	$1,200			$2,200	
2.076	Kempt Road Sewer Replacement	West		$475				$475	
2.163	Barrington Street Combined Sewer Upgrade	West			$500			$500	
2.195	Gravity sewer from Little Albro Lake to Jamieson Street Pumping Station	East		$1,900				$1,900	
2.196	Sewer Improvements from Fenwick Street to Old Ferry Rd Pumping Station with the addition of Maynard Street	East			$500	$1,355	$1,355	$3,210	
2.390	Sewer Twinning - Albro Lake/Slayter Street to Old Ferry Road Pumping Station	East				$948	$4,266	$5,214	$4,266
2.438	Wastewater Diversion Program (Collection System) - West Region	West			$1,000	$1,000	$2,495	$4,495	$34,440
2.074	Bedford West Collection System Capital Cost Contribution	West	$20	$20	$100	$1,000		$1,140	$153
2.072	Russell Lake/Portland Hills West Collection System Capital Cost Contribution	East		$25	$200			$225	$1,600
2.359	West Region Infrastructure Plan	West	$450					$450	
2.360	Central Region Infrastructure Plan	West	$350					$350	
2.381	Regional Centre Local Wastewater Servicing Capacity Analysis	West	$25					$25	
	Wastewater - Collection System – T O T A L S		**$7,945**	**$12,782**	**$13,945**	**$15,132**	**$18,853**	**$68,657**	

Project ID	Project Name	Region	All $ in 000's						
			Y1	Y2	Y3	Y4	Y5	Total Y1 to Y5	Future Years
			2015-2016	2016-2017	2017-2018	2018-2019	2019-2020		
	Wastewater - Forcemains								
2.080	Forcemain Replacement Program	HRM		$1,000	$2,750	$750	$1,000	$5,500	
2.179	Balsam Road Pumping Station - Forcemain Replacement	Central	$240					$240	
2.363	Bissett Pumping Station Forcemain Replacement	East	$400					$400	
2.394	Wastewater Forcemain - Condition Assessment	HRM	$60	$125				$185	
2.399	Old Ferry Road Forcemain Upgrade	East			$283	$283		$566	$2,268
2.440	Wastewater Diversion Program (Forcemains) - West Region	West				$2,265	$2,000	$4,265	$46,359
	Wastewater - Forcemains -- T O T A L S		**$700**	**$1,125**	**$3,033**	**$3,298**	**$3,000**	**$11,156**	
	Wastewater - Structures								
2.420	Emergency Pumping Station Pump Replacements	HRM	$270	$270	$270	$270	$270	$1,350	
2.046	Wastewater Pumping Station Upgrade Program - Various Locations	HRM		$550	$6,550	$550	$550	$8,200	
2.442	Wastewater Pumping Station Upgrade Program - West Region	West	$420					$420	
2.443	Wastewater Pumping Station Upgrade Program - East Region	East	$110					$110	
2.444	Wastewater Pumping Station Upgrade Program - Central Region	Central	$70					$70	
2.039	New Pumping Station and Forcemain plus Belmont WWTF decommissioning	East	$3,000	$2,260				$5,260	
2.091	Bedford Pumping Station Rehabilitation (at Mill Cove WWTF)	Central	$1,000	$1,767				$2,767	
2.336	Wastewater Pumping Stations Condition and Performance Assessments	HRM	$200					$200	
2.380	Gantry Road Manhole Rehabilitation	Central		$22				$22	
2.366	Shipyard Road Pumping Station Upgrade	Central			$200	$800		$1,000	
2.088	Russell Lake Pumping Station Upgrade	East			$1,000	$1,000		$2,000	
2.180	Lions Club Pumping Station Elimination	Central			$150	$850		$1,000	
2.038	Roach's Pond Grit Building Rehabilitation	West					$250	$250	$1,300
2.249	Duffus Street CSO Outfall Condition Assessment	West				$50		$50	
2.405	Old Ferry Road Pumping Station Upgrade	East				$968	$968	$1,936	$7,748
2.445	Wastewater Diversion Program (Structures) - West Region	West				$2,256	$7,200	$9,456	$24,144
2.447	Wastewater Storage Program (Structures) - Central Region	Central				$1,920	$6,640	$8,560	$33,040
	Wastewater Structures -- T O T A L S		**$5,070**	**$4,869**	**$8,170**	**$8,664**	**$15,878**	**$42,651**	

Project ID	Project Name	Region	All $ in 000's						
			Y1	Y2	Y3	Y4	Y5	Total Y1 to Y5	Future Years
			2015-2016	2016-2017	2017-2018	2018-2019	2019-2020		
	Wastewater - Treatment Facility								
2.057	HHSP Upgrade Program	HRM	$250	$1,250	$1,250	$2,250	$2,250	$7,250	
2.050	Wastewater Treatment Facilities Upgrades	HRM	$250	$250	$250	$250	$2,250	$3,250	
	Middle Musquodoboit WWTF Lift Pumps	Central		$10				$10	$35
2.124	Mill Cove WWTF UV Upgrade	Central	$200	$1,800				$2,000	
2.330	Beechville Lakeside Timberlea WWTF - Process Upgrade	West	$1,000		$3,500			$4,500	
2.056	Plant Optimization Audit Program	HRM	$125	$125	$125	$125	$125	$625	
2.162	Mill Cove WWTF Vacuum Swing Absorption	Central	$1,500					$1,500	
2.448	Halifax WWTF - Sludge Tank Mixing	West	$100					$100	
2.024	Aerotech WWTF Upgrade - Design/Construction	Aerotech	$5,970	$13,930				$19,900	
2.126	Biosolids Processing Facility - Upgrade Program	HRM	$120	$360	$250	$150	$310	$1,190	
2.425	Biosolids Processing Facility - New Warehouse Ventilation System and HVAC Controls	HRM	$100	$765				$865	
2.424	Biosolids Processing Facility - Miscellaneous Ventilation System Upgrades	HRM		$230				$230	
2.423	Biosolids Processing Facility - New Biofilter Fan and Biofilter Modifications	HRM		$95				$95	
2.421	Biosolids Processing Facility - Dust Collection System	HRM		$635				$635	
2.422	Biosolids Processing Facility - New Screening and Loading Building	HRM	$615					$615	
2.411	Biosolids Processing Facility Expansion	HRM			$120	$120		$240	$960
2.410	Dartmouth WWTF - Upgrade UV disinfection system	East	$200		$1,792	$1,792		$3,784	
2.413	Middle Musquodoboit WWTF - Additional Equalization Storage Volume	Central			$120			$120	
2.414	North Preston WWTF - Biological Treatment Capacity Assessment	East	$33					$33	
2.415	North Preston WWTF - Autosampler	East	$37					$37	
	Wastewater - Treatment Facility -- T O T A L S		**$10,500**	**$19,450**	**$7,407**	**$4,687**	**$4,935**	**$46,979**	

Project ID	Project Name	Region	All $ in 000's						
			Y1	Y2	Y3	Y4	Y5	Total Y1 to Y5	Future Years
			2015-2016	2016-2017	2017-2018	2018-2019	2019-2020		
	Wastewater - Energy								
2.362	Energy Management Retrofit Program	HRM	$110		$510	$400	$400	$1,420	
2.252	Dartmouth WWTF - Carbon Scrubber Ventilation By-pass and Automation	East	$250					$250	
2.258	Halifax WWTF - Carbon Scrubber Ventilation By-pass and Automation	West	$300					$300	
2.236	Halifax WWTF - Ventilation Air Heat Recovery	West	$175					$175	
2.261	Herring Cove WWTF - Effluent Heat Recovery	West	$250					$250	
2.262	Herring Cove WWTF - Carbon Scrubber Ventilation By-pass and Automation	West	$200					$200	
2.263	Herring Cove WWTF - Sludge Mixing System Upgrades	West			$75			$75	
2.173	Mill Cove WWTF - Bio-Gas CHP - Installation	Central		$250				$250	
2.235	Dartmouth WWTF - Ventilation Air Heat Recovery	East		$150				$150	
2.256	Halifax WWTF - UV Channel Isolation and UVT Monitoring/Control	West		$100				$100	
	Wastewater - Energy – T O T A L S		**$1,285**	**$500**	**$585**	**$400**	**$400**	**$3,170**	
	Wastewater - Security								
4.008	Security Upgrade Program	HRM	$200	$200	$200	$200	$200	$1,000	
	Wastewater - Security – T O T A L S		**$200**	**$200**	**$200**	**$200**	**$200**	**$1,000**	
	Wastewater - Equipment								
2.161	SIR Program Flow Meters and Related Equipment	HRM	$55	$55	$55	$55	$55	$275	
2.451	Miscellaneous Equipment Replacement	HRM		$70	$70	$70	$70	$280	
2.418	Wastewater Operations Equipment	HRM	$120					$120	
2.419	Trenchless Lateral Equipment Rehabilitation	HRM	$450	$250				$700	
			$625	**$375**	**$125**	**$125**	**$125**	**$1,375**	
	TOTALS - Wastewater		**$27,425**	**$39,301**	**$33,465**	**$42,864**	**$51,695**	**$194,750**	

	Five Year Capital Budget- Stormwater								
Project ID	Project Name	Region	All $ in 000's						
			Y1	Y2	Y3	Y4	Y5	Total Y1 to Y5	Future Years
			2015-2016	2016-2017	2017-2018	2018-2019	2019-2020		
	Stormwater - Pipes								
1.102	Manhole Renewals	HRM	$26	$29	$32	$35	$35	$157	
1.103	Catchbasin Renewals	HRM	$26	$29	$32	$35	$35	$157	
1.135	Lateral Replacements	HRM	$80	$87	$95	$105	$110	$477	
1.042	Deep Storm Sewer Installation Program	HRM	$100	$1,000	$1,500	$1,500	$1,500	$5,600	
1.038	Integrated Stormwater Projects	HRM	$650	$600	$600	$600	$600	$3,050	
1.019	Drainage Remediation Program Surveys/Studies	HRM	$200	$200	$200	$200	$200	$1,000	
1.051	Sackville Cross Road Stormwater System Renewal	Central	$1,240					$1,240	
1.128	Rolling Hills Drive Stormwater Rehabilitation	East	$157					$157	
1.123	Shore Drive Storm Sewer Diversion	East	$291					$291	
1.043	Sullivan's Pond Storm Sewer System Replacement	East	$100	$7,700	$500			$8,300	$8,300
1.132	Little Sackville River Flood Plain Mapping	Central	$57					$57	
1.134	Stormwater Quality Compliance Needs Assessment	HRM			$75	$75	$75	$225	$75
1.025	Pinehill Drive Embankment Protection	Central			$166			$166	
1.034	Raymond Street, Phase 2 - Storm Sewer Rehabilitation	East			$300			$300	
1.066	Winston Drive Stormwater Cross-Connection - Churchill Estates, Herring Cove	West			$100			$100	
1.071	Kempt Road Stormwater Sewer	West					$500	$500	
1.003	Ivylea Crescent - Storm Sewer	West					$645	$645	
1.129	Storm Sewer Springfield Lake Stormwater Collection System	Central					$500	$500	$10,242
1.050	Alder - Piper Park Stormwater System Replacement	East					$1,000	$1,000	
	Stormwater - Pipes – T O T A L S		**$2,927**	**$9,645**	**$3,600**	**$2,550**	**$5,200**	**$23,922**	
	Stormwater - Culverts/Ditches								
1.104	Driveway Culvert Replacements	HRM	$427	$427	$427	$427	$427	$2,135	
1.109	Culvert Renewal Program	HRM			$2,000	$2,000	$2,000	$6,000	
1.009	183 Lakeview Avenue - Twin Culvert Replacement	Central	$201					$201	
1.016	Holly Court - Culvert Replacement	Central	$200					$200	
1.111	Bedford Highway at Shaunslieve Drive Culvert Upgrade	West	$407					$407	
1.131	North Preston Road - Cross Culvert Replacement	East	$347					$347	
1.113	Yankeetown Road Civic 206 - Cross Culvert	West	$141					$141	
1.114	Yankeetown Road Near Cox Lake Road Cross Culvert	West	$141					$141	
1.126	2016/17 Culvert Program - Design	HRM	$174					$174	
1.124	Stormwater Inlet Structure - Keating Road	West		$110				$110	
1.127	Wilson Drive & Highway 2 - Culvert Replacement	Central		$260				$260	
1.023	Cobequid Road at Sucker Brook - Culvert Replacement	Central			$326			$326	
1.010	Kipawa Crescent - Culvert Replacement	Central			$264			$264	
1.125	Coronet Avenue Driveway Culvert Replacement Project	West			$586			$586	
	Stormwater - Culverts/Ditches – T O T A L S		**$2,038**	**$797**	**$3,603**	**$2,427**	**$2,427**	**$11,292**	

Project ID	Project Name	Region	All $ in 000's						
			Y1	Y2	Y3	Y4	Y5	Total Y1 to Y5	Future Years
			2015-2016	2016-2017	2017-2018	2018-2019	2019-2020		
	Stormwater - Structures								
1.133	Ellenvale Run Retaining Wall System - Replacement	East		$500	$500	$500	$500	$2,000	
	Stormwater - Structures – T O T A L S		$0	$500	$500	$500	$500	$2,000	
	Stormwater - Security								
	Stormwater - Security – T O T A L S		$0	$0	$0	$0	$0	$0	
	Stormwater - Equipment								
	Stormwater - Equipment – T O T A L S		$0	$0	$0	$0	$0	$0	
	TOTALS - Stormwater		$4,965	$10,942	$7,703	$5,477	$8,127	$37,214	

	Five Year Capital Budget- Corporate Projects								
Project ID	Project Name	Region	Y1	Y2	Y3	Y4	Y5	Total Y1 to Y5	Future Years
			2015-2016	2016-2017	2017-2018	2018-2019	2019-2020		
4.031	Information Technology Projects identified from IT Strategic Steering Committee	HRM	$300	$450	$600	$600	$600	$2,550	
4.011	Desktop Computer Replacement Program	HRM	$180	$180	$180	$180	$180	$900	
4.012	Network Infrastructure Upgrades	HRM	$200	$200	$200	$200	$200	$1,000	
4.013	Document Management System	HRM	$200	$200	$100	$100		$600	
4.019	Computerized Maintenance Management System	HRM	$1,500	$1,500	$1,340			$4,340	
4.024	Sharepoint Implementation	HRM	$200	$200	$100	$100		$600	
4.027	Asset Accounting in SAP	HRM	$100					$100	
4.044	Customer Relationship Management (CRM) Selection and Implementation	HRM	$600	$200				$800	
4.048	SAP Rate Structure Support	HRM	$220		$220		$220	$660	
4.057	Website Strategy	HRM	$200					$200	
4.043	AMI/AMR Meter System Upgrades	HRM	$2,500	$4,500	$4,500	$4,500	$2,100	$18,100	
4.014	Information Technology Disaster Recovery Site	HRM		$300	$100			$400	
4.032	Server Renewals	HRM			$800			$800	
4.040	GIS Data Program	HRM	$1,500	$1,000	$1,000	$500	$500	$4,500	
4.038	GIS Hardware/Software Program	HRM	$400	$100	$100	$100	$400	$1,100	
4.039	GIS Application Support Program	HRM	$250	$250	$250	$250	$250	$1,250	
4.059	Water Database Model	HRM	$50	$100			$50	$200	
4.030	Drawing Index Database Application	HRM	$200					$200	
4.010	Lateral Card Database Conversion Project	HRM	$250					$250	
4.022	Land Acquisition and Management Program	HRM	$30	$30	$30	$30		$120	
2.176	East Region Operation Facility - Design	East	$300			$4,000		$4,300	
4.020	Asset Management Program	HRM	$100	$150	$800			$1,050	$2,500
4.021	Integrated Resource Plan	HRM		$100	$400			$500	
4.045	Asset Management Strategies for Corporate Strategic Plan	HRM	$30					$30	
4.047	Asset Management Procedures and Standards	HRM	$10	$100				$110	
4.055	Water and Wastewater Modeling Tools Evaluation	HRM	$40					$40	
4.054	Asset Management Software and Tools	HRM	$50					$50	
4.049	Asset Management Risk-Based Decision Model Development	HRM	$15	$100	$15			$130	
4.035	Cowie Hill 450 2nd Floor Renovations	HRM	$75					$75	
4.060	Climate Change Adaptation Program	HRM			$200	$250	$250	$700	
4.053	Water and Wastewater Master Plan Framework Development	HRM	$35	$475	$440			$950	
4.052	Long Term Planning Coordination Framework Development	HRM	$200					$200	
4.016	SCADA Master Plan Implementation	HRM	$500	$200				$700	
4.004	SCADA Control System Enhancements	HRM	$200	$200	$200	$200	$200	$1,000	
4.005	SCADA Master Plan Update	HRM			$200	$200		$400	
3.251	Survey Equipment - GPS Total Station	HRM	$26					$26	
4.006	Fleet Upgrade Program - Stormwater	HRM	$247	$230	$201	$188	$316	$1,182	
4.008	Fleet Upgrade Program - Wastewater	HRM	$988	$918	$802	$753	$1,262	$4,723	
4.007	Fleet Upgrade Program - Water	HRM	$398	$507	$699	$639	$403	$2,646	
	CANDIDATE Corporate Projects TOTALS		**$12,094**	**$12,190**	**$13,477**	**$12,790**	**$8,931**	**$57,482**	

Appendix F

Projected Operating Statements - Consolidated

Halifax Water

HALIFAX WATER
CONSOLIDATED SUMMARY OF ESTIMATED REVENUES & EXPENDITURES
FIVE (5) YEAR BUSINESS PLAN
APRIL 1, 2015 to MARCH 31, 2020
(in thousands)

