July15, 2024

Halifax Regional Water Commission

WATER, WASTEWATER, STORMWATER AND DISTRICT ENERGY SYSTEMS

COST-OF-SERVICE MANUAL

Halifax Water

Table of Contents

SECTION 1 - INTRODUCTION

Background

Following the transfer of Wastewater and Stormwater service delivery responsibilities from the Halifax Regional Municipality (HRM) to the Halifax Regional Water Commission (Halifax Water) in 2007, Halifax Water became the first regulated water, wastewater, and stormwater utility in Canada. In March of 2023, Halifax Water received approval from the Nova Scotia Utility and Review Board (NSUARB) to construct and operate an ambient temperature district energy system (ATDES), and to establish a revenue deficiency account in support of the ATDES development. Halifax Water is a self-financing regulated utility under the Public Utilities Act by the Nova Scotia Utility and Review Board (NSUARB). Halifax Water generates the majority of its revenue from rates and charges for the services provided to its customers. These rates and charges must be approved by the NSUARB following a review process and public hearing. This process ensures that rates are fair and equitable for the services provided. Following assessment of operating and capital improvement requirements of the combined utility, Halifax Water filed a general rate application [2010 NSUARB 244] to address funding needs. In a decision dated December 17, 2010, the NSUARB directed Halifax Water to file a Cost-of-Service and Rate Methodology Study that would form the basis of a "stand alone" proceeding. This was filed by Halifax Water on May 20, 2011.

Following completion of documentary discovery and filing of evidence by interested parties, a settlement agreement dated November 21, 2011 related to matters at issue in the application was signed by Halifax Water, the Consumer Advocate, and the Investment Property Owners Association of Nova Scotia (IPOANS). The settlement agreement was supported by all interveners who filed evidence and was not opposed by other parties to the proceeding.

The Cost-of-Service (COS) Manual was examined as part of Halifax Water's 2013 general rate application [2013 NSUARB 127]. Through the hearing process, the consultants working on behalf of the NSUARB and the Consumer Advocate noted several suggestions and improvements to the COS Manual. Those revisions have been incorporated in this updated COS Manual, and all underlying data relied upon in the COS Manual has been updated.

In the June 24, 2013 NSUARB decision on the general rate application, Section 2 (pages 9-19) address cost-of-service rate design. In Paragraph [48], the NSUARB approved the COS Manual.

[48] Based upon the information provided, the Board approves the COS Manual with the revisions as recommended by Mr. Rubin and Mr. Whalen.

Process Leading to COS Manual Development

In response to the NSUARB direction, Halifax Water[1] evaluated the existing NSUARB methodology and well-established cost-of-service/rate design methodologies delineated in manuals of practice of the American Water Works Association (AWWA), and Water Environment Federation (WEF) in the context of the local and operational characteristics prevalent for Halifax Water. As part of the review, Halifax Water's consultants worked directly with a broad group of Halifax Water staff with direct operational responsibilities and who are best positioned to understand the cost drivers and distribution of costs for their respective functional areas.

Various options were considered based on industry best practices and standards, and analytical models were constructed for each option to illustrate the implications of methodological alternatives. The respective characteristics and relative merits of the models were evaluated against established utility rate setting principles as discussed in Section 2 – Methodology Review.

The AWWA/WEF framework achieved substantial improvements over the NSUARB alternatives 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 previously established Halifax Water rate calculation procedure. However, the AWWA/WEF methodological framework was deemed preferable in that it provides for more detailed and system specific evaluation of Halifax Water's increasingly complex operations, facilitates rate designs that can be adapted in response to change, and allocates costs in a fair and equitable manner.

Given the potential improvements in fairness and equity of cost allocations and that the resultant rate structures would feature the same fundamental components (*e.g.*, fixed charges by meter size and uniform volume rates), thereby easing customer understanding and acceptance, Halifax Water recommended the adoption of the AWWA/WEF framework on a go forward basis.

[1] Halifax Water engaged the services of Galardi Rothstein Group, LLC, G.A. Isenor Consulting, Ltd., and Blaine Rooney Consulting Ltd. to assist with the methodology review process and prepare the Cost-of-Service Methodology submission filed with the NSUARB.

In response to the NSUARB directive to file an interim COS manual for the ATDES, Halifax Water has also reviewed other Canadian municipally based District Energy rate structures, the existing NSUARB methodology, and cost-of-service/rate design methodologies delineated in manuals of practice of the American Water Works Association (AWWA), and Water Environment Federation (WEF). While the AWWA and WEF methodologies are targeted towards water and wastewater, the same concepts can be applied to determine a preliminary cost of service structure for the ATDES.