DESCRIPTION	ACTUAL APR 1/13 MAR 31/14	BUDGET * APR 1/14 MAR 31/15	PROPOSED BUDGET ** APR 1/15 MAR 31/16	PROPOSED BUDGET ** APR 1/16 MAR 31/17	BUSINESS PLAN APR 1/17 MAR 31/18	BUSINESS PLAN APR 1/18 MAR 31/19	BUSINESS PLAN APR 1/19 MAR 31/20
OPERATING REVENUES	$111,502	$129,853	$127,276	$125,349	$124,366	$123,420	$122,513
OPERATING EXPENDITURES	$89,737	$99,452	$103,271	$108,439	$108,210	$111,838	$114,263
OPERATING PROFIT	**$21,765**	**$30,401**	**$24,006**	**$16,909**	**$16,156**	**$11,583**	**$8,250**
FINANCIAL REVENUES (NON-OPERATING)							
INVESTMENT INCOME	$690	$660	$660	$720	$720	$720	$720
PNS FUNDING HHSP DEBT	$2,000	$2,000	$2,000	$2,000	$2,000	$1,000	$0
MISCELLANEOUS	$319	$419	$417	$507	$508	$510	$511
	$3,009	**$3,079**	**$3,077**	**$3,227**	**$3,228**	**$2,230**	**$1,231**
FINANCIAL EXPENDITURES (NON-OPERATING)							
LONG TERM DEBT INTEREST	$8,161	$9,188	$9,380	$9,722	$10,278	$10,910	$11,992
LONG TERM DEBT PRINCIPAL	$17,257	$18,888	$20,427	$21,796	$23,113	$23,868	$22,940
AMORTIZATION DEBT DISCOUNT	$131	$144	$172	$198	$219	$226	$218
DIVIDEND/GRANT IN LIEU OF TAXES	$4,187	$4,340	$4,579	$4,714	$5,245	$5,856	$6,195
	$29,736	**$32,560**	**$34,558**	**$36,430**	**$38,855**	**$40,861**	**$41,345**
NET PROFIT (LOSS) AVAILABLE FOR CAPITAL EXPENDITURES	**($4,963)**	**$920**	**($7,475)**	**($16,293)**	**($19,471)**	**($27,048)**	**($31,864)**

* - *Revised 2014/15 Operating Budget as approved by the Board of Directors, July 31, 2014*

** - *Revised 2015/16 Operating Budgets as approved by the Board of Directors, November 20, 2014*

HALIFAX WATER
ESTIMATED REVENUES AND EXPENDITURES - WATER OPERATIONS
FIVE (5) YEAR BUSINESS PLAN
APRIL 1, 2015 to MARCH 31, 2020
(in thousands)

DESCRIPTION	ACTUAL APR 1/13 MAR 31/14	BUDGET * APR 1/14 MAR 31/15	PROPOSED BUDGET ** APR 1/15 MAR 31/16	PROPOSED BUDGET ** APR 1/16 MAR 31/17	BUSINESS PLAN APR 1/17 MAR 31/18	BUSINESS PLAN APR 1/18 MAR 31/19	BUSINESS PLAN APR 1/19 MAR 31/20
REVENUES							
METERED SALES	$34,961	$40,055	$38,777	$38,287	$38,009	$37,740	$37,479
FIRE PROTECTION	$9,758	$9,146	$8,953	$8,953	$8,953	$8,953	$8,953
PRIVATE FIRE PROTECTION SERVICES	$429	$562	$578	$584	$591	$597	$603
BULK WATER STATIONS	$241	$258	$308	$308	$308	$308	$308
CUSTOMER LATE PAY./COLLECTION FEES	$257	$454	$332	$327	$324	$321	$318
MISCELLANEOUS	$146	$163	$150	$151	$151	$152	$152
	$45,791	**$50,638**	**$49,098**	**$48,611**	**$48,336**	**$48,070**	**$47,814**
EXPENDITURES							
WATER SUPPLY & TREATMENT	$6,883	$7,453	$7,931	$7,990	$8,150	$8,313	$8,479
TRANSMISSION & DISTRIBUTION	$7,845	$8,579	$9,158	$10,310	$10,516	$10,726	$10,941
SMALL SYSTEMS (incl. Contract Systems)	$1,043	$725	$794	$808	$824	$840	$857
TECHNICAL SERVICES (SCADA)	$783	$871	$810	$835	$852	$869	$886
ENGINEERING & INFORMATION SERVICES	$3,418	$3,562	$3,809	$3,899	$3,977	$4,057	$4,138
ENVIRONMENTAL SERVICES	$694	$660	$628	$597	$609	$621	$634
CUSTOMER SERVICE	$2,008	$2,086	$2,227	$2,234	$2,278	$2,324	$2,371
ADMINISTRATION & PENSION	$5,310	$6,155	$6,089	$6,182	$6,306	$6,432	$6,560
DEPRECIATION	$7,157	$7,751	$8,573	$9,337	$9,076	$9,643	$9,563
	$35,140	**$37,841**	**$40,018**	**$42,192**	**$42,588**	**$43,825**	**$44,429**
OPERATING PROFIT	**$10,650**	**$12,797**	**$9,080**	**$6,418**	**$5,748**	**$4,245**	**$3,385**
FINANCIAL REVENUES (NON-OPERATING)							
INVESTMENT INCOME	$344	$330	$330	$360	$360	$360	$360
MISCELLANEOUS	$236	$346	$344	$434	$434	$435	$435
	$581	**$676**	**$674**	**$794**	**$794**	**$795**	**$795**
FINANCIAL EXPENDITURES (NON-OPERATING)							
LONG TERM DEBT INTEREST	$2,517	$2,406	$2,682	$2,860	$2,951	$2,978	$3,186
LONG TERM DEBT PRINCIPAL	$6,341	$7,007	$7,987	$8,767	$9,015	$8,447	$5,785
AMORTIZATION DEBT DISCOUNT	$70	$83	$97	$107	$113	$104	$82
DIVIDEND/GRANT IN LIEU OF TAXES	$4,187	$4,340	$4,579	$4,714	$5,245	$5,856	$6,195
	$13,115	**$13,836**	**$15,344**	**$16,448**	**$17,323**	**$17,385**	**$15,248**
NET PROFIT (LOSS) AVAILABLE FOR CAPITAL EXPENDITURES	**($1,883)**	**($363)**	**($5,590)**	**($9,236)**	**($10,781)**	**($12,344)**	**($11,067)**

* - *Revised 2014/15 Operating Budget as approved by the Board of Directors, July 31, 2014*

** - *Revised 2015/16 Operating Budgets as approved by the Board of Directors, November 20, 2014*

HALIFAX WATER
ESTIMATED REVENUES AND EXPENDITURES - WASTEWATER OPERATIONS
FIVE (5) YEAR BUSINESS PLAN
APRIL 1, 2015 to MARCH 31, 2020
(in thousands)

DESCRIPTION	ACTUAL APR 1/13 MAR 31/14	BUDGET * APR 1/14 MAR 31/15	PROPOSED BUDGET ** APR 1/15 MAR 31/16	PROPOSED BUDGET ** APR 1/16 MAR 31/17	BUSINESS PLAN APR 1/17 MAR 31/18	BUSINESS PLAN APR 1/18 MAR 31/19	BUSINESS PLAN APR 1/19 MAR 31/20
REVENUES							
METERED SALES	$55,320	$67,267	$66,423	$65,122	$64,326	$63,549	$62,793
WASTEWATER OVERSTRENGTH AGREEMENTS	$226	$300	$174	$0	$0	$0	$0
LEACHATE	$322	$366	$379	$393	$400	$408	$417
CONTRACT REVENUE	$91	$86	$86	$86	$86	$86	$86
SEPTAGE TIPPING FEES	$633	$800	$800	$825	$908	$998	$1,098
DEWATERING FACILITY/ SLUDGE LAGOON	$210	$210	$210	$210	$210	$210	$210
AIRLINE EFFLUENT	$75	$80	$78	$78	$78	$78	$78
CUSTOMER LATE PAY./COLLECTION FEES	$193	$219	$211	$207	$205	$203	$200
MISCELLANEOUS	$101	$134	$121	$121	$121	$121	$121
	$57,170	**$69,462**	**$68,482**	**$67,041**	**$66,333**	**$65,653**	**$65,002**
EXPENDITURES							
WASTEWATER COLLECTION	$9,666	$9,507	$9,744	$10,034	$10,235	$10,439	$10,648
WASTEWATER TREATMENT PLANTS	$16,821	$19,031	$18,466	$18,873	$19,250	$19,635	$20,028
SMALL SYSTEMS	$1,025	$1,017	$1,132	$1,132	$1,155	$1,178	$1,201
DEWATERING FACILITY/ SLUDGE MGM'T	$656	$696	$767	$703	$717	$731	$746
BIOSOLIDS TREATMENT	$97	$96	$101	$101	$103	$105	$107
LEACHATE CONTRACT	$286	$320	$330	$341	$348	$355	$362
TECHNICAL SERVICES (SCADA)	$1,034	$1,056	$1,191	$1,216	$1,240	$1,265	$1,291
ENGINEERING & INFORMATION SERVICES	$2,789	$3,134	$3,493	$3,654	$3,727	$3,802	$3,878
ENVIRONMENTAL SERVICES	$1,283	$1,324	$1,343	$1,326	$1,352	$1,379	$1,407
CUSTOMER SERVICE	$1,598	$1,667	$1,844	$1,850	$1,887	$1,924	$1,963
ADMINISTRATION & PENSION	$4,223	$4,919	$5,042	$5,119	$5,221	$5,326	$5,432
DEPRECIATION	$8,406	$10,518	$11,674	$13,318	$11,521	$12,667	$13,363
	$47,885	**$53,284**	**$55,129**	**$57,667**	**$56,757**	**$58,807**	**$60,426**
OPERATING PROFIT	**$9,285**	**$16,178**	**$13,353**	**$9,375**	**$9,576**	**$6,846**	**$4,576**
FINANCIAL REVENUES (NON-OPERATING)							
INVESTMENT INCOME	$345	$330	$330	$360	$360	$360	$360
PNS FUNDING HHSP DEBT	$2,000	$2,000	$2,000	$2,000	$2,000	$1,000	$0
MISCELLANEOUS	$83	$73	$73	$73	$74	$75	$76
	$2,428	**$2,403**	**$2,403**	**$2,433**	**$2,434**	**$1,435**	**$436**
FINANCIAL EXPENDITURES (NON-OPERATING)							
LONG TERM DEBT INTEREST	$5,250	$6,275	$6,164	$6,158	$6,418	$6,922	$7,693
LONG TERM DEBT PRINCIPAL	$10,263	$11,038	$11,530	$11,860	$12,619	$13,764	$15,320
AMORTIZATION DEBT DISCOUNT	$61	$59	$66	$79	$88	$103	$115
	$15,575	**$17,372**	**$17,761**	**$18,097**	**$19,125**	**$20,788**	**$23,128**
NET PROFIT (LOSS) AVAILABLE FOR CAPITAL EXPENDITURES	**($3,861)**	**$1,208**	**($2,005)**	**($6,289)**	**($7,115)**	**($12,507)**	**($18,117)**

* - *Revised 2014/15 Operating Budget as approved by the Board of Directors, July 31, 2014*

HALIFAX WATER
ESTIMATED REVENUES AND EXPENDITURES - STORMWATER OPERATIONS
FIVE (5) YEAR BUSINESS PLAN
APRIL 1, 2015 to MARCH 31, 2020
(in thousands)

DESCRIPTION	ACTUAL APR 1/13 MAR 31/14	BUDGET * APR 1/14 MAR 31/15	PROPOSED BUDGET ** APR 1/15 MAR 31/16	PROPOSED BUDGET ** APR 1/16 MAR 31/17	BUSINESS PLAN APR 1/17 MAR 31/18	BUSINESS PLAN APR 1/18 MAR 31/19	BUSINESS PLAN APR 1/19 MAR 31/20
REVENUES							
STORMWATER SITE GENERATED SERVICE ***	$5,775	**$3,881**	$3,927	$3,927	$3,927	$3,927	$3,927
STORMWATER RIGHT-OF-WAY SERVICE	$2,671	**$5,766**	$5,669	$5,669	$5,669	$5,669	$5,669
CUSTOMER LATE PAY./COLLECTION FEES	$19	**$11**	$10	$10	$10	$10	$10
MISCELLANEOUS	$76	**$95**	$91	$91	$91	$91	$91
	$8,541	**$9,754**	**$9,697**	**$9,697**	**$9,697**	**$9,697**	**$9,697**
EXPENDITURES							
STORMWATER COLLECTION	$4,022	$5,281	$5,017	$5,161	$5,264	$5,370	$5,477
TECHNICAL SERVICES (SCADA)	$34	$35	$28	$28	$29	$29	$30
ENGINEERING & INFORMATION SERVICES	$571	$641	$568	$595	$606	$619	$631
ENVIRONMENTAL SERVICES	$584	$620	$825	$829	$846	$863	$880
CUSTOMER SERVICE	$327	$341	$300	$301	$307	$313	$319
ADMINISTRATION & PENSION	$864	$1,007	$820	$833	$849	$866	$883
DEPRECIATION	$310	$403	$565	$834	$964	$1,146	$1,188
	$6,711	**$8,328**	**$8,123**	**$8,580**	**$8,865**	**$9,206**	**$9,409**
OPERATING PROFIT	**$1,829**	**$1,426**	**$1,573**	**$1,117**	**$831**	**$491**	**$288**
FINANCIAL EXPENDITURES (NON-OPERATING)							
LONG TERM DEBT INTEREST	$394	**$507**	$534	$704	$909	$1,011	$1,113
LONG TERM DEBT PRINCIPAL	$653	**$843**	$910	$1,168	$1,479	$1,658	$1,834
AMORTIZATION DEBT DISCOUNT	$0	**$2**	$9	$13	$18	$19	$21
	$1,047	**$1,352**	**$1,453**	**$1,885**	**$2,407**	**$2,688**	**$2,969**
NET PROFIT (LOSS) AVAILABLE FOR CAPITAL EXPENDITURES	**$782**	**$74**	**$120**	**($769)**	**($1,575)**	**($2,197)**	**($2,680)**

** - Revised 2014/15 Operating Budget as approved by the Board of Directors, July 31, 2014*

*** - Revised 2015/16 Operating Budgets as approved by the Board of Directors, November 20, 2014*

****- Metered sales are included with stormwater site generated service amount as of rate application dated July 1, 2014*

HALIFAX WATER
ESTIMATED REVENUES & EXPENDITURES, SEGREGATED BY REGULATED AND UNREGULATED ACTIVITIES
FIVE (5) YEAR BUSINESS PLAN
APRIL 1, 2015 to MARCH 31, 2020
(in thousands)

DESCRIPTION	ACTUAL APR 1/13 MAR 31/14	BUDGET * APR 1/14 MAR 31/15	PROPOSED BUDGET APR 1/15 MAR 31/16	PROPOSED BUDGET APR 1/16 MAR 31/17	BUSINESS PLAN APR 1/17 MAR 31/18	BUSINESS PLAN APR 1/18 MAR 31/19	BUSINESS PLAN APR 1/19 MAR 31/20
REGULATED ACTIVITIES							
REVENUES							
METERED SALES	$90,281	$107,321	$105,199	$103,410	$102,335	$101,289	$100,272
FIRE PROTECTION	$9,758	$9,146	$8,953	$8,953	$8,953	$8,953	$8,953
PRIVATE FIRE PROTECTION	$429	$562	$578	$584	$591	$597	$603
STORMWATER SITE GENERATED SERVICE ***	$5,775	$3,881	$3,927	$3,927	$3,927	$3,927	$3,927
STORMWATER RIGHT-OF-WAY SERVICE	$2,671	$5,766	$5,669	$5,669	$5,669	$5,669	$5,669
OTHER OPERATING REVENUE	$1,237	$1,613	$1,376	$1,193	$1,188	$1,183	$1,178
	$110,151	**$128,290**	**$125,702**	**$123,736**	**$122,662**	**$121,618**	**$120,602**
EXPENDITURES							
WATER SUPPLY & TREATMENT	$6,883	$7,446	$7,924	$7,983	$8,143	$8,306	$8,472
TRANSMISSION & DISTRIBUTION	$7,845	$8,579	$9,158	$10,310	$10,516	$10,726	$10,941
WASTEWATER & STORMWATER COLLECTION	$13,659	$14,776	$14,749	$15,183	$15,487	$15,797	$16,113
WASTEWATER TREATMENT PLANTS	$16,821	$19,031	$18,466	$18,873	$19,250	$19,635	$20,028
SMALL SYSTEMS	$2,059	$1,728	$1,911	$1,924	$1,963	$2,002	$2,042
SCADA, CONTROL & PUMPING	$1,851	$1,959	$2,026	$2,077	$2,119	$2,161	$2,204
ENGINEERING & INFORMATION SERVICES	$6,778	$7,312	$7,845	$8,123	$8,286	$8,452	$8,621
ENVIRONMENTAL SERVICES	$2,561	$2,604	$2,796	$2,752	$2,807	$2,863	$2,920
CUSTOMER SERVICE	$3,907	$4,059	$4,337	$4,349	$4,436	$4,525	$4,615
ADMINISTRATION & PENSION	$10,378	$12,020	$11,888	$12,070	$12,313	$12,560	$12,812
DEPRECIATION	$15,867	$18,671	$20,812	$23,489	$21,561	$23,456	$24,113
	$88,608	**$98,183**	**$101,912**	**$107,133**	**$106,880**	**$110,483**	**$112,883**
OPERATING PROFIT	**$21,543**	**$30,106**	**$23,791**	**$16,603**	**$15,782**	**$11,135**	**$7,719**
FINANCIAL REVENUES (NON-OPERATING)							
INVESTMENT INCOME	$690	$660	$660	$720	$720	$720	$720
MISCELLANEOUS	$2,070	$2,160	$2,074	$2,074	$2,074	$1,074	$74
	$2,760	**$2,820**	**$2,734**	**$2,794**	**$2,794**	**$1,794**	**$794**
FINANCIAL EXPENDITURES (NON-OPERATING)							
LONG TERM DEBT INTEREST	$8,161	$9,188	$9,380	$9,722	$10,278	$10,910	$11,992
LONG TERM DEBT PRINCIPAL	$17,257	$18,888	$20,427	$21,796	$23,113	$23,868	$22,940
AMORTIZATION DEBT DISCOUNT	$131	$144	$172	$198	$219	$226	$218
DIVIDEND/GRANT IN LIEU OF TAXES	$4,187	$4,340	$4,579	$4,714	$5,245	$5,856	$6,195
	$29,736	**$32,560**	**$34,558**	**$36,430**	**$38,855**	**$40,861**	**$41,345**
NET PROFIT (LOSS) AVAILABLE FOR CAPITAL EXPENDITURES - REGULATED ACTIVITIES	**($5,434)**	**$367**	**($8,033)**	**($17,033)**	**($20,278)**	**($27,932)**	**($32,832)**
UNREGULATED ACTIVITIES							
REVENUES							
AEROTECH SEPTAGE TIPPING FEES	$633	$800	$800	$825	$908	$998	$1,098
LEACHATE	$322	$366	$379	$393	$400	$408	$417
CONTRACT REVENUE	$91	$86	$86	$86	$86	$86	$86
DEWATERING FACILITY/ SLUDGE LAGOON	$210	$210	$210	$210	$210	$210	$210
AIRLINE EFFLUENT	$75	$80	$78	$78	$78	$78	$78
ENERGY PROJECTS	$0	$38	$115	$198	$198	$198	$198
MISCELLANEOUS	$21	$21	$21	$22	$22	$23	$23
	$1,351	**$1,601**	**$1,689**	**$1,811**	**$1,902**	**$2,001**	**$2,109**
EXPENDITURES							
- DIRECT							
WATER SUPPLY & TREATMENT	$10	$14	$15	$16	$16	$16	$16
WASTEWATER TREATMENT	$1,067	$1,112	$1,198	$1,145	$1,168	$1,191	$1,215
ENERGY PROJECTS	$0	$9	$0	$0	$0	$0	$0
SPONSORSHIPS & DONATIONS	$45	$54	$56	$56	$57	$58	$59
DEPRECIATION	$6	$0	$0	$0	$0	$0	$0
	$1,129	**$1,188**	**$1,269**	**$1,216**	**$1,240**	**$1,265**	**$1,291**
- INDIRECT (ADMINISTRATION)	$0	$90	$90	$90	$90	$90	$90
	$1,129	**$1,278**	**$1,359**	**$1,306**	**$1,330**	**$1,355**	**$1,380**
OPERATING PROFIT	**$222**	**$323**	**$330**	**$505**	**$571**	**$646**	**$729**
FINANCIAL REVENUES (NON-OPERATING)							
MISCELLANEOUS	**$249**	**$229**	**$228**	**$235**	**$236**	**$238**	**$239**
NET PROFIT (LOSS) AVAILABLE FOR CAPITAL EXPENDITURES - UNREGULATED ACTIVITIES	**$471**	**$553**	**$558**	**$740**	**$807**	**$884**	**$968**
NET PROFIT (LOSS) AVAILABLE FOR CAPITAL EXPENDITURES - COMBINED ACTIVITIES	**($4,963)**	**$920**	**($7,475)**	**($16,293)**	**($19,471)**	**($27,048)**	**($31,864)**

** - Revised 2014/15 Operating Budget as approved by the Board of Directors, July 31, 2014*
*** - Revised 2015/16 Operating Budgets as approved by the Board of Directors, November 20, 2014*
****- Metered sales are included with stormwater site generated service amount*

Appendix G

Water Quality Master Plan

Version 2.1

Halifax Water

APPENDIX G

WATER QUALITY MASTER PLAN Version 2.1

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1.0 Introduction

Halifax Water has consistently produced drinking water that has safeguarded public health and achieved regulatory compliance, despite the challenges that occur as regulations become more stringent, infrastructure ages and once current technologies are eclipsed by more modern designs to meet the new regulatory environment. One important tool Halifax Water uses is water quality strategic planning which is formally executed through a Water Quality Master Plan (WQMP). Water quality master planning describes the process whereby a water utility assesses the public's expectations for water quality and the direction of water quality regulations and trends, sets corresponding water quality goals and then plans for necessary capital or operational improvements.

In 2006, Halifax Water completed its first formal WQMP. This plan was designed to set goals for water quality that exceed regulatory requirements and to set a path for Halifax Water to achieve those goals while treating water at an optimal cost. In 2011, the WQMP Version 2.0 was created and focused on upgrades and investigations concerning the JD Kline Water Treatment Plant; Halifax Water's most mature treatment facility. The research plan proposed to achieve these goals focused on optimization projects that would result in improvements with a low capital or operating cost.

Within the last 3 years, many of the research goals outlined in the WQMP V 2.0 were completed and/or the focus of research shifted as a result of changes in source water quality and research outcomes (Table A.1, Appendix A). As such, the need to update the previous WQMP and outline the next phases in research was identified. The WQMP V 2.1 aims to provide an overview of outcomes to the strategic research tasks identified in V 2.0. Additionally, V 2.1 outlines several additional research tasks taken on by HW which were derived either from operational needs, changes in source water quality, regulatory changes and/or research outcomes.

A key resource to HW in completing strategic water quality goals has been its partnership with Dr. Graham Gagnon at Dalhousie University. Dr. Gagnon's team has provided valuable research that has guided HW in making important process changes in its treatment plants.

2.0 Research Partnership with Dalhousie

Halifax Water first entered into a research partnership with Dr. Graham Gagnon in 2007, the goal of which was to evaluate treatment strategies for upgrading the J.D. Kline Water Treatment Plant (JDKWTP) identified in the WQMP V 1.0.

A summary of key milestones in the partnership are outlined in Table 1.

Table 1 – Key Milestones in the Dalhousie Research Partnership

Date	Milestones
2007	HW enters into a 3-year research agreement with Dr. Graham Gagnon (Dalhousie) valued at $400,000.
2007	Dr. Graham Gagnon is awarded a prestigious 5-year NSERC Industrial Research Chair in water quality and treatment, matching Halifax Water's funding contribution.
2007	HW constructs a pilot water treatment plant, valued at $600,000, at this facility to be used as an investigative tool in the implementation of this research program
2009	HW extends its research agreement for 2 years to take advantage of the additional NSERC funding and to fully complete the initial phase of the research program.
2009	As an extension of the research partnership, HW agrees to make annual contributions of &70,000 over seven years to fund D. Graham Gagnon's new state of the art Clean Water Laboratory at Dalhousie University. In return, HW will receive access to the laboratory, facilities and staff. This contribution was also matched by NSERC.
2012	Dr. Gagnon is awarded a 5-year renewal of his NSERC Research Chair.
2012	HW renews its research contract for $700,000 over 5 years to complete objectives identified in the WQMP V 2.0.
2012	LuminUltra, CBRM Water and CBCL become partners in the Research Chair, and their joint funding contributions are further matched by NSERC. The total value of the Research Chair from all funding sources is ~ $560,000 per year.
2012	The pilot plant filter columns and under drains are upgraded to allow for research into biological filtration for improved natural organic matter removal.
2012	The pilot plant is commissioned for research.

3.0 Research Accomplishments

Many of the research tasks outlined in the WQMP V 2.0 were achieved. Tables B.1 and B.2 in Appendix B provide an overview of the research tasks, outcomes and next steps forward. Table B.1 provides an overview of research tasks that are driven by regulatory requirements set by Nova Scotia Environment and outlined in the *Nova Scotia Treatment Standard for Municipal Drinking Water Systems.* Table B.2 provides an overview of research tasks that are driven by process requirements, taste and odor complaints and opportunities for optimization. A summary of key research findings are presented below.

4.0 Regulatory Driven Research

4.1 JD Kline Water Treatment Plant

The focus of research being conducted under the Research Chair has largely been on upgrades and investigations concerning the JD Kline Water Treatment Plant. Research tasks focused on addressing research needs at this facility to ensure that the plant will be able to maintain treatment performance in an increasingly volatile regulatory regime, despite the advancing age of this facility.

4.1.1 Disinfection By-Products (DBPs)

A multi-faceted study was conducted by Dalhousie to improve removal of natural organic matter (NOM) in the plant to reduce disinfection DBP precursors. This study looked at the mixing efficiency of chemicals in the flocculators, optimization of coagulant type and dosing and the characterization of natural organic matter to better understand barriers to enhanced NOM removal:

Computational fluid dynamics (CFD) modeling determined that the flocculation tanks at the JD Kline plant are not optimized for contaminant removal and that increased efficiencies can be sought; a direct result of a dated design and the plant not achieving design flow rates in the hydraulic flocculators.

An investigation of alternate coagulants was completed to optimize the removal of particles, natural organic matter and subsequent disinfection by-product formation reductions at the JD Kline treatment plant. Research completed to date has found that alternate coagulants are not a viable option for achieving increased NOM removal without comprising filtration performance at this direct filtration facility. In addition, the alternate coagulants evaluated did not provide any significant potential for improved particle removal at this facility.

Natural organic matter characterization was completed on both the raw and treated water at the JD Kline facility. This work provided a clear picture of the seasonal impacts of organic matter content in the watershed and the overall performance of the treatment process in terms of removing specific organic fractions. It further indicated that, even under optimized conditions, coagulation alone would not sufficiently reduce DBPs to meet internal strategic goals of 80 µg/L for trihalomethanes (THMs) and 60 µg/L for haloacetic acids (HAAs).

The outcomes of these studies indicated that, in order to achieve enhanced NOM removal, additional treatment would be required. Biological filtration was examined by Dalhousie due to its low cost and feasibility for implementation at the JD Kline plant. Dalhousie undertook bench scale biological filtration experiments which were later adopted at the pilot plant. In order to accommodate this research, the pilot plant filter columns and under drains were retrofitted to accommodate biological filtration. Sand and anthracite filter media was enhanced with a granular activated carbon (GAC) cap. Engineered biological filtration, consisting of nutrient enhancement to promote biological

growth on filter media, was first evaluated for impact on DBP formation and filter run times. No significant reduction in NOM was observed.

The removal of chlorination pre-filter was subsequently evaluated in the pilot plant. While it was always understood that chlorination of the raw water, even to a minimal residual of 0.5 mg/L was contributing to DBP formation in the treated water, the amount of DBPs formed was unknown. Chlorination pre-filter was removed in the pilot plant to evaluate passive biological filtration and its impact on NOM removal and DBP formation. A 20% reduction in THMs was observed in the treated water. Additionally, it was found that filter run times and finished water turbidity were not impacted by this process change.

As a direct result of this research, J.D. Kline ceased chlorination of raw water in the spring of 2013. An average THM reduction of 30% was observed in the central and west distribution systems. No significant change in HAAs was observed.

The next steps in research to further reduce DBPs will focus on research in the distribution systems.

4.1.2 Aluminum Residuals

Halifax Water retained Stantec Consulting to complete a study to evaluate treatment options for aluminum residuals in process water waste streams leaving the plant. The study proposed treatment wetlands, the size of which was cost prohibitive. Halifax Water is currently working with Stantec and the regulator for approval to conduct a study to determine site specific regulatory aluminum residuals. If successful, Halifax Water may pursue this approach for elevated, non-compliant, aluminum in waste streams at Lake Major and Collins Park.

4.1.3 Filter Resting Risk Assessment

Dalhousie University supported a regulatory research task driven by the absence of filter-to-waste at the Pockwock treatment plant, which is considered non-compliant under the Province of Nova Scotia's Drinking Water Strategy. As part of Halifax Water's plan to achieve compliance, Nova Scotia Environment (NSE) required Halifax Water to evaluate alternative means of managing filter ripening and to conduct microbial risk analysis. Based on both pilot and full scale studies, it was concluded that filter resting is indeed reducing risks associated with particle breakthrough during filter ripening sequences and should be continued as an operational alternative for the Pockwock treatment facility. Microbial sampling of *Cryptosporidium*, *Giardia* and *E.coli* during filter ripening events provided further evidence there is no microbial risks associated with the absence of filter-to-waste capabilities at this facility.

4.2 Bennery Lake Water Treatment Plant

4.2.1 Manganese

Water quality issues at the plant relate to elevated manganese concentrations above regulatory aesthetic objectives. Manganese concentrations increase above guideline levels in late summer / early fall and impact other areas of plant performance such as finished water turbidity and disinfection by-product precursor removal. Two approaches to reducing manganese were investigated:

i. Water quality staff completed comprehensive water quality depth profiling at the raw water intake to determine if the depth of the intake could be relocated seasonally, to minimize concentrations in the raw water. Results of the study found that relocation might alleviate one problem but could potentially cause others.

ii. Bench scale biological filtration was investigated as a means of iron and manganese removal. Results of this study indicated that removal of manganese below aesthetic objectives was achievable.

iii. In addition to elevated manganese, several process challenges were identified by staff. As a result, Halifax Water issued a Request for Proposals for consulting services to complete and optimization study of the plant which included a review of treatment strategies to address manganese. The study suggested that the annual increase in raw water manganese during the summer is likely caused by bacteria oxidizing manganese from the sediment of the lake due to a deficiency in dissolved oxygen in the water. In order to address the problem at the source, the study recommended oxygenation of the lake.

Halifax Water is currently compiling the necessary data (watershed sampling, bathymetry study etc…) for preliminary design of an in-lake oxygenation system. Next steps in this study will be to complete a preliminary design of the system and submit to NSE for approval.

4.3 Distribution System

4.3.1 Lead

Halifax Water has addressed lead in the distribution system under three umbrella programs: the annual residential lead sampling program, the lead service line replacement program and the corrosion control program.

i. In 2009, Health Canada released its *Guidance on Controlling Corrosion in Drinking Water Distribution Systems.* The document sought to provide framework for corrosion monitoring programs and response protocols. With respect to lead, the document outlined a comprehensive sampling protocol for the determination of lead in drinking water. In 2011, Halifax Water adopted the Annual Residential Lead and Copper sampling protocol to assess the effectiveness of its corrosion control program on minimizing lead corrosion. While the number of sample locations has been below the

targeted number set out in the guidelines, lead levels have been below 10 µg/L in all distribution systems with the exception of the Central and West distribution systems supplied by the JD Kline plant. The 90th percentile lead concentrations from this system, calculated per the guidelines, has been 13.8 – 22.3 µg/L. This is likely owing to the increased number of lead service lines found in the West Distribution system.

ii. Halifax Water has been proactively replacing lead service lines in the distribution system in conjunction with HALIFAX street renewal projects, water main replacements and repairs and following the replacement or the service line on the private side. In 2011, Halifax Water and Dalhousie developed a comprehensive, voluntary, sampling program for residents undergoing a full or partial replacement of their service laterals. The program consists of lead sampling before and following a lateral replacements at 72 hours, 1 month, 3 months, 6 months and 1 year. Results from this study showed partial lateral replacements can result in increased lead in drinking water for periods up to and greater than 1 year. Results of this study were published in Journal AWWA in 2013 and won Best Paper in its division. As a direct result of this research, Halifax Water abandoned its proactive approach to service line replacements in 2014. Halifax Water now only replaces lead services following replacement of the private side or during an emergency repair or watermain renewal, in which replacement of the public portion of the lateral is necessary. In these circumstances, Halifax Water has begun piloting the use of a plastic coupling to minimize galvanic corrosion at the lead/copper joints.

iii. Halifax Water maintains an effective corrosion control program, whereby a zinc ortho-polyphosphate is added to treated water at the Bennery, Lake Major and JD Kline plants to minimize corrosion in the distribution system. Results from the Annual Residential Sampling Program has shown that lead concentrations are generally below the Health Canada MAC despite there being lead in premise plumbing and/or service laterals. Currently, Dalhousie is conducting bench scale and pilot scale experiments investigating other corrosion inhibitors that might be more cost effective and/or effective at reducing corrosion of metals. Results from this study may be piloted at Bennery Lake in 2015 before consideration or switching corrosion control products at Lake Major and JD Kline.

4.3.2 DBPs

In addition to research efforts to improve NOM removal in the treatment plants to minimized DBP precursors, several research tasks were completed to assess DBP formation in the distribution system:

i. Numerous municipalities have made the switch from chlorine to chloramines to achieve CT disinfection to reduce THM and HAA formation. Under the research partnership, Dalhousie completed a pilot scale study to assess the impacts of switching disinfectants on DBP formation. Outcomes of the study found that, while a reduction in DBPs could be achieved, chloramines significantly increased lead corrosion. This approach was abandoned to be protective of the estimated 4,000 homes with lead service lines on the peninsular Halifax.

ii. Halifax Water has several re-chlorination stations located throughout its East, West and Central distribution systems. Many of these are located at inflows to storage reservoirs. Six reservoirs were identified to assess the impact of water age and re-chlorination on DBP formation. Outcomes of this study helped determine the magnitude of impact re-chlorination at influent flow to reservoirs on DBP formation. Additionally, a prioritization of reservoirs requiring additional studies and/or upgrades has been developed from this preliminary study.

iii. North Preston community experiences seasonal increases in THMs above the MAC. In an effort to reduce THMs, several operational changes were evaluated such as optimizing the chlorine dose at the re-chlorination station and improving water turnover in the Mount Edwards and North Preston Reservoirs. While some reductions in THMs and HAAs were observed following these operational changes, the reductions were not significant. The next phase in this study was to add a second re-chlorination point at the reservoir effluent to ensure a chlorine residual of 0.2 mg/L is maintained in the distribution system. In doing so, it is anticipated that the first re-chlorination station chlorine dosing can be decreased or eliminated, thereby minimizing DBP formation in the reservoir. The next steps in this research task will be to optimize the two re-chlorination points and evaluate the impact on THM and HAA formation in North Preston.

iv. One of the tasks in the 2012 System Assessment Reports for NSE was to evaluate compliance sampling locations for THMs and HAAs. Additional sites were added to quarterly compliance sampling.

4.3.3 Chlorine Residuals

Chlorine residuals in the distribution system continue to be problematic in the summer months. Halifax Water staff have been working to achieve regulatory compliance by meeting the minimum 0.2 mg/L chlorine residual. In instances where low chlorine residuals are detected, Water Quality staff have developed a response protocol consisting of verification, increased chlorination at the plant or re-chlorination station and/or manual flushing. In addition to this response procedure, Halifax Water has completed some distribution system optimization strategies.

i. Where appropriate, Halifax Water has implemented automated hydrant flushing units to cycle water in dead-end locations where chlorine residuals are problematic year round. Two permanent units have been installed so far; one in Cole Harbour and one in Sackville. Chlorine residuals in these locations have been successfully addressed, which minor optimization of flushing cycles required seasonally. A temporary unit was recently installed in Purcells Cove with much success.

ii. Water Quality staff have completed a review of Compliance sampling protocol which currently consists of a 5 minute flushing prior to sample collection. Field flush times and hydraulic calculations based on GIS data have shown that 5 minutes of flushing is insufficient at most sampling locations and does not provide a representative sample. This study has identified several sample sites which should be relocated within the same area due to flush times exceeding 25 minutes. Additionally, the study has shown that no

single flush time is appropriate for all sites, but rather flushing should continue until two consecutive samples are within an acceptable range.