Review of COS Submittal Settlement Agreement

On May 20, 2011, Halifax Water filed an application for approval of a Cost-of-Service and Rate Design Methodology. A public hearing was held on November 21, 2011 to consider the proposed COS recommendation. At the request of the NSUARB, Board Counsel convened a meeting of the expert witnesses prior to the hearing on November 17, 2011, to determine whether any of the issues in the proceeding could be resolved in advance of the hearing. The meeting of expert witnesses resulted in a settlement agreement signed by Halifax Water, the Consumer Advocate, and IPOANS that was filed with the Board when the hearing commenced. Other interveners, who were not part of the settlement process such as the Halifax Port Authority, Labatt Breweries, and Concerned Citizens of Springfield Lake, were permitted to review the proposed settlement, and pose questions to a Halifax Water panel at the hearing, and present information. Details of the settlement agreement include the following;

1) Subject to section (7), the AWWA Base-Extra Capacity (BEC) cost-of-service methodology is an appropriate method for assigning water costs to Halifax Water's customers. However, the percentages used in Halifax Water's submission to assign costs will be refined as described in (5).
2) The total cost of fire protection (public and private) will be determined within the BEC method and appropriately allocated between the two. The cost of fire protection shall be allocated between public and private fire protection by use of the size of water main connections for public fire connections and the size of private fire service lines at the first point of use that reflects the actual flow demand. [2]
3) The WEF hybrid method is an acceptable cost-of-service method for assigning wastewater costs to Halifax Water's customers. However, the percentages used in Halifax Water's submission to assign costs

[2] As clarified as part of the last General Rate Application of January 9, 2013, the private fire protection charge shall be based on the size of the fire service line before the first (point of use) connection, whether it is a hydrant line or sprinkler line entering the building. IPOANS 1

will be refined as described in (5). Should the refined percentages not support the hybrid method, one of the other WEF methods may be recommended by Halifax Water.

4) Halifax Water's proposed cost-of-service method for assigning stormwater costs to Halifax Water's customers is appropriate with the revision presented in Exhibit 4 of Halifax Water's rebuttal evidence of November 14, 2011, a copy of which is attached to the settlement agreement. IPOANS reserves its right to take the position that HRM should be responsible for the Right-of-Way flow charge.
5) Halifax Water will collaborate with stakeholders to develop a COS Manual. This COS Manual will document the basis for all cost assignments (functionalization, classifications, and allocations) applied to water, wastewater, and stormwater. It will be completed before any application is made to the NSUARB for new rates based on the new cost-of-service.
6) Parties retain the right to challenge any portion of the COS Manual when it is first used by Halifax Water as the basis for new rates.
7) For greater certainty, the issue of whether density should be taken into account for the cost-of-service for each of the services remains to be determined. Halifax Water agrees to provide further available information in response to reasonable requests from IPOANS in order to study this issue. Where Halifax Water considers the level of effort to respond to requests to be excessive, IPOANS will explain the reasons for the request and Halifax Water will explain the reasons for its objections. Halifax Water and IPOANS will collaborate to find alternative approaches to obtain reasonably required information. The parties agree to refer any dispute regarding such requests to the Board for resolution.

The NSUARB issued their decision on January 16, 2012 and stated in part:

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

Halifax Water's terms of reference for development of the COS Manual were approved on February 17, 2012.

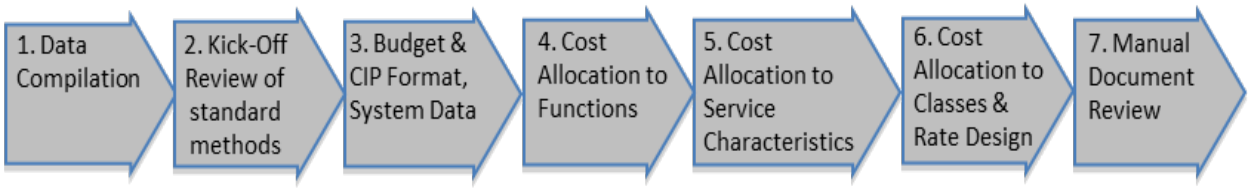
The timeline was altered as a result of the NSUARB decision regarding Halifax Water's Aerotech rate application. In this decision, the NSUARB directed Halifax Water to submit a rate application for a combined Urban Core & Aerotech System by January 31, 2013. As a result of consideration of the combined Urban Core & Aerotech System, the COS Manual deadline was extended to October 31, 2012 to permit inclusion of the Aerotech system. The COS Manual was filed on October 24, 2012 and approved in the June 24, 2013 general rate application decision M05463.