4.4 CT Disinfection

CT disinfection was adopted by NSE as a means to ensure that plants consistently achieve the required virus and pathogen removal. Real time CT monitoring was implemented at the Pockwock and Lake Major treatment plants in 2006. Online CT monitoring has allowed for the facilities to respond quickly to operational changes or anomalies that require CT to be subsequently adjusted to meet regulatory requirements. It has also identified some seasonal time frames in which the facilities need to carefully monitor CT trends to ensure regulatory requirements are consistently met. In response to numerous incidents involving water-borne contaminants, regulatory requirements for evaluating, monitoring and reporting disinfection performance are becoming more stringent in the water industry. In response to NSE recently requiring real-time CT monitoring in new operating permits, Halifax Water has been working to implement online CT monitoring at all of its facilities.

Currently, all of Halifax Water's plants have online CT monitoring capabilities with the exception of Bomont. In addition to real-time monitoring, an alert call-out system has been established with alarm set-points above compliance requirements. This ensures that operators receive alarms in advance of non-compliance events to allow operators sufficient reaction time to investigate and address any operational issues affecting CT.

With the implementation of real-time CT monitoring in all of the small systems, Halifax Water also conducted internal training sessions with plant operators. These sessions instructed operators on the theory behind the CT calculation, parameters affecting CT and how to manually calculate CT in the event of instrument failure.

The next steps in this task are to implement real-time CT monitoring at the Bomont Water Treatment Plant.

4.5 Silversands Process Optimization

Several process challenges have been identified by small systems staff which have led to non-compliance events for CT disinfection and elevated manganese concentrations. It was found that manganese was not being removed sufficiently before the filters and was precipitating in the filter effluent, resulting in turbidity spikes and manganese concentrations above the MAC. As well, chlorine disinfection and oxidation of manganese was occurring in the same treatment step pre-filter. As a result, increases in manganese concentrations in the raw water exerted an increased in chlorine demand, thereby reducing chlorine residual for CT.

The media was replaced in the filters with new greensand plus media. Pre-oxidation using potassium permanganate was abandoned due to the process instability of the oxidant. Pre-oxidation of manganese was enhanced by increasing the injection point and creating sufficient reaction time before filtration. A second chlorination point was added post filter to ensure CT disinfection. Addition of phosphate, used to sequester manganese in the distribution system, was abandoned in the process as plant staff were able to reduce treated water manganese by 90% and

reduce turbidity below 0.04 NTUs. Since the process enhancements, the plant has been compliant.

4.6 Bomont Commissioning

The Bomont plant was constructed in 2011 and services 15 homes on Bomont Drive. Financial constraints resulted in a plant design using household ultra filtration and UV units and unfamiliar technologies such as ion-exchange resins. As well, the plant's design did not consider water quality from heavy rain events when establishing preliminary design water quality parameters. Following construction, small system operators have been challenged with getting the plant on-line to complete performance testing and commissioning.

One of the main challenges with operating the plant has been in operating the ion-exchange resin filter beds which remove color and odor from the water. Over the past few years staff have tried using granular activated carbon as a polisher, various ion-exchange resins including mixed bed resin combinations. None of these media were able to sustain color and odor removal over a week in service.

In Summer 2014, new ion exchange resins were used to create mono-media filters. Mechanical mixers were installed on the brine mix tanks, to ensure complete mixing of the salt pellets. As well, the regeneration solution was adjusted to a pH of ~ 9.0 to aid in foulant removal.

The plant completed performance testing and was put into service on July 25, 2014. A commissioning letter was sent to the regulator by CBCL on September 25, 2014 followed by an application for an Approval to Operate on October 3, 2014.

4.7 2013 NSE System Assessment & Corrective Action Plan Implementation

In 2013, Halifax Water completed System Assessment Reports for each of its water supply systems as part of the Nova Scotia Drinking Water Strategy. The purpose of the assessments was to complete an evaluation of treatment processes, facilities and equipment and to review operations, monitoring and management of the system as per guidelines set by Nova Scotia Environment in the Terms of Reference. This exercised provided Halifax Water the opportunity to critically assess each water systems' ability to consistency and reliably deliver safe drinking water and to identify barriers to achieving compliance.

Following submission of the system assessment report, Halifax Water developed a Corrective Action Plan with timelines for implementation for any deficiencies identified through the system assessment. Halifax Water is currently one year into completing Corrective Action Plan items and anticipates most being addressed by October 2015.

5.0 Internal Optimization Driven Research

5.1 Pilot Plant Studies

Since many of the research tasks focused on process improvements at the JD Kline facility, in the summer of 2007, Halifax Water constructed a pilot water treatment plant, valued at $600,000, at this facility to be used as an investigative tool in the implementation of this research program. In the fall of 2007, the research team commissioned the pilot plant and has been conducting research at the facility since that time. Several research projects have been completed over the years:

i. The pilot plant was first used to investigate the use of alternate coagulants for optimized particle and NOM removal. Research completed to date has found that alternate coagulants are not a viable option for achieving increased NOM removal without comprising filtration performance at this direct filtration facility. In addition, the alternate coagulants evaluated did not provide any significant potential for improved particle removal at this facility.

This research identified that the pilot plant treatment process produces water quality with lower DBP formation potential than the full scale plant, highlighting the superior performance of mechanical mixing, as opposed to hydraulic flocculation. Due to the mixing benefits associated with mechanical flocculation in the pilot plant, aluminum sulfate coagulation in the pilot plant was achieving lower disinfection by-product formation potentials than the full scale plant. This enhanced performance suggests that aluminum sulfate coagulation can be optimized for improved performance once the mixing inefficiencies are addressed in the full-scale plant.

ii. The overall research objective of this program was to evaluate the effectiveness of biological filtration for removing organic matter while reducing disinfection by-products (DBPs) and to identify appropriate operational conditions and tools that can be used to ensure effectiveness in application. This aspect of the research chair program has involved many of the partners and several graduate student researchers. This work started by retrofitting the pilot plant in Halifax to enable biological filtration. Dalhousie led this the work at the Halifax pilot plant and demonstrated that trihalomethanes (THMs) can be reduced by 20% by simply removing a pre-filtration chlorination step, and allowing biofilm to develop on the filter media. As a direct result of this finding, Halifax Water removed their pre-chlorination step (which provided only 0.05 mg/L of residual on the filters) in spring 2013. This process change resulted in approximately 40% reduction in instantaneous THM concentration.

The next steps in pilot plant research will involve the compilation of process data to support the Water Research Foundation Project #4555 entitled “Optimizing Biological Filtration for Various Source Water Quality Conditions” which was awarded in Summer 2014. As well,

5.2 Lake Major Optimization Research

Over the years plant staff have identified numerous operational challenges affecting chemical feed systems, filtration systems, clarifiers, residuals handling and equipment etc… These challenges have led to the operational instability of the plant, increased operating costs and inability to achieve regulatory compliance of distribution system DBPs and waste stream water quality.

In order to meet regulatory compliance and improve operational stability of the plant, Halifax Water engaged consulting services from CBCL/HDR to complete an optimization study of the plant by June 2015. Outcomes of this study will be incorporated into a capital improvement plan.

5.3 Bennery Lake Optimization Research

The performance of Bennery Lake WSP is limited by raw water quality and the existing plant design, in spite of extensive efforts by operators to overcome the plant's deficiencies. Numerous process challenges were highlighted by staff over the years including floc carryover during settling, unbalanced hydraulics, short filter run times, manganese and HAAs above regulatory levels and turbidity spikes in the filtered water during start up and shut down. In order to meet Halifax Water's water quality goals and Atlantic Canada Design Standards for Water Treatment Plants, it was determined that capital improvements would be necessary.

Water quality issues at the plant relate to elevated manganese and disinfection by-product concentrations. Manganese concentrations increase above guideline levels in late summer / early fall and impact other areas of plant performance such as finished water turbidity and disinfection by-product precursor removal. A number of hydraulic limitations are also impacting the plant performance which include improper mixing in the rapid mix tanks, inadequate flocculation, uneven flow distribution and lack of sedimentation.

In an effort to improve the operation of the facility, Stantec Consulting/HDR was hired in 2012 to complete a process optimization study and provide Halifax Water with recommendations to improve the operation of the facility. From these recommendations, Halifax Water developed a 5-year capital improvement plan.

5.4 JD Kline Research

5,4,1 Taste & Odor (Geosmin) Research

In October 2012, Halifax Water experienced its first onset of Geosmin in Pockwock Lake. While treated water concentrations never exceeded 20 ng/L, customer satisfaction has decreased substantially. Halifax Water has taken a number of steps to better understand the occurrence and treatment of Geosmin:

i. A Geosmin Monitoring Program was initiated in the Fall of 2012 and has continued with sampling of the tributaries, lake and treated water. Sampling of our other watersheds has also been undertaken annually to collect baseline data. Mycrocystin, a regulated toxin produced by some species of cyanobacteria is regularly tested in the treated water at Pockwock Lake. To date, microcystin has not been detected Pockwock Lake.

ii. In the fall of 2013, Halifax Water retained TreeFrog Environmental to complete advanced speciation of algae to better understand the source and occurrence of geosmin in the watershed. The study identified the planktonic cyanobacteria *Anabaena lemmermannii* to be the most prevalent with a few other species (*Planktolyngbya* and *Leptolyngbya*) present to a lesser extent. Anabaena are nitrogen-fixing bacteria and

require a nitrogen rich source water to proliferate. Coincidentally, the nitrogen concentrations in Pockwock Lake have been increasing slightly.

iii. Dalhousie has undertaken studies looking at Geosmin removal through advanced oxidation processes using hydrogen peroxide and ultraviolet light. Preliminary results indicate that Geosmin removal can be achieved at high doses. The next steps in this project will look at refining the required dosage of UV and hydrogen peroxide to estimate operating costs for full scale treatment.

iv. In the spring of 2014, Halifax Water retained AECOM to complete a Geosmin treatment study to evaluate the feasibility and cost of implementing various treatment strategies. Halifax Water is currently reviewing treatment options to determine which, if any, will be pursued for pilot studies.

5.4.2 Microbial Risk Assessment

A quantitative microbial risk assessment (QMRA) was completed by Dalhousie to assess the risks associated with cryptosporidium, giardia and E.coli in the treated water under various operational scenarios including worst-case scenarios with one of more treatment barriers at risk. Outcomes of this study indicated that there was very low risk of contamination of the drinking water.

5.4.3 Filter Underdrain Assessment

AECOM recently completed a study of the filter underdrains and filter media at the JD Kline plant following a filter underdrain failure in Spring 2014. The report suggested a phased replacement of all underdrains with provisions for air scour which has the ability to enhance cleaning during backwash and may be critical if the plant were to implement enhance biological filtration. Several media types were evaluated, however it was recommended that replacement of the current media with new sand/anthracite would be sufficient.

The next step in this project is to develop a capital improvement plan for phased filter replacement.

5.4.4 USEPA Source Water Monitoring

Halifax Water has adopted the USEPA Surface Water Assessment program to assess the microbiological risk of its water systems. This program consists of 24 consecutive monthly raw water samples for *Giardia* and *Cryptosporidium*. The assessment has been completed at the JD Kline, Lake Major, Bennery Lake, Collins Park, Middle Musquodoboit surface water systems. Neither cryptosporidium nor giardia was detected in raw water at the JD Kline, Lake Major or Bennery Lake Water Treatment Plants. Cryptosporidium was detected once in a two year period at Collins Park, while giardia has been detected occasionally at both Collins Park and Middle Musquodoboit Water Treatment Plants. Sampling is currently underway at Bomont and Chain Lake with Lake Lamont remaining. The anticipated completion date for this program is 2017.

5.4.5 Operator Training

A formal internal training program was developed in 2012 to support the implementation of locational water quality goals and monitoring programs and to encourage the continued optimization of treatment processes on a daily basis. This training program involves classroom and hands on demonstrations to provide operators with the necessary tools to be successful in the proposed monitoring and optimization tasks. Previous topics covered include CT disinfection, lead, filter surveillance and optimizing coagulation. HW is working to have these training sessions accepted as formal Continued Education Training (CEU) sessions by NSE.

5.5 Filter Optimization and Monitoring

In 2013, Halifax Water Operations and Water Quality staff underwent in-house formal training on filter surveillance techniques. From this, a filter surveillance monitoring program was adopted and implemented at JD Kline, Bennery Lake and Lake Major in 2014. The goal of this program is to complete continuous monitoring of filter beds in each of the three plants to assess the media and performance of the filters.

A second component of this program is to develop optimized filter backwash SOPs. Currently, each plant has developed SOPs for filter backwashing, however recent optimization studies completed at Bennery Lake and JD Kline have identified mechanical/hydraulic limitations to optimizing backwash of the filter media. Once the necessary capital improvements are completed, this task will be completed.

5.6 Membrane Process Optimization

Following the construction and commissioning of the ultra and nano-filtration plants at Collins Park and Middle Musquodoboit, small systems' staff noted seasonal fouling of membranes from iron, manganese and organics. Dalhousie completed bench scale and pilot plant studies to investigate pre-treatment strategies to reduce membrane fouling. Outcomes of the study showed that energy consumption could be reduced if a small dose of coagulant was injected prior to UF treatment. Small systems operators were able to successfully manage membrane fouling by varying their membrane cleaning solvents seasonally. As a result of their success, further research into pre-treatment strategies was abandoned.

5.7 IWTA & Partnership for Safe Water Initiatives

Halifax Water completed the IWTA program with the objective of evaluating filtration performance at the JD Kline and Lake Major treatment plants, and also support optimization and continuous improvement at these treatment facilities. As participants in this program, Halifax Water was required to demonstrate that high levels of filter performance are being achieved and the capability to maintain these levels long term. The filter performance program included continuous online monitoring and the analysis of filtration data to demonstrate that individual filters produced filtered water turbidity was less than 0.10-NTU 95% of the time, consistent filter performance was being achieved, maximum filtered water turbidity was less than 0.3-NTU and to confirm that CT objectives for the removal of giardia and viruses are being achieved. Both the

JD Kline and Lake Major facilities successfully met all of these stringent performance goals and were subsequently awarded the 3-Star Excellence in Water Treatment Award in June of 2009.

In 2013, Halifax Water subscribed to the Partnership for Safe Water. This program is a voluntary initiative for enhancing water treatment to provide higher quality drinking water. The program is divided into two separate programs; one for water treatment and one for distribution. Each program is a four-phased, self-assessment and peer-review process to help water utilities to critically examine their water operations, maintenance, and management practices to determine where operational improvements can be made without capital upgrades. The program incorporates many elements of the IWTA program and the Comprehensive Performance Evaluation.

Halifax Water has currently registered JD Kline, Lake Major, Bennery Lake, Collins Park and Middle Musquodoboit plants into the program. Phase I has been completed for all plants, and Phase II has been initiated at Lake Major and Bennery Lake. This program is a continuous self-improvement program with no defined timelines for project completion.

APPENDICIES

Appendix A - Table A.1

HRWC Water Quality Master Plan Implementation Progress Chart

= Not Started | = In Progress/W Caution | = In Progress / On Track | = Completed

Goal	Status	Comments
Source Water Quality		
Source Water Monitoring for Crypto and Giardia		Anticipated completion date 2018. Completed 5/8 systems.
Source Water Protection Research		
Water Quality & Treatment		
Organic Matter Monitoring		Program was established in 2012 and initiated at Bennery, Lake Major and JD Kline. Due to staffing limitations, data collection from Bennery has been dependent on student research projects at the plant.
Water Quality / Treatment Performance Monitoring Programs		
Locational Operational and Water Quality Goals		
Operator Training Program		A program was established in 2012.
Particle & Precursor Removal		
Filter Monitoring and Optimization Program		A formal filter surveillance program was established in 2013. Optimization of filter backwash is on hold until optimization studies are completed and capital upgrades to the filters have been implemented.
Filter Backwash Optimization and SOPs		Filter operation SOPs have been established for Bennery, Lake Major, J.D. Kline, Middle Musquodoboit and Collins Park. Optimization of filter backwash is on hold until optimization studies are completed and capital upgrades to the filters have been implemented.
J.D Kline WTP		
Flocculation Mechanical Mixing Studies		
Chemistry Assessment and Finalization		
Filter Operational Strategy and Flow Control (Pilot)		
Filter Operational Strategy and Flow Control (Pilot) - Consultant Facilitated		Filter underdrain study completed by AECOM found that conversion of the full scale plant to ETSW is not feasible. As such, this task was removed from the research goals.
Pre-chlorination Evaluation		
Bio-filtration Study		
Advanced Pilot Studies - *as required*		WaterRF biological filtration pilot work to commence in 2014
Lake Major WTP		
Coagulation and Upflow Clarification Assessment		This will be evaluated by HDR/CBCL as part of an optimization study to be completed in Spring 2015.
Residuals Handling Optimization		This will be evaluated by HDR/CBCL as part of an optimization study to be completed in Spring 2015.
Bennery Lake WTP		
Coagulation Optimization Study		
Manganese Removal Study		The optimization study completed by Stantec/HDR has recommended in-lake aeration. Halifax Water is currently working with Mobley Engineering for a system pre-design.
Distribution System		
Distribution System Water Quality and Integrity Monitoring		
Disinfection Efficiency and THM/HAA Removal Study		
Adopt and Implement New Lead Policy		
Lead Service Line Replacement and Monitoring Program		
Implement New Residential Lead Monitoring Program		

Appendix B - Table B.1

Regulatory Driven Research

	Regulatory Driver	Research Goals	Outcomes	Next Steps in Research	Outcomes	Next Steps in Research	Outcomes	Next Steps in Research
J.D. Kline WSP	DBP Strategic Goals: 100 ug/L THMs / 80 ug/L HAAs	NOM Characterization Study	Section	Evaluate the impact of removing pre-chlorination on filter run times and disinfection by-product formation.	Work was completed at the J.D. Kline Pilot Plant to evaluate the impact of removing pre-chlorination on disinfection by-product formation. Pilot work showed that THMs could be reduced by 20%.	Remove pre-chlorination at the plant and evaluate the impact on filter run times, THM and HAA formation in the plant and distribution system.	An average reduction in THMs of 30% has been observed since the process change was made. Regulatory goals for THMs and HAAs have been achieved however internal strategic DBP goals have not yet been achieved.	Identify DBP reductions from the proposed geosmin treatment strategies
		Alternative Coagulant Evaluation	Viable alternative impacted filter run times					
		Evaluate Mixing	CFD modeling determined that hydraulic mixing in the flocculators is not optimized.	Evaluate engineered and passive biological filtration for improving NOM removal.				
				Evaluate impact of changing the hydraulic flocculators to mechanical flocculators to achieve better mixing and NOM removal.				
	Aluminum Residuals in Waste Stream	Evaluate detention time and treatment.	Retention time is insufficient to promote settling of aluminum in the lagoons and absorption in the treatment wetlands.					
		Waste Residuals Management Study / Lagoon Study	The required treatment wetland to meet aluminum guidelines is cost-prohibitive.	Consultations with NSE to discuss site specific aluminum guidelines.				
	Filter Resting Risk Assessment in Absence of Filter-to-Waste	The absence of filter-to-waste is considered non-compliant under the Nova Scotia's Drinking Water Strategy. In order to achieve compliance, NSE requested that Halifax Water evaluate alternative means of managing filter ripening and to conduct a microbial risk analysis.	Pilot and full scale studies were completed by Dalhousie to show that filter resting was appropriate to mitigate microbial risk at this facility.					
Bennery Lake	Manganese Aesthetic Objective 0.05 mg/L	Evaluate pre-treatment options for manganese removal.	Bench-Scale pre-treatment using biological filtration reduced manganese concentrations however implementation at full scale could be challenging.	Optimization study recommended in-lake aeration.				
		Evaluate in-lake strategies to reduce manganese at the plant	Watershed sampling indicated that relocation of the intake might alleviate one water quality problem but cause several others.	Optimization study recommended in-lake aeration.				
Distribution System	Health Canada Lead Action Level: 15 ug/L and an MAC of 10 ug/L	Evaluate the impact of coagulant change on lead leaching in drinking water.	Coagulant changeovers can have impacts on iron, aluminum, chloride and sulfate.					
		Evaluate the impacts of partial lead service line replacements.	Lead leaching is significantly increased following replacement of a lead service line.	Evaluate the use of plastic couplings between service line connections on lead leaching.				
		Adopt Health Canada's Annual Residential Lead and Copper Sampling Program.	Lead and copper sampling at several heritage buildings with lead service laterals showed that Halifax Water's corrosion control program was effective and reducing lead corrosion.					
			Results show that Halifax Water is below or near the Lead Action Level for lead in drinking water in all systems.	Increase number of volunteers in the study to those recommended in the Health Canada Guidelines.				
	DBP MAC: 100 ug/L THMs / 80 ug/L HAAs (Strategic Goals of 80/60)	Evaluate disinfection by-product formation in reservoirs.	THM and HAAs were quantified from select reservoirs across the East, Central and West Regions.	Complete distribution system water quality model study to identify vulnerable points in the distribution system for improved management.				
		Determine if the number of THM and HAA sampling sites are adequate.	Several THM and HAA sites were added in the East and West systems during the 2012 System Assessment Reports.	Water modeling				
		North Preston Reservoir DBP Mitigation	Greater process control on the rechlorination station upstream of the reservoir along with maximizing water turnover in the reservoir was insufficient in reducing DBPs below the MAC.	A second rechlorination point was added to the effluent of the reservoir with the expectation that the chlorine residual at the upstream booster station could be decreased or eliminated from the system.				
		Evaluate the impacts of switching to chloramines.	Pilot scale pipe-loop setup showed that switching to chloramines had significant impacts on lead leaching from lead service lines. Halifax Water abandoned chloramines as an alternative disinfectant.					
	Maintain a chlorine residual of 0.2 mg/L	Evaluate distribution system sampling locations for chlorine residual monitoring.	Hydraluic information along with field sampling has shown current sampling practices does not adequately capture a representative sample.	Implement duplicate sampling practices to confirm that the sample is representative.				
				Evaluate alternative sampling locations and request a sampling location change.				
		Chlorine residual profiling in reservoirs.	All reservoirs in the distribution system were equipped with remote chlorine residual analyzers with continuous online monitoring data storage.					
CT Disinfection	CT Disinfection	Install Real Time CT Monitoring at plants and develop disinfection SOPs.	Online CT monitoring has been installed at all plants with alert set points at CT ratios of 1.5 before non-compliance.	Install real-time CT at Bomont and Otter Lake				
All Systems	NSE System Assessment and Corrective Action Plan & Implementation	Identify areas for improvements in water quality monitoring, training, waste residuals management etc…	A Corrective Actions Plan with timelines associated with any deficiencies identified was implemented October 1, 2013.					

Appendix B - Table B.2

Optimization Driven Research

	Driver	Goals	Outcomes	Next Steps	Outcomes	Next Steps	Outcomes	Next Steps
Pilot Plant Studies	Commissioning	To review the success of pilot work, its applicability for full scale implementation and to determine if any interim findings can be implemented full scale.	Results have shown that improved NOM removal is achieved in the pilot plant compared to the full scale, likely owing to the difference in mixing.	Evaluate engineered and passive biological filtration for improving NOM removal.	The pilot plant was retrofitted to support biological filtration studies.	WaterRF Project 4555 "Optimizing Biofiltration for Various Source Water Quality Conditions" which was awarded in 2014 and/or geosmin treatment evaluations.		
Lake Major	Numerous process challenges	Issue RFP for consulting services to complete a review of treatment processes at the plant and develop a comprehensive optimization strategy and recommendation to improve the operation of the facility.						
Bennery Lake	Numerous process challenges	Issue RFP for consulting services to complete a review of treatment processes at the plant and develop a comprehensive optimization strategy and recommendation to improve the operation of the facility.	Stantec was retained in 2012 to complete an optimization study. A capital improvement plant was developed based on the outcomes of the workshop and has been implemented in 2013.	Procure VFD mechanical rapid mixers for the pre-mix and plate settlers for the settling basins and evaluate and optimize process following upgrades to the plant.				
				Pursue pre-design of the lake oxygenation system from Mobley Engineering.				
J.D. Kline	Geosmin Taste & Odor Complaints	Establish a monitoring program	A monitoring plan was established in October 2012 consisting of tributary and lake sampling for geosmin and MIB.	Investigate the source and occurrence of geosmin	A ecological study was completed in 2013 and found that a nitrogen-fixing cyanobacteria was likely the primary contributor to geosmin however in-lake treatment options would likely not be effective.	Evaluate treatment options for removal of geosmin	A feasibility and and cost estimate study of potential treatment options was completed in Fall 2014.	Complete pilot testing of preferred treatment option to evaluate geosmin removal and other water quality improvements (DBPs).
	Microbial Risk Assessment	Quantitative microbial risk assessment (QMRA) study to determine risks associated with Cryptosporidium, Giardia and E.coli in the treated water	Outcomes of the study indicated that there is very low risk of contamination of the drinking water by Cryptosporidium, Giardia and E.coli.					
	Filter Failure	Filter Underdrain Replacement Study	Outcomes of this study recommended the phased replacement of all underdrains with provisions for a scour.	Develop capital improvements plan for phased filter underdrain replacement.				
	USEPA Source Water Monitoring for Crypto/Giardia	Halifax Water adopted the USEPA Surface Water Assessment Program in 2008 to assess microbial risk of its water systems.	This program is approximately 65% complete and is expected to be completed in 2018.	The anticipated outcome of this study is to show that there is low risk or cryptosporidium and giardia in our source water supplies.				
J.D. Kline, Lake Major and Bennery WSP	Operator Training	To develop formal internal training programs to support the implementation of water quality goals and monitoring programs and to encourage the continued optimization of treatment processes.	Training sessions have been underway since 2012 and occur 1 -2 times per year.					
	Filter Monitoring Program	Form a formal filter surveillance program to implement continuous filter monitoring practices at the plants.	A filter surveillance team made up of plant operators from each of the plants has been identified.					
	Filter Backwash Optimization	Optimize filter backwashing procedures and develop SOPs	SOPs have been drafted to outline current backwash procedures however optimization of backwashin will be on hold until the recommended capital improvements are completed for each of the plant.					
Bomont	Commissioning and operation of the plant	Address operational challenges idenfitied by small systems staff.	Process challenges have been addressed and the plant is now operational.	Procurement of in-line UV254 measurements for ion exchange filter effluent monitoring.				
				Evalute limitations to water treatment during rain events.				
		Finalize application for Approval to Operate from NSE	An application for Approval to Operate and Commissioning Letter were sent to NSE in September 2014.					
Collins Park	Membrane Founling	Evaluate membrane foulants and provide recommendations for process optimization	Outcomes of this study showed that energy consumption could be reduced if a small dose of coagulant was injected prior to UF treatment.					
Middle Musquodoboit								
Silversands	Numerous process challenges	Review current process and provide operational recommendations to improve iron, manganese, CT and turbidity at the plant.	Several process improvements (new media and contact time) were completed which have improved iron and manganese removal and to reduce turbidity.	Implement a second sodium hypochlorite injection point; one for oxidation of iron and manganese pre-filter and a second one for CT disinfection post-filter.	Second injection point has eliminated CT alarms at the plant.			
Partnership for Safe Water	Industry best practices	Complete Phase I Water Treatment - Commitment.	Participating plants include J.D. Kline, Lake Major, Bennery Lake, Collins Park and Middle Musquodoboit.	Complete Phase II - Baseline and Annual Data Collection.				
		Complete Phase I Distribution System - Commitment.	Participating plants include J.D. Kline, Lake Major, Bennery Lake, Collins Park and Middle Musquodoboit.	Complete Phase II - Baseline and Annual Data Collection.				

Appendix H

Wastewater Treatment Facility Compliance Plan

Halifax Water

APPENDIX H

Halifax Water

Wastewater Treatment Facilities (WWTF) Compliance Plan

John Sheppard, P.Eng.

Director, Environmental Services

Halifax Water

September 26, 2014

Halifax Water

Introduction

This Compliance Plan has been developed to document efforts and plans by Halifax Water to achieve compliance at the 15 wastewater treatment facilities (WWTFs) owned and operated by Halifax Water. With new Wastewater System Effluent Regulations (WSER) implemented by the federal government in 2012, there are now both provincial and federal wastewater standards for compliance. Nova Scotia Environment (NSE) is working to make the provincial standards equivalent to the federal standards.

This Compliance Plan forms part of the Halifax Water Business Plan, and has been updated to September of calendar year 2014, for the 2015/16 to 2019/20 Business Plan.

Non-Compliance Issues identified up to September, 2014.

(References to years are for calendar years.)

Aerotech

2011 and 2012 Non-Compliance Issues –	NSE: TSS, Ammonia	CCME: TSS, CBOD
2013 and 2014 Non-Compliance Issues -	NSE: TSS	WSER: None

Toxicity (WSER, effective Jan 2015): Aerotech WWTF exhibited toxicity (acute, trout) during sampling in 2010 and 2011, coincident with high total ammonia levels. Since toxicity testing resumed in June 2013, with low total ammonia levels, there have been no toxic effluent results.

Steps have been taken to reduce the ammonia loading on the Aerotech WWTF: diversion of sludge from Mill Cove WWTF, diversion of sludge from Eastern Passage to Dartmouth, maintenance of septage loading to the maximum of 2011 levels for each hauler, diversion of septage under a pilot program to the Mill Cove and Dartmouth sewersheds, and discontinuing acceptance of "biowater" at Aerotech. The Eastern Passage WWTF now includes dewatering, so that EP sludge will no longer go to AeroTech. In addition, a third sand filter has been installed at Aerotech WWTF to improve TSS performance. Between the 2nd and 3rd quarter of 2013, ammonia performance significantly improved, and is currently (Q3 2014) compliant with NSE requirements. TSS continues to be an issue, with performance slightly below the NSE requirement of 80% compliant samples. Improvements to the SBR decanters are being considered as one possible solution.

For 2014, the Aerotech WWTF has been compliant with the federal Wastewater System Effluent Regulation (WSER) requirements for all regulated parameters.

Better management of wet-weather flows is also key to improving performance of this SBR facility. The lagoon is now being used to store wet-weather peak volumes, and improvements are being made to better manage discharge of water from the lagoon to the WWTF.

These measures are consistent with the actions proposed in the 2011 Compliance Plan.

Belmont

2011 and 2012 Non-Compliance Issues –	NSE: CBOD, FC, TSS	CCME: TSS
2013 and 2014 Non-Compliance Issues - (Decommissioning 2015/16)	NSE: CBOD, FC, TSS	WSER: TSS

Toxicity: Not subject to WSER toxicity testing requirements.

The Belmont WWTF had shown improvements in performance in 2013. However, performance degraded in 2014. Higher flow rates encountered recently had depleted the hypochlorite disinfection system, so a two-container system has now been installed to accommodate the higher flows. This should improve disinfection performance.

The Belmont WWTF is scheduled to be de-commissioned, with diversion of flows to the Eastern Passage WWTF by 2016, consistent with the 2011 Compliance Plan.

Dartmouth

2011 and 2012 Non-Compliance Issues -	NSE: FC, CBOD (2012)	CCME: TSS, CBOD
2013 and 2014 Non-Compliance Issues -	NSE: FC	WSER: TSS, CBOD

Toxicity: Since toxicity testing began in 2012, Dartmouth WWTF effluent has been non-toxic.

In 2013, NSE changed the compliance requirement from 80% to average values must meet the discharge limits, consistent with WSER. Since that time, Dartmouth has been mostly compliant. Fecal coliform has occasionally exceeded the NSE limit.

TSS and CBOD levels are sometimes below and sometimes slightly above the WSER limits. An application has been filed under WSER for a Transitional Authorization to allow discharge of non-compliant effluent for a specified period to achieve compliance through upgrade.

Eastern Passage

2011 and 2012 Non-Compliance Issues -	NSE: CBOD, FC, TSS (2012)	CCME: TSS, CBOD
2013 and 2014 Non-Compliance Issues -	NSE: None	WSER: None

Toxicity: Eastern Passage effluent was toxic for Q1-Q3 of 2013, but was non-toxic for Q4 and for 2014. This was related to chlorine levels, and has not been an issue since the upgrade to UV disinfection.

The Eastern Passage WWTF completed a significant secondary upgrade and capacity expansion in 2014, consistent with the 2011 Compliance Plan. The secondary upgrade has achieved NSE and WSER compliance. NSE now assesses compliance based on average values.

Frame

2011 and 2012 Non-Compliance Issues –	NSE: FC, TSS, CBOD	CCME: Chlorine
2013 and 2014 Non-Compliance Issues -	NSE: TSS	WSER: Does not apply

Toxicity: Not subject to WSER toxicity testing requirements.

TSS performance continued to be poor throughout 2013 and 2014.

Installation of a new collection system has been completed. The planned replacement of the WWTF and conversion to UV disinfection has been deferred. The WWTF operation will be optimized and the outfall may be relocated from the stream to the lake.

Halifax

2011 and 2012 Non-Compliance Issues -	NSE: CBOD	CCME: TSS, CBOD
2013 and 2014 Non-Compliance Issues -	NSE: CBOD	WSER: CBOD

Toxicity: Halifax WWTF had toxic effluent during Q2 of 2014.

In 2013, NSE changed the compliance requirement from 80% to average values must meet the discharge limits, consistent with WSER. Since that time, Halifax has been fully compliant as judged by average values.

Significant soluble BOD source control, or a secondary upgrade, is required for WSER compliance. Oland Brewery has recently made a commitment to reduce their BOD discharge through on-site treatment, which should address high soluble BOD. An application has been filed under WSER for a Transitional Authorization to allow discharge of non-compliant effluent for a specified period to achieve compliance through upgrade.

Herring Cove

2011 and 2012 Non-Compliance Issues -	NSE: None	CCME: TSS, CBOD
2013 and 2014 Non-Compliance Issues -	NSE: None	WSER: None

Toxicity: Herring Cove effluent has not been toxic.

In 2013, NSE changed the compliance requirement from 80% to average values must meet the discharge limits, consistent with WSER. Since that time, Herring Cove has been fully compliant as judged by average values.

The transfer of sludge from the Mill Cove WWTF has not impacted performance, consistent with the 2011 Compliance Plan.

No upgrades are required for WSER compliance if performance remains consistent. Performance will need to be tracked closely if development in the Herring Cove sewershed results in flows approaching the deign limits.

Lakeside-Timberlea

2011 and 2012 Non-Compliance Issues -	NSE: TSS, Ammonia	CCME: Chlorine
2013 and 2014 Non-Compliance Issues -	NSE: TSS, Ammonia	WSER: Chlorine, TSS

Toxicity: Lakeside-Timberlea effluent has been toxic for Q1-Q2, but not Q3, of 2014. Toxicity may be related to use of chlorine disinfection, and this will be investigated further by comparing chlorinated and de-chlorinated samples for toxicity. An early conversion to UV disinfection may be required to meet the 2015 toxicity prohibition of WSER.

TSS and ammonia continue to be non-compliant. FC had not been compliant for much of 2013 and 2014, but has improved and was compliant for Q4 2014. CBOD, FC, DO and TP continue to be compliant. Mechanical issues at the facility have been addressed through upgrades and operational optimization.

An upgrade to UV disinfection (by 2021) will be required for WSER compliance to meet chlorine limits, and TSS performance has been just non-compliant on an average basis.

A plan is in progress to divert approximately 34% of the sewage volume in this sewershed to the Halifax sewershed to reduce loading on the Lakeside-Timberlea facility. Halifax Water continues to develop options to improve the Lakeside-Timberlea facility and achieve NSE compliance. Planned improvements (subject to available budget) include flow equalization, an additional bank of RBC's, UV disinfection, and a finer bar screen.

Lockview-MacPherson

2011 and 2012 Non-Compliance Issues -	NSE: CBOD, TSS	CCME: None
2013 and 2014 Non-Compliance Issues -	NSE: CBOD, TSS	WSER: None

Toxicity: Not subject to WSER toxicity testing requirements.

Performance for CBOD has improved during 2013 but declined during 2014. TSS remains non-compliant. The objective is to achieve compliance by the end of 2014/15 through process improvements and optimization of operations.

Middle Musquodoboit

2011 and 2012 Non-Compliance Issues -	NSE: None	CCME: None
2013 and 2014 Non-Compliance Issues -	NSE: TSS	WSER: None

Toxicity: Not subject to WSER toxicity testing requirements.

TSS was non-compliant during Q2 of 2013, and again through Q2 and Q3 of 2014.