The decision spoke to the topic of density at paragraphs [45] and [46]

> [45] The Board understands the argument with respect to cost of service differentials related to density which IPOANS notes have been used in other, albeit not water service, utilities. However, no data has been presented, or appears to be available at this time, to support any calculation of these differentials. In the absence of such data, the Loudon Report has been relied upon, which, at this time, represents the best data available. Halifax Water has indicated that it is in the initial stages of looking at the installation of AMI technology. Once it is installed it can be used to collect the relevant data. However, it will be several years before such data can be collected and properly analyzed.
>
> [46] Therefore, the Board accepts that the density concept should not be included in the COS Manual at this time. The Board will not revisit this issue until significant research, based upon data obtained by the new metering technology, has been collected and analyzed. The Board views the COS Manual as a living document which allows any changes to be made as a result of updated relevant data and information.

Halifax Water completed the implementation of AMI technology in 2019/20. The AMI meters have enabled Halifax Water to develop the Customer Connect portal and to begin to provide high consumption notifications to customers. Halifax Water has engaged Raftelis to develop an updated Water Demand Analysis.

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:



Stakeholder consultation meetings were held on March 7, May 9 & 10, and September 25, 2012. Feedback from stakeholders was accepted throughout the process, resulting in many changes and improvements in the final product.

Purpose and Scope

The fundamental purpose of this manual is to allow for the development of equitable water, wastewater, stormwater, and district energy rate structures to ensure that all users pay, through user charges, for their share of the costs imposed on the system. Some of these expenditures are a function of water or energy used, wastewater discharged or stormwater contributed; others may be a function of the characteristics of that use (*e.g.*, peak demands) or discharge (*e.g.*, strength loadings). Finally, some costs (*e.g.*, billing and meter costs) are associated with serving customers regardless of the volume consumed or discharged, or the volume of stormwater contributed.

The COS Manual addresses the procedures involved in the calculation of proposed water, wastewater, stormwater, and district energy rates including the presentation of *pro-forma* rate revenue requirements, cost allocations and rate design.

The COS Manual delineates procedures for Water System rate calculations, including charges for public and private fire protection, through the identification of Water System functions, the classification of these functional costs, and their allocation as set out in the "base-extra capacity" method described in the AWWA *Principles of Water Rates, Fees and Charges, Manual of Practice (M1)*. The COS Manual is based on combining the AWWA methodology with the existing NSUARB standard procedures for accounting and reporting. In response to IR-2MUL in the 2013 general rate hearing, Halifax Water noted that "In general, the AWWA and NSUARB methods are combined in the sense that the prescribed methodology uses the formats and initial schedules for delineation of system revenue requirements as has been employed historically for NSUARB rate application filings while the procedures employed for cost allocation are drawn

from the methodological approaches delineated in the AWWA's Principles of Water Rates, Fees and Related Charges (M1) Manual of Practice".

Similarly, the COS Manual delineates procedures for Wastewater System rate calculations, including charges for over-strength discharges through the identification of Wastewater System functions, the classification of these functional costs, and their allocation as set out in the methods described in the WEF Manual of Practice No. 27 *Financing and Charges for Wastewater Systems*. The COS Manual is based on combining the "WEF" methodology with the principles used in the NSUARB standard procedures for accounting and reporting for Water Systems. As noted in response to IR-3MUL in the 2013 general rate application, "In general, the WEF and NSUARB methods are combined in the sense that the prescribed methodology uses the formats and initial schedules for delineation of system revenue requirements as has been employed historically for NSUARB rate application filings while the procedures employed for cost allocation are drawn from the methodological approaches delineated in the WEF's Financing and Charges of Wastewater Systems (M29) Manual of Practice".

The COS Manual identifies procedures for stormwater rate calculations based on the system characteristics which drive costs. The first COS Manual and 2013 rate application proposed a two-part rate structure to assign costs to customer groups such that all users pay for core (street right-of-way) services while only those contributing flow to Halifax Water's system pay for management of site-generated flows. The NSUARB directed that the costs for street right of way services be billed to HRM.