Mill Cove

2011 and 2012 Non-Compliance Issues -	NSE: None	CCME: None
2013 and 2014 Non-Compliance Issues -	NSE: None	WSER: None

Toxicity: Mill Cove effluent has shown sporadic toxicity, possibly related to discharge of Otter Lake leachate to the WWTF. This will be further investigated by comparing sample toxicity on days with leachate discharge vs. days without. pH drift during the tests is also being investigated. A pH-stabilized test is available.

Performance at Mill Cove has otherwise remained compliant, with no issues except fecal coliform in Q1 2014.

North Preston

2011 and 2012 Non-Compliance Issues -	NSE: pH	CCME: None
2013 and 2014 Non-Compliance Issues -	NSE: pH	WSER: Un-ionized Ammonia

Toxicity: North Preston WWTF effluent has not been toxic. Not subject to WSER toxicity testing requirements.

Un-ionized ammonia was non-compliant with the WSER limit for the first half of 2013, but improved and was compliant for 2014 with better pH control.

pH control improved at North Preston through 2014. New alum pumps have been installed with greater capacity. Alum consumes alkalinity and depresses pH, so an alternative to alum (PAC – Poly-aluminum chloride) is under consideration.

Springfield Lake

2011 and 2012 Non-Compliance Issues -	NSE: CBOD, FC, TSS	CCME: Chlorine
2013 and 2014 Non-Compliance Issues -	NSE: None	WSER: Chlorine

Toxicity: Springfield WWTF effluent was found to be toxic during testing in 2012 and 2014, possibly related to chlorine disinfection. This will be investigated further by comparing chlorinated and de-chlorinated samples for toxicity. Preliminary results indicate this to be the case. Early de-chlorination or conversion to UV disinfection may be required for WSER compliance by the 2015 deadline prohibiting toxicity.

Performance has remained compliant through 2013 and 2014, with the exception of TSS in Q2 and Q3 2014. Conversion to UV disinfection (by 2021) will be required for WSER compliance to meet chlorine limits.

Uplands Park

2011 and 2012 Non-Compliance Issues -	NSE: None	CCME: None
2013 and 2014 Non-Compliance Issues -	NSE: None*	WSER: Does not apply

Toxicity: Not subject to WSER toxicity testing requirements.

* Performance of the Uplands WWTF has continued to be good, except that performance has declined rapidly in Q3 2014 due to mechanical problems. This has been corrected and performance should improve.

Wellington

2011 and 2012 Non-Compliance Issues -	NSE: FC, TSS	CCME: Chlorine
2013 and 2014 Non-Compliance Issues -	NSE: pH	WSER: Does not apply

Toxicity: Not subject to WSER toxicity testing requirements.

The new WWTF came online as of October 2012. The new NSE Approval imposed new limits for phosphorus, ammonia, pH and aluminum, in addition to CBOD, TSS and FC. pH was not compliant through Q3/Q4 of 2013 and Q1 of 2014, but has since improved. Ammonia was not compliant only in Q2 of 2014.

Appendix I

Wet Weather Management Program

Near Term Action Plan

Halifax Water

APPENDIX I

Halifax Water

Halifax Water Wet Weather Management Program
Near-Term Action Plan

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February 7, 2014

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1. PURPOSE AND BACKGROUND

1.1 Purpose and Contents

The purpose of this document is to provide a near term Action Plan for the Halifax Water Wet Weather Management Program (WWMP). The focus of the Action Plan is the period ending in January 2015. The Action Plan is based on the on-going efforts of Halifax Water staff that culminated in a workshop held on December 10 and 11, 2013. Further refinement to the document is the result of a workshop held February 28th, 2014 with the Tellus Group and Wright-Price.

1.2 Infrastructure Background

The Halifax wastewater collection system is strongly influenced by wet weather inputs. In a service area of 19,924 ha, the system is comprised of both combined sewers in the older portions of peninsular Halifax and inside the circumferential highway of Dartmouth as well as separated sanitary sewers in the remaining audit areas[1].

The separated sanitary sewers are designed so that the sanitary portion transports wastewater flows, with a limited allowance for inflow (surface runoff) and infiltration (groundwater), in its own piped network while the stormwater portion is collected and transported separately.

The sanitary system evolved largely independently over a period of years in the various governing communities prior to the amalgamation of the Halifax Regional Municipality (HRM) in 1996. As a consequence of the different design and construction standards and connection practices used across the region, large portions of the sanitary collection system receive excessive I/I. As an example, it is not uncommon to have areas of HRM that have no piped storm drainage typically connect on-lot footing drains to the sanitary sewer contributing significant flows during wet weather periods.

In the region, management of the sanitary system is a shared responsibility between Halifax Water and the private property owner with Halifax Water owning and maintaining the public portion of the system that travels in the public right-of-way with service connections off the mainline up to the lot line. The sewer laterals connecting on-lot plumbing to the public system are in turn the responsibility of the individual property owner. It has been acknowledged through a number of studies[2,3] that up to 60% of I/I can originate within the private system. Accordingly, any I/I strategy must be able to address the entire collection system regardless of ownership.

Halifax Water owns and operates 14 wastewater treatment facilities (WWTF) and hence has 14 areas served by sewer systems with varying degrees of inflow and infiltration (I/I). Within those 14 WWTF service areas, the Utility operates 172 pumping stations and 19 combined sewer overflow structures that further narrow the I/I areas of concentration. For the purposes of seeking out and managing I/I, Halifax Water will be defining and prioritizing audit areas.

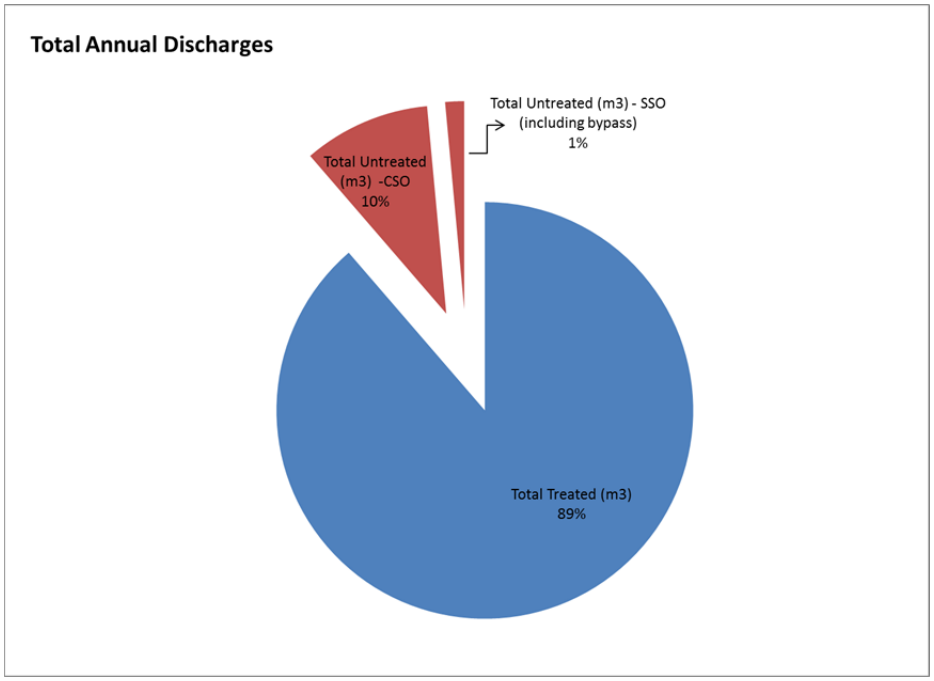
[1] An audit area refers to the area tributary to any point of interest in the collection system where through a combination of measurement, modelling and evaluation the amount and sources of I/I are determined.
[2] York Region Inflow & Infiltration Reduction Strategy, York Region March 2011;
[3] Executive's Recommended Regional Infiltration and Inflow Control Program, King County Washington, December 2005;

1.3 Wet Weather Impacts

Halifax Water wastewater treatment facilities (WWTF) manage more than 87 million cubic meters of wastewater flows annually. Of the total annual discharges, 89% of those wastewater flows are treated before discharging to the environment, with the bulk of treatment happening at plants on the Halifax Harbour including the Mill Cove, Halifax, Dartmouth, Herring Cove and Eastern Passage WWTFs.

Within each of those systems and the in-land freshwater smaller WWTFs, wet weather flows are causing 11% of Halifax Water's untreated discharges. Of that 11%, 10% are in the form of combined sewer overflows (CSO) while 1% are sanitary sewer overflows (SSO) and WWTF plant bypasses. Figure 1.1 shows the percentage of total annual discharges.

Figure 1.1 % Total Annual Discharges



Within the wastewater service boundary, HRM's older combined system was designed with a single piped network to carry wet weather flows as well as sanitary flows. During wet weather events, CSOs are permitted to happen at select locations under the approvals to operate for the Halifax and Dartmouth WWTFs pursuant with the *Environment Act* as regulated by Nova Scotia Environment (NSE). This design feature was incorporated to protect individual sewer connections, pumping stations and treatment facilities from flooding.

From a regulatory perspective, the CSOs are licenced discharges presently subject only to monitoring and reporting requirements.[4] However, future growth tributary to CSO locations will need to be mitigated so that no increase in CSO frequency or quantity is observed.

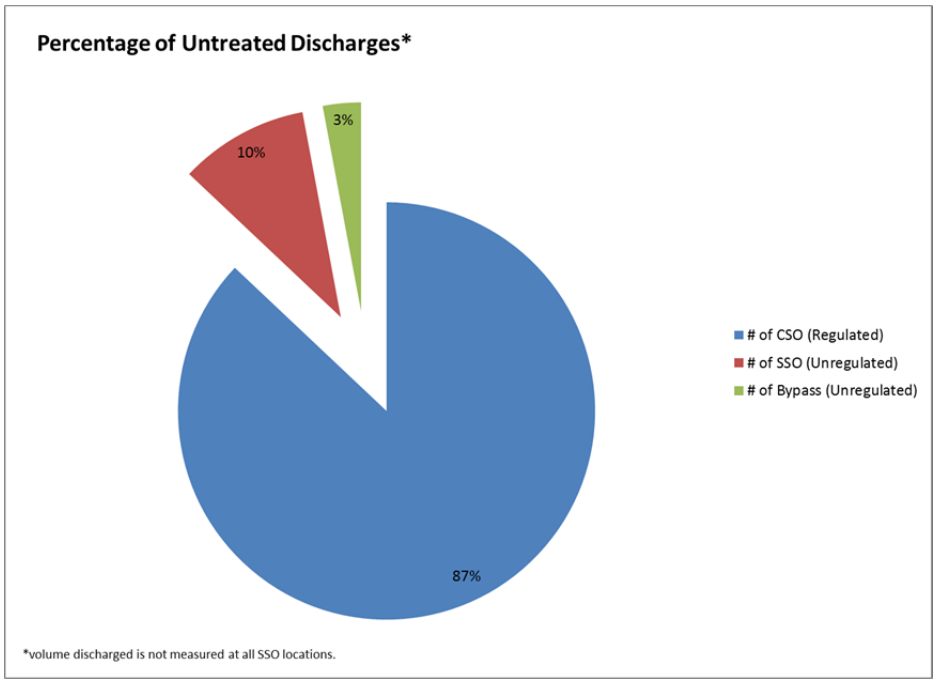
Within separated sanitary systems, wet weather flows impact both the treatment process and pose human health and environmental risks since those untreated discharges are occurring at in-land freshwater release points.

At treatment plants, excess flows cause treatment process upsets due to variances in flow and loading that can result in non-compliant effluents. Excess treatment plant flows can also result in bypasses of all or portions of the process and depending on the operating strategies used to manage the excess flows, the facilities may also incur extra operating costs.

While in the sanitary collection system, excess flows often result in SSOs at pumping stations and manholes as well as customer basement flooding. SSOs are not licenced discharges and should be managed on a priority basis.

The majority of untreated discharges are occurring at the CSO locations. A breakdown of the number of events occurring annually shows that 87% of untreated discharges are CSO regulated events. The remainder 13% of untreated discharges are unregulated and occurring at SSO locations (10%) and plant bypasses (3%) as seen in figure 1.2 Percentage of untreated discharges.

Figure 1.2 Percentage of Untreated Discharges



Historically underfunded sanitary sewer system asset renewal has exacerbated the I/I issue in the region. In an effort to address this, Halifax Water has had the program components - flow

[4] Wastewater Systems Effluent Regulations, Canada Gazette Vol 144, No. 12, March 20 2010; Halifax & Dartmouth Wastewater Treatment Facility Approvals to Operate (2010-075214-R02 & 2010-070605-R02).

monitoring, private-side inspection, CCTV inspection and local sewer system repair capability for some time operating independently within the Utility. However, a global coordinated systematic I/I program is only now being developed. This program is being linked to the maturing asset renewal and wastewater master plan programs also under development.

1.4 Integrated Program

An integrated system-wide approach will be an essential aspect of the overall Halifax Water WWMP. As the WWMP progresses through its I/I Strategy development and through its learning experiences with the I/I Pilot Program, it will provide feedback into the next rounds of wastewater master planning and integrated resource planning.

In 2012, Halifax Water completed its Regional Wastewater Functional Plan[5] (RWWFP) and its Integrated Resource Plan[6] (IRP). The RWWFP provides a wastewater servicing plan for existing and future planned serviced growth areas with projections to 2046 while the IRP is a high level plan to guide program and resource needs for the Utility for the next 30 years (2013-2043).

WWMP is one component program feeding Halifax Water's IRP and growth master planning, having its inception in the first IRP completed in 2012. The IRP recommended that Halifax Water develop a new planning program specifically targeted at managing demand reduction (I/I) and overflow control strategies. Possible reduced anticipated flows could sufficiently defer required treatment plant expansions and reduce incidents of untreated discharges into the environment. Figure 1.3 illustrates the relationships between the WWMP, the Wastewater Master Plan and the IRP.

Figure 1.3 Integrated Programs

[5] Halifax Water Regional Wastewater Functional Plan, Halifax Water, November 2012 ;
[6] Halifax Water Integrated Resource Plan, Halifax Water, October 2012 ;

Excessive I/I competes for sanitary system capacity that could otherwise provide operational flexibility within the collection system and/or be devoted to support future growth. One of the themes of the recently completed Halifax Water IRP is the reduction of wastewater "demand" through water efficiency measures and most importantly through I/I reduction programs. The I/I demand reduction approach was notionally based on determining the I/I threshold that is more economical to remove than transmit and treat. This idea is central to developing a cost-effective I/I program.

As noted, the Halifax Water WWMP had its genesis within the IRP.

The IRP presents three recommendations that required action as follows:

1. *New Planning Program*: Development of the WWMP itself, which in turn would flow into an overall Wastewater Master Plan. The WWMP is intended to tie together all wet weather related aspects of the wastewater collection and treatment system. This embraces CSO and SSO overflow control, I/I flow reduction for capacity and flood relief. A key component of the WWMP would be the HW I/I Reduction Strategy (I/I Strategy) designed to systematically manage I/I flows in the sanitary system.

2. *I/I Pilot Program*: Implementation of an I/I Pilot Program designed to help refine the HW I/I Strategy (as well as provide supporting tools and information).

3. *Wet Weather LOS*: Extension of Halifax Water Levels of Service (LOS) to include wet weather related LOS that supports the 14 IRP objectives. The objectives/proposed LOS include:

    - *Objective 3*: *Meet Current Overflow Compliance* – Develop frequency and volume targets for overflows.
    - *Objective 6*: *Meet Future Overflow Compliance* – Develop frequency and volume targets for long term overflow program.
    - *Objective 14*: *Manage Flow Capacity Allocations* – Develop specific targets for I/I reduction at the WWTFs and in major pumping stations and other locations e.g. overflows.

2. WWMP PROGRAM MANDATE, GOALS AND OBJECTIVES

The purpose of this section is to present the overall WWMP mandate and the specific program goals. The mandate, goals and objectives are based on the discussions within the December 10-11, 2013 workshop and the associated background information provided by Halifax Water with updated feedback resulting from the February 28th workshop with the Tellus Group.

2.1 WWMP Program Mandate and Goals

Halifax Water's WWMP mandate is as follows:

> *"To efficiently manage the volume of wet weather generated flows entering sanitary system, both combined and separate systems."*

In order to meet this mandate four specific WWMP goals have been developed as follows:

1. Provide wastewater and stormwater services to the residents of HRM meeting LOS while minimizing rate impacts;

2. Support protection of human health and the environment through management of system overflows and wet weather impacts on wastewater treatment facilities;
3. Provide cost-effective treatment plant and pump station operations through managing wet weather flow volumes;
4. Provide cost-effective management of wet weather flows to support wastewater system capacity for future growth and reduce or defer capital requirements for system expansion.

2.2 WWMP Action Plan Objectives

In order to address the WWMP goals, three major near term objectives have been developed. The first of the objectives addresses an overall framework for the WWMP while the remaining objectives are more focussed on the aspects of the WWMP associated with the I/I Strategy and the I/I Reduction Pilot Program (Pilot Program).

The near term Action Plan objectives are as follows:

1. Develop the overall WWMP framework including specific group roles, responsibilities and resources and integrate the groups into an overall WWMP Team.
2. Develop a system-wide I/I Strategy and Pilot Program that includes:
    - Developing and implementing an I/I Reduction Pilot Program designed to help refine the I/I Strategy;
    - Developing measures of I/I reduction effectiveness;
    - Developing and implementing a flow and rainfall monitoring program designed to support the overflow monitoring and I/I Strategy and Pilot Program;
    - Extending and integrating the HW data management program to support the activities of the WWMP including the I/I Strategy and Pilot Program;
    - Extending and integrating the Halifax Water sewer system evaluation capabilities (e.g. SIR program and CCTV inspections) to support the WWMP including the I/I Strategy and Pilot Program;
    - Developing and implementing the data analysis tools and procedures to support the WWMP including the I/I Strategy and Pilot Program;
    - Developing the procedures for identifying cost-effective I/I reduction strategies;
    - Refining the wastewater system hydrologic/hydraulic modelling tools needed to support the WWMP including the I/I Strategy and Pilot Program;
    - Developing sewerage policies and standards supporting the WWMP including the I/I Strategy's policies and standards related to larger planning decisions and policies from the Halifax Regional Municipality (HRM) which impact Halifax Water's compliance program;
    - Developing actions and consequences to be pursued against any agency, owner, or party that is non-compliant with Halifax Water's Rules and Regulations and wet weather related policies and standards;
    - Developing internal and external communications and outreach to support the implementation of the WWMP overall including the I/I Strategy and Pilot Program.
3. Provide the necessary demand reduction inputs to the next IRP Update.

Other objectives will be needed as the WWMP matures (for example addressing CSO control).

The WWMP is still evolving. In future it will address comprehensively an overall wet weather management strategy for both the combined and separated portions of the collection system. The WWMP will be a vital input to the HW Wastewater Master Plan and form part of long-term capital planning. Figure 1.1 shows the relationship of the WWMP to the I/I Strategy and Pilot Program

Figure 2.1 Wet Weather Management Program

3. WWMP FRAMEWORK AND GROUP ROLES

The purpose of this section is to present the overall WWMP framework showing the roles and responsibilities of the HW groups participating in the WWMP. The section is based on the information and supporting material provided in advance of and at the December 10-11, 2013 Workshop as well as the workshop discussions themselves.

3.1 WWMP Framework

The overall WWMP framework is presented in Figure 3.1. The figure serves multiple purposes. It presents the WWMP organizational structure, the individuals responsible for component activities and the nature of the individual responsibilities (role). All the components are existing HW activities/programs that have individual histories and established practices. The organizational structure also spans a number of HW Departments each with their own reporting structure.

The WWMP Steering Committee comprised of senior HW staff provides overall direction to the functional groups participating in the WWMP Action Committee and also links to the HW Executive Team. The WWMP Lead is responsible for day-to-day WWMP operations and coordinating the activities of the component groups. A Data Analyst supports the Lead. The individuals named in the component groups are responsible for fulfilling the roles outlined in the figure.

Even though senior HW management has placed priority on the WWMP, one of the great challenges that the program faces is breaking down any remaining barriers between functional groups and ensuring the free flow of information across the relevant parts of the HW organization. It was frequently noted in the workshop discussions that “silos” need to be bridged and communications enhanced.

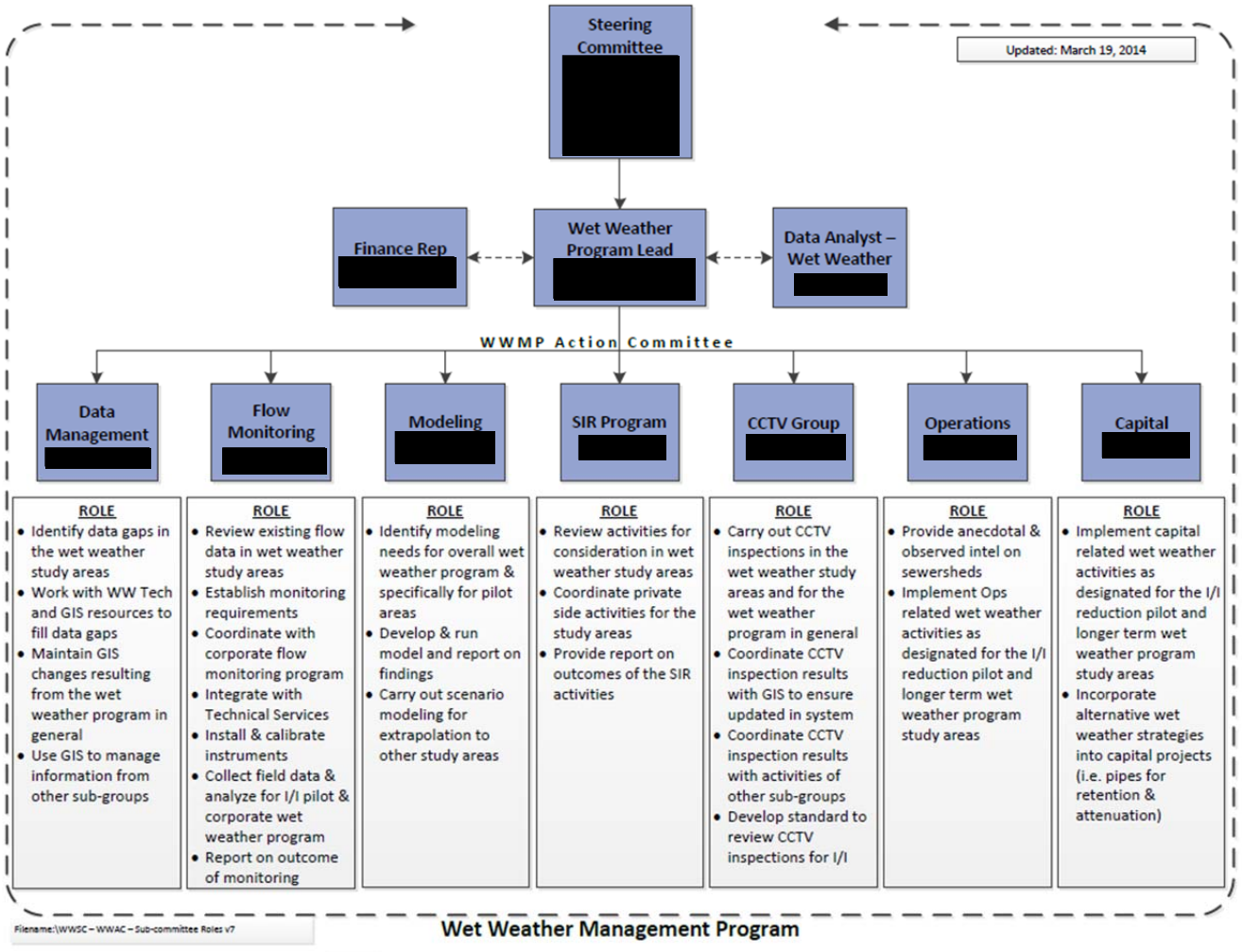


Figure 3.1 Wet Weather Management Program Framework

3.2 WWMP Group Roles

3.2.1 Overview

The groups listed in the above diagram participate on the WWMP Action Committee representing focused functions and programs within various Halifax Water departments. The details of the role played by each group with responsibilities in the WWMP were presented in the December 10-11, 2013 Workshop. The individual PowerPoint presentations are included in Appendix A while the Workshop discussions are summarized in meeting notes presented in Appendix B. In addition, each group has prepared a Resources and Tools Summary sheet. An example sheet is provided in Figure 3.2. All the sheets are provided in Appendix C. Among other details the sheet also includes required new resources and linkages to other groups.

Wet Weather Management (WWM) – Flow Monitoring Group, Resources & Tools

The Wet Weather Flow Management (WWM) Program has been established with the mandate "to efficiently manage the volume of wet weather generated flows entering the sanitary wastewater system". Within this mandate a number of smaller sub-groups have been created to help focus certain functions. The sub-group under discussion here is the Flow Monitoring Group.

Existing Resources are displayed in plain text (eg. Engineer).

Required (New) resources are displayed in italic and underlined text (eg. *Call Taker / Scheduler*)

Resource Projection

Category	Resource and Tools
Project Team (Full and Part Time Staff)	Group Champion – Craig Campbell Data Analyst (Chantel Parkin) – GIS mapping, other data analysis *Engineer (New Position?) – RFP and Tender Preparation, Contract Administration, site assessments, engineering analysis, data QA/QC* SIR Group Champion (Charles Lloyd) Modeling Engineer (David Blades) *Technical Services – Scada and PI set-up for each site, some instrument instalations* *Consultants – site assessment, design, site inspection* *Contractors - installation*
Support from others in Halifax Water	Wet Weather Flow Management Committee – Funding, Resourcing support, decisions on priorities and direction. *Operations resources to clean systems in advance of installations and regularly thereafter* *Technical Services – Ongoing calibration, maintenance, replacement of installed equipment*
Facilities	Offices, storage facilities for in-stock items
Equipment	*Permanent flow meters, rain gauges and associated equipment to be kept in stock (spares)* Equipment that Technical Services requires
Software Tools	Data analysis software (FlowLink Pro), Excel, PCSWMM, PI
Other Resources or Services	Traffic Control when working in the street.
Data	Accurate GIS mapping.

Figure 3.2 Example Resources and Tools Summary

The key elements of the individual group activities and the main workshop discussion points are summarized in the following sections.

3.2.2 Flow Monitoring

This element of the Workshop was presented by the Flow Monitoring Lead (Craig Campbell) and addressed the proposed flow-monitoring program (See Appendix A HW slides 13 - 28). The flow monitoring program extends beyond the WWMP to support a number of HW functions including: compliance, asset management, system modelling calibration and system capacity assessment.

Main Workshop discussion points included:

- Fifty flow monitoring zones (FMZ) are identified for installation of permanent flow meters. This will be a key tool to assess wet weather flow impacts and develop management programs.
- Other flow monitoring program elements include short and long-term flow monitoring and a rain gauge network.
- Monitoring technologies include non-contact and contact meters as well as weirs and flumes.
- CSO overflows are a high monitoring priority due to regulatory reporting requirements. Annual CSO reporting statistics as per Federal Wastewater Systems Effluent Regulations (WSER) commence February 15, 2014 while provincial reporting is required as part of the Halifax and Dartmouth WWTF approvals to operate.
- SSOs are unregulated discharges under provincial regulations while CSOs appearing to be a higher priority than SSOs under the federal WSER in terms of monitoring and reporting.
- Prioritization of flow monitoring sites is based in part on the results of the WWMP's prioritization matrix (see section 3.3 and Appendix F).

Current principal locations include:

- 6 permanent meters (installed before development of FMZs. Therefore these may not correspond to FMZ locations).
- 4-6 long term meters (e.g. Crescent Avenue: installed for a period of a few years).
- 1 HHSP CSO structure is a permanent flow meter site.
- All 19 HHSP CSO locations have permanent level sensors with calculated volume discharge determined through the model which was calibrated with short term flow monitoring.
- 18 SSO overflow pipes at pumping stations (12 remaining for approx. 30 total).
- 6 non-HHSP CSOs remaining to be monitored.
- Monitoring of overflows at SSOs and CSOs does not replace the need for permanent monitoring of incoming gravity lines in FMZs and priority audit areas.
- 7 rain gauges at selected locations throughout the region with several more planned.

Pending work:

- Flow monitoring SOP;

- Data QA/QC methodology;
- 2014 study to develop permanent meter location specific designs;
- Vendor trials to assess outsourcing metering;
- Data analysis methodology;
- Standards for installations;
- Approach/Resources for maintenance and calibration.

3.2.3 CCTV/Operations

This element of the Workshop was presented by the Operations Lead (Danny Patey) and addressed the HW CCTV inspections / network repairs program. (See Appendix A HW slides 29 - 36). The program provides the WWMP with CCTV capability and minor/local repairs.

Main Workshop discussion points included:

- HW employs in-house CCTV inspection capability as well as contractors. External requirements are currently being upgraded to incorporate better reporting, linkages to GIS and condition ratings.
- CCTV inspections are mainly capital driven based primarily on the integrated program with HRM (in-house program started less than 3 years ago).
- Operations recently changed drivers – trenchless repairs driven through I/I impacts as well as by asset management.
- Operations generally do not apply other investigative techniques such as smoke testing in-house. The SIR program has these capabilities.

3.2.4 SIR Program

This element of the Workshop was presented by the SIR Program Lead (Patricia Isnor) and addressed the HW Stormwater Inflow Reduction (SIR) program. (See Appendix A HW slides 37 - 49). The SIR program focussed on on-lot or “private side” I/I source reduction.

Main Workshop discussion points included:

- It is currently illegal for stormwater to enter the wastewater system.
- SIR program does not address the combined portion of the system.
- SIR has investigative, assessment and enforcement functions as well as a strong education program.
- SIR has a prioritization rating scheme based on 8 factors. It has been applied to 31 areas.
- The SIR rating scheme may be used as the basis for priority setting within the WWMP.
- One outcome of SIR assessment is the recommendation for a storm sewer in areas without piped storm service, to facilitate reduction of stormwater being discharged into the wastewater system. This is a cost shared program with HRM.

A major challenge is the integration of SIR within the WWMP. Communication will be key.

3.2.5 Data Management

This element of the Workshop was presented by the Data Management Lead (Harold MacNeil) and addressed WWMP data management. (See Appendix A HW slides 50-56). HW data management capabilities are centered on the GIS system. They can provide both standard data themes and custom products to support the WWMP.

Main Workshop discussion points included:

- GIS team is a service group to WWMP initiative;
- Need to refine/improve data coming in;
- GIS is an integrating tool for WWMP – flow meters, CCTV inspections;
- GIS presently has desktop "viewer". Could have separate tool for WWMP.

3.2.6 Capital Program

This element of the Workshop was presented by the Capital Lead (Dave Ellis) and addressed the interaction of capital delivery with the WWMP. (See Appendix A HW slides 57-62). Capital delivery supports the WWMP through the implementation of specific I/I related capital projects. Projects can be direct I/I management or supporting projects for WWMP (i.e. flow meters).

Main Workshop discussion points included:

- Not currently included in the capital program but would be a function of the overall WWMP under the direction of Operations for:
    - Overall program development.
    - Prioritizing I/I projects.
    - Post-project analysis for success.
- Require lead-time for in-house or capital projects and the need to line up resources, and plan for external resource which may take time to identify project and secure funding through the budget process.
- Capital program going from less than $23 million to $56 million for stormwater/wastewater.
- Capital projects generally do not include pre/post monitoring to assess project success (would be looking at other groups to carry out this function if needed).

3.2.7 Wastewater System Model

This element of the Workshop was presented by the Modeling Lead (David Blades) and addressed the wastewater system model that was originally developed as part of the RWWFP. It is intended to employ the wastewater system model to support the analysis activities of the WWMP. No supporting PowerPoint slides were associated with this presentation (presentation to be made at a future Wet Weather Action Committee).

Main Workshop discussion points included:

- The model is based on RWWFP which currently covers the audit areas for all 14 WWTFs.
- Only pipes greater than 300 mm are included in the model.

- It is used as a decision and analysis support tool.
- Data management is a critical issue.

3.3 Audit Area Prioritization

An audit area prioritization matrix was developed to guide the WWMP to focus on areas with high levels of I/I. Priorities are defined by running audit areas through a matrix that creates relationships between varying I/I related elements and generating a total score for the audit area. Each element is given a specific weighting depending on its perceived importance and within each element a score of 1 to 5 is assigned. All elements are then calculated to give a total score per audit area. Scores are ranked from highest to lowest thus defining the WWMP priority audit areas. The prioritization matrix is presented in Appendix F.

The original prioritization matrix was based on the SIR rating scheme which was applied to 31 sanitary areas. The modified WWMP prioritization matrix was adapted to include elements relating to infrastructure data availability and to include scoring of the combined areas.

Halifax Water recently identified and reported all known CSO and SSO discharge locations to Environment Canada as a regulatory requirement of WSER's "Identification Report" on May 15, 2013. The areas draining via those discharge locations will be incorporated into prioritization matrix.

The priorities identified by the WWMP will in turn influence and drive the Utility's activities for system condition assessment, flow monitoring, data management, and system modeling prioritizations as well as selecting additional Pilot Program audit areas.

4. I/I STRATEGY AND PILOT PROGRAM

4.1 I/I Strategy

The I/I Strategy is one of the key expectations arising from the 2012 IRP and is seen as an important input supporting the wastewater demand reduction analysis in the next IRP update. At present the I/I Strategy is still formative but, as is evident from the discussion of the previous section, it is well underway.

There are a number of other activities initiated by HW that will feed into the overall strategy. One such activity is Halifax Water's long and successful experience with water loss management within its drinking water distribution system. Water loss has been systematically assessed through system wide monitoring of water usage. Locations with anomalous results are subject to more detailed evaluation. The decision is then made on the basis of cost-effectiveness whether or not to proceed with repair (i.e. more economical to repair vs. supply and transmit). This program is in many ways analogous to the proposed I/I reduction program and represents the kind of Best Practice that the I/I program will become.

The elements of an overall strategy can be discerned through the review of Best Practices applied by other jurisdictions. York Region recently published one such Best Practice. The Workshop presentation presenting the York and Seattle Best Practices are included in Appendix D.

Figure 4.1 presents an overview of the elements of the HW I/I Strategy proposed for the WWMP. It is based on the York Best Practices combined with the current HW component activities and Workshop discussions.

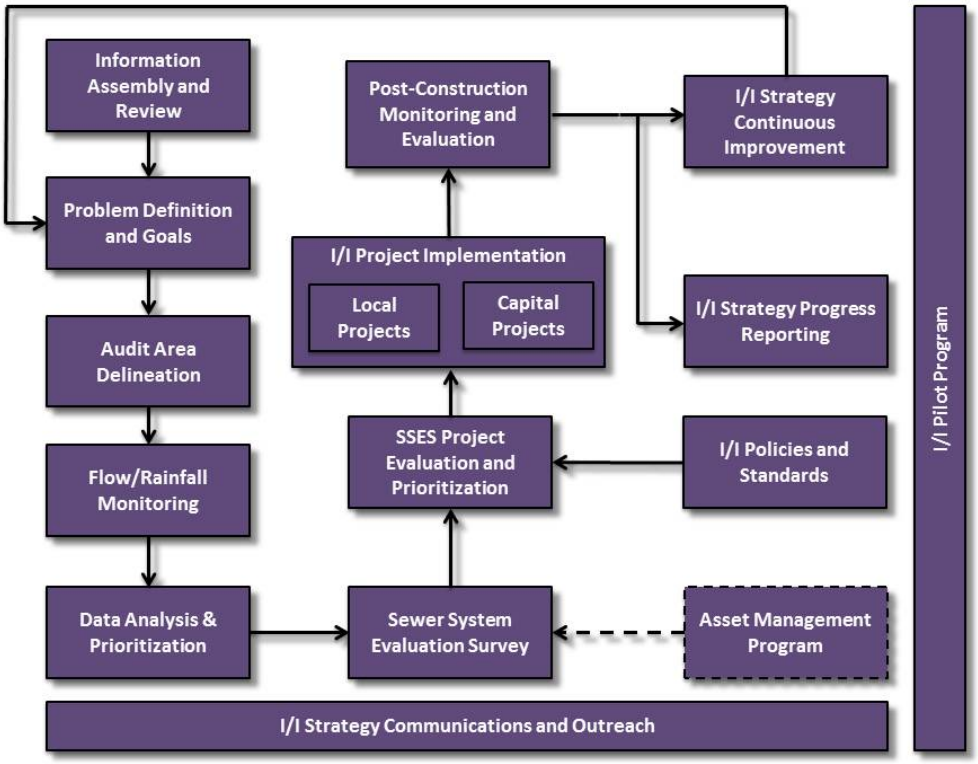


Figure 4.1 Halifax Water I/I Strategy Overview

The following provides an overview of the purpose, principal activities and current status and near term actions of each of the I/I Strategy elements. The actions presented for each I/I Strategy element merged the needs identified in Workshop discussions with additional needs arising from Action Plan preparation. A summary table of the near term I/I Strategy actions is presented in Appendix G. The Steering Committee with WWMP Program Lead will work with the sub-groups to assign activity responsibility and due dates.

4.1.1 Information Assembly and Review

Purpose/Activities:

- Collect, assemble and review historical information and Best Practices documentation related to wet weather in the wastewater system. This represents a starting point in delineating audit areas and developing understanding of the problem locations and magnitudes;
- Review the collection systems with known present and future capacity issues, SSOs, flooding and related WWTF wet weather impacts;

- Review previous I/I studies (see appendix to Workshop Binder for RWWFP summary of previous I/I studies);
- Review of Best Practices documentation from key jurisdictions;
- Identify data gaps.

Current Status:

- There are numerous historical I/I studies throughout the wastewater system. RWWFP summarized studies and details are presented in the appendix section of the Workshop Binder;
- Staff reviewed "Best Practices" in York and other jurisdictions;
- Staff identified and reported known SSO and CSO discharge locations under WSER's "Identification Report";
- Staff review of historical information and reports is underway.

Actions:

- Assess utility of further review and analysis of collection system reports and "Best Practices". Continue review and analyses if warranted;
- Prepare summary Technical Memo (TM) on data review, lessons learned and data gaps with recommendations for additional data collection efforts.

4.1.2 Problem Definition and Goals

Purpose/Activities:

- Summarize collection system and WWTF wet weather impacts and identify requirements and opportunities for demand reduction;
- Define wet weather impacts/interactions on the IRP drivers: - regulatory compliance, growth and asset renewal;
- Develop and refine I/I Strategy goals (See Section 2.1);
- Define I/I performance metrics (e.g. peaking factor - PF) relevant to the strategy goals;
- Define threshold values for I/I performance metrics (e.g. PF< 6) to be used for prioritization and decision analysis.

Current Status:

- Good knowledge of wet weather related issues with respect to overflows and observed WWTF impacts;
- Draft goals are in Section 2.1 based on Workshop discussions;
- Good Best Practices examples from York and Seattle with example performance measures and threshold values.

Actions:

- The WWMP mandate, goals and near-term objectives should be examined through the review of this Action Plan and refined as appropriate;
- Confirm program objectives including consideration for CSO management;
- Define I/I Strategy performance metrics and thresholds;
- Prepare TM summarizing problem definition, goals, performance measures and thresholds.

4.1.3 Audit Area Delineation

Purpose/Activities:

- Define a prioritization matrix to rank in order of priority, areas to audit I/I;
- Delineate audit areas at various scales to organize monitoring and data analysis, sewer system evaluation survey (SSES) follow-on evaluation and repair, rehabilitation and replacement priorities;
- Delineate audit areas to facilitate analysis and reporting of performance metrics and tracking overall I/I strategy progress.

Current Status:

- Fifty FMZs have been defined including a number containing sub-zones;
- WWTF and pumping station sewershed areas are delineated;
- Preliminary rating has been done for approximately 30 of the pumping station sewersheds.

Actions:

- Review and refine the audit area prioritization matrix methodology and complete ratings;
- Incorporate "Growth Management" element into the prioritization matrix;
- Review sewershed delineation relative to WWMP prioritization outcomes and adjust where necessary.

4.1.4 Flow/Rainfall Monitoring

Purpose/Activities:

- Primary tool to determine wet weather impacts at specific locations within the study area(s);
- Provides calibration data for wastewater system model and any other modeling and evaluation tools.

Current Status:

- Flow and rainfall monitoring program has been initiated (See Section 3.2.2).

Actions:

- Accelerate monitoring program;
- Finalize the monitoring approach and details including preparation of SOPs for monitoring and data validation;
- Review FMZ structure and adjust if needed;
- Develop QA/QC protocol to ensure valid data.

4.1.5 Data Analysis and Prioritization

Purpose/Activities:

- The data analysis step is designed to transform the SSES, flow and rainfall monitoring data into the I/I performance metrics and thresholds at the monitoring sites;
- Data analysis also prepares the data for the wastewater system model calibration/validation;
- The wastewater system model is used to transfer and aggregate the monitored data to other locations such as the WWTFs. It can also be used to evaluate system behaviour under critical historic or design rainfalls;
- The performance metric thresholds among other factors can be used to prioritize monitored sites for follow-on SSES evaluation.

Current Status:

- The data analysis process is presently under development;
- The prioritization scheme used for defining flow monitoring priorities as well as the separate SIR program scheme (See Appendix C) is a good starting point.

Actions:

- Finalize and document the entire data analysis process including inter-group data/information sharing. Develop data workflow process (i.e. Business Process Mapping);
- Finalize and document the prioritization of the SSES follow-on activity (i.e. threshold to initiate follow–on investigation and nature of investigative activities);
- Carry out a data workshop to define data management requirements for each group.

4.1.6 Sewer System Evaluation Survey

Purpose and Activities:

- The SSES is the investigative part of the I/I Strategy. The SSES identifies the specific system deficiencies that are the source of the I/I. The SSES not only identifies specific sources but also quantifies the I/I volumes originating from each source;
- The SSES should also be closely tied to the HW Asset Renewal and SIR programs so that each program can share information and collaborate on establishing repair/rehabilitation/replacement priorities.

Current Status:

- Several departments are involved in aspects of SSES depending on the focus area;
- CCTV and other investigative tools such as smoke-testing are available through in-house resources in Operations and the SIR program;
- The CCTV team has good in-house capability to review video and identify sewer system deficiencies;
- Integration of inspection and condition rating data with GIS area presently under development;
- External CCTV SOPs and data reporting is presently under development.

Actions:

- Develop a process and framework to document SSES activities and communicate reports to committee;
- Develop SOPs for internal/external inspection and I/I flow estimation;
- Develop a process and framework to integrate SSES data within GIS;
- Improve communications among the sub-groups relative to ongoing activities.

4.1.7 SSES Project Evaluation and Prioritization

Purpose/Activities:

- Potential I/I reduction projects are evaluated for costs and benefits and prioritized for repair/rehabilitation/replacement. Analysis can be conducted at various sewershed scales ranging from local to entire sewershed (i.e. area tributary to WWTF). This will likely involve application of the wastewater system model;
- Develop defined rules for setting priorities and initiating projects. Prioritization should be carried out in conjunction with Asset Renewal program. Other factors such as SSOs or WWTF effluent impacts will also need to be considered;
- Output from this activity should be the prioritized list of I/I reduction projects for implementation through either local improvements or as part of the capital program.

Current Status:

- SIR program has priority setting mechanism; expand this approach;
- Asset Renewal program is under development with good opportunities for integration;
- Wastewater System Model also under development.

Actions:

- Development and documentation of cost/benefit analysis and prioritization procedures;
- Define methods for quantifying pre/post system benefits (i.e. demand reduction);
- Development of Wastewater System Model and associated procedures to support cost/benefit analysis. Existing model needs expansion, update and additional calibration.

4.1.8 I/I Related Policies and Standards

Purpose/Activities:

- Review existing drainage/sewer connection policies and procedures and identify potential enhancements; also compare to Best Practices of other jurisdictions;
- Review sewerage design and construction standards and identify potential enhancements; also compare to Best Practices of other jurisdictions;
- Develop/refine policy and standards for application in I/I Strategy.

Current Status:

- I/I Strategy is currently being developed;
- I/I Reduction Pilot Program (see next section) will provide initial input to developing/refining policies and standards.

Actions:

- Establish lead individual/group responsible for developing/refining policies/standards;
- Review Best Practice policies used in other jurisdictions;
- Identify needed amendments to Halifax Water's Rules and Regulations.

4.1.9 I/I Project Implementation

Purpose/Activities:

- Design and construction of local (delivered by in-house resources) I/I projects;
- Design and construction of capital (externally-delivered) I/I projects;
- Update and implement capital delivery procedures (as needed) to support I/I Strategy and Pilot Program;
- Incorporate I/I projects into capital program planning;
- Development of project record keeping (record of as-built facilities and lessons learned about I/I reduction techniques/technologies);
- Development of cost-accounting to support program continuous improvement and post-construction evaluation.

Current Status:

- Expertise supporting capital program delivery;
- Operations currently undertakes local projects;
- I/I projects currently included in HW Capital Plan.

Actions:

- Incorporation of new I/I projects in HW Capital Plan;
- Development Pre/Post rehabilitation evaluation protocol that incorporates pre/post I/I assessment for structural rehabilitation projects;

- Development of projected work volume for local repairs and capital projects and incorporation into operational and capital program planning;
- Development and implementation of project record keeping and accounting procedures to support continuous improvement program and post-construction evaluation.

4.1.10 Post-Construction Monitoring and Evaluation

Purpose/Activities:

- Determine effectiveness of I/I reduction measures through a combination of monitoring, data analysis and modeling activities. The post-rehabilitation results are compared to the pre-rehabilitation analysis;
- Determine the actual costs of repair/rehabilitation/replacement;
- Determine the cost-effectiveness (i.e. $/m^3 removed etc.) of the I/I reduction measures;
- Report on costs, effectiveness and cost-effectiveness of reduction program and any lessons learned.

Current Status:

- Post-construction program being formulated.

Actions:

- Identification of lead individual/group for post-construction evaluation activities;
- Establish monitoring protocol for post-construction monitoring (e.g. period, location, no. of events etc.) and communication plan;
- Develop data analysis and model evaluation procedures for post-construction effectiveness analysis;
- Develop project accounting procedures to provide needed project specific cost data;
- Develop reporting format/content for post-rehabilitation evaluation.

4.1.11 I/I Strategy Continuous Improvement

Purpose/Activities:

- "Learning by doing" – Applying the data and lessons learned through the I/I program implementation;
- Developing a HW I/I Best Practice document.

Current Status:

- I/I Strategy is currently being developed including continuous improvement aspect;
- I/I Pilot Program will provide initial input.

Actions:

- Establish lead individual/group responsible for continuous improvement program;

- Establish procedure for periodic program review and incorporation of feedback/lessons learned;
- Develop HW Best Practice including level of service (LOS).

4.1.12 I/I Strategy Progress Report

Purpose/Activities:

- Develop reporting format presenting accomplishments of I/I Strategy;
- Prepare periodic reports presenting program results.

Current Status:

- I/I Strategy is currently being developed including continuous improvement aspect;
- I/I Pilot Program will provide initial input.

Actions:

- Establish lead individual/group responsible for program reporting;
- Establish content for program reporting;
- Establish procedure for program reporting and frequency;
- Integrate results from I/I Pilot Program into reporting procedure.

4.1.13 I/I Pilot Program

Purpose/Activities:

- Support the development and refinement of all aspects of the I/I Strategy - "Learning through doing" opportunity;
- Address specific I/I problem/issues through pilot projects including: design and construction and pre/post evaluation and policy effectiveness assessment.

Current Status:

- Three I/I pilot projects have been identified and are under development.

Actions:

- Develop project plans for each of the pilot projects;
- Develop communications strategy for each of the pilot projects.

4.1.14 I/I Strategy Communications and Outreach

Purpose/Activities:

- Develop and implement an internal and external communications strategy for the WWMP, I/I Strategy and Pilot Program.

Current Status:

- The I/I Strategy is currently being developed including a communications aspect;
- The I/I Pilot Program will provide initial input.

Actions:

- Establish lead individual/group responsible for the communications strategy;
- Develop and implement an internal and external communications strategy for the WWMP and I/I Strategy including methods, formats, and frequency.

4.2 Pilot Program

The WWMP is considering three I/I pilot projects. These projects are specifically designed to support the IRP Pilot Program recommendation that is reflected in the WWMP near term objectives. The pilot projects were discussed in some detail at the recent Workshop. This element of the Workshop reviewed the 3 proposed pilot projects from the perspective of solving a "real" problem as well as a "learning" opportunity for the WWMP.

The three pilot projects offer a "learning through doing" experience addressing the following I/I reduction approaches:

1. *Stuart Harris* – Public-side I/I reduction through repairs/replacement. Private-side I/I reduction through on-lot lateral repair/replacement.
2. *Crescent Avenue* – Public-side I/I reduction through repairs/replacement. Private-side I/I reduction through on-lot lateral repair/replacement. This project highlights an opportunity to test pipe rehabilitation using trenchless technology.
3. *Cow Bay* – Private-side inflow reduction through deep storm sewer implementation and household drainage reconnection. This project highlights an opportunity to test policy decisions and enforcement.

The pilot projects are summarized in Table 4.1.

Table 4.1 Pilot Program Summary

Pilot Project Name	Purpose	Background	Deliverables
Stuart Harris	• Eliminate SSO location. • Identify and correct cross connections	• Nine SSOs in 2013. • Baseline monitoring available.	• Pilot Program Action Plan. • WWMP team coordination. • Developing monitoring protocols. • Capturing/analysing data to assess pilot project performance. • Application of the wastewater system model to evaluate benefits. • Best practices for CCTV; smoke testing and overall investigative approach. • Repair methods and costs. • Communication with public. • Summary report documenting above.
Crescent Avenue	• Demonstration “private-side” program. • Reinstate lateral structure (public & private sides). • Eliminate/reduce SSO.	• Lake intrusion is a significant concern. • Failure of Pitch/no-corrode was the origin of the project. Now need to line the main to facilitate repair.	• Pilot Program Action Plan. • WWMP team coordination. • Developing monitoring protocols. • Capturing/analysing data to assess pilot project performance. • Application of the wastewater system model to evaluate benefits. • Best practices for CCTV; smoke testing and overall investigative approach. • Repair methods and costs. • Opportunity to measure results of efforts on no-corrode and main line repair for learning opportunities. • Communication with public. • Summary report documenting above.
Cow Bay	• Surface and basement flooding. • Contributing to SSO at Quigley’s Corners.	• HRM is leading, but Halifax Water is providing technical advice/support. • Will use SIR program to promote connection to the storm once installed (enforcement).	• Pilot Program Action Plan. • WWMP team coordination. • Developing monitoring protocols. • Capturing/analysing data to assess pilot project

Cow Bay - Cont'd		• Possible feed back into Quigley's Corner re-fit or replacement.	performance. • Application of the wastewater system model to evaluate benefits. • Best practices for CCTV; smoke testing and overall investigative approach. • Implementation of deep storm. • Repair methods and costs. • Opportunity to measure results of efforts on no-corrode and main line repair for learning opportunities. • Strong communication with public – timing. • Summary report documenting above.

5. WWMP ACTION PLAN AND SCHEDULE

5.1 WWMP Action Plan

As was noted, the Action Plan is designed to address the near term needs of the WWMP culminating in the IRP update scheduled for commencement in early 2015. Based on the results of the Workshop and through the preparation of this document, a draft Action Plan has been prepared. Table 5.1 presents the Action Plan developed at the Workshop.

Since the Action Plan was prepared prior to the I/I Strategy shown in the previous section it will need to be harmonized with the actions suggested in the Strategy.

5.2 WWMP Schedule

A draft schedule for preliminary WWMP activity in 2014 was prepared prior to the Workshop and the preparation of this document. It is presented in Appendix E. This schedule was intended initially to outline high level tasks that needed to be considered for planning and budget forecasting purposes. It will also need to be harmonized with the Workshop findings and the current Action Plan document.

Table 5.1 WWMP Action Plan – Short Term Focus

Wet Weather Program Component	Action Item	Action By	Target Due Date
WW Program	Develop Action Plan for Wet Weather Program	VW/SR	January 30, 2014
	Tables of Contents for Pilot Project Plans	VW/SR	January 30, 2014
	Business Process Mapping for Data Management	VW	January 30, 2014
	Organization Chart Update	VW	January 17, 2014
	Review of Roles and Responsibilities (Individual Meetings)	SR/SA	December 24, 2013
	Pilot Project Cost Accounting	VW/SR	January 30, 2014
	Prioritization of Problem Areas	SR/PI/CL/CC/SD	January 30, 2014
	Tellus Meeting Package	VW	January 30, 2014
	Tellus Meeting	VW	Mid-February
	Update Executive Team	SA	January 7, 2014
	Project Drivers/Goals/Metrics	CL	Mid-January, 2014
	Draft Workshop Notes	XCG	December 24, 2013
	Draft Initial WWAP	XCG	Mid-January 2014
Flow Monitoring	Initiate Flow Meter Supplier Service Trials (10 meters)	CC/SA/SR	January 30, 2014
	Flow Meter Trials (if needed)	CC/SA/SR	May 2014
	Baseline Monitoring Crescent Ave	CC	January 30, 2014
	Determine Next Monitoring Priorities	CC	January 30, 2014
	Initiate Cow Bay Monitoring	CC	February 2014
	Initiate Monitoring of Priority Areas	CC	April 2014
CCTV	Standardize Contractor Templates	VW	January 7, 2014
	Determine CCTV Requirements	VW/All Leads	January 7, 2014
SIR	Activities/Data Posting on Common Server	PI/SD	Mid-January 2014
	Utilize SIR Program to Develop Data Organization	PI/SD	Mid-January 2014
Pilot Projects	Stuart Harris Project Plan	PI/SR	February 2014
	Cow Bay Project Plan	DE	February 2014
	Crescent Ave Review	JS/DE/J.Spur	December 14, 2013
	Crescent Ave Project Plan	DE	February 2014
Data Management	Develop WWP Full Data Catalogue	HM/SR	Mid-January 2014
	Data Management Business Process Implementation	HM/VW	Mid-February 2014 (Initiate)
	Initiate Data Distribution	HM/Data Users	Mid 2014
Wastewater System Model	RWWFP Model Overview Presentation to WWAC	DB	January 30, 2014
	Evaluation of Modelling Tools	DB	January 30 2014
	Model Pilot Areas	DB/Pilot Project Leads	Mid-February 2014 (Initiate)