The need to enhance understanding about the nature of stormwater services being received by Halifax Water's customers was evident following implementation of the first regulated rates for stormwater service. In so doing, the merits of the cost of service, and ratemaking process may also be articulated. Halifax Water has included updated information on stormwater service within the COS Manual to reflect developments since the October 2012 filing of the first COS Manual.

The COS Manual identifies procedures for district energy rate calculations based on the system characteristics which drive costs. Halifax Water will determine prior to filing a final COS manual, through consultation with experts, whether there will be a need to have separate customer classes and/or whether both a fixed charge, demand charge, and/or a usage charge would be required.

The purpose of the COS Manual is to provide guidance (through explanations, standard schedules, and example calculations) to cost-of-service/rate design methodologies, including the NSUARB approved

AWWA/WEF approach for water, wastewater, and stormwater services. The NSUARB approved this approach in a decision dated January 16, 2012. For District Energy, the methodology for cost-of-service/rate design will be developed as the system is established. The methodologies for all four services employs the approach for determination of revenue requirements as presented in the NSUARB *Accounting and Reporting Handbook for Water Utilities (Handbook)*.

Halifax Water notes that accurately establishing the cost of service for the regulated services offered is only the first step in establishing rates, and that there are other important rate design considerations that come into play. Accordingly, Halifax Water will reference the updated COS Manual to prepare the rate studies for future rate applications but may submit for rates which differ from the COS Manual approach to take into account objectives such as revenue stability, gradual redistribution of revenue responsibilities and rate-smoothing.

COS Manual Structure

This COS Manual is structured to provide direction and examples of cost allocation procedures for each of Halifax Water's individual utility systems. The COS Manual offers a general review of a common methodological framework that is employed across systems – and which represents the foundation of both the AWWA and WEF cost-of-service methodologies. Subsequent sections provide guidance on the distribution of costs to functions, classification of costs by service characteristic and calculation of unit costs of service (potentially for allocation to distinct customer classes). This refers to the potential for future disaggregation of Halifax Water's customer classification structure in the event that pronounced distinctions in potential customer class user characteristics are determined. For Water System customer classifications, the potential for class distinctions on the basis of peak vs. average demand has not been demonstrated. This is due to the relative homogeneity of demand patterns across customer types as evidenced by the Loudon Demand Study. The potential for Wastewater System customer classifications on the basis of strength differentials is examined through a plant balance analysis provided in Halifax Water's worksheet WW-1: User Characteristics and Plant Balance Analysis. This form of analysis is useful for ensuring that assigned strength loading attributes of individual customer classes result in overall values for influent strengths that are consistent with actual plant influent values. In so doing, user rates are based on actual system flow/loading characteristics. In the event that strength differentiated classifications were considered, assigned strength

loading differences would need to maintain consistency with overall plant influent loading values to ensure resultant rates reflect true costs of service.

For Water System cost allocation, unique considerations relate to relationships between peak and average demands and identifying costs associated with providing fire protection capabilities. For the Wastewater System, unique considerations relate to allocations of costs for dry and wet weather flow management and treatment for different pollutant loadings. For the Stormwater System, issues relate to the allocation of costs for management of stormwater flows in street rights-of-way and discharged from private properties and complexities caused by multi-jurisdictional responsibility for stormwater. For the District Energy System cost allocations, unique considerations relate to peak demands and annual energy consumption requirements, provision of both heating and cooling services within the system, whether connection has been mandated by law (ref. HRM By-Law D500 – Respecting District Energy) or whether connection is optional, and whether service is guaranteed or interruptible.

The COS Manual sections outline information as summarized below:

1) **Introduction** – Provides a discussion of the process leading to development of the COS Manual, the purpose of scope of the document and its structure;

2) **Methodology Review** – Provides a general review of the multi-step process for determination of utility rates by utility system; Principles of cost allocation commonly employed across utility systems are outlined;

3) **Allocation of Requirements Across Utility Systems** – Principles of cost allocation commonly employed across utility systems are outlined;

4) **Water System Cost Allocation** – Provides a review of the application of the AWWA cost allocation methodology for determination of rates based on revenue requirements delineated using standard NSUARB formats;

5) **Wastewater System Cost Allocation** - Provides a review of the application of the WEF cost allocation methodology for determination of rates based on revenue requirements delineated using standard NSUARB formats; and,

6) **Stormwater System Cost Allocation** - Provides a review of the simplified application of common AWWA/WEF procedures for determination of stormwater fees based on impervious area measures.

7) **District Energy System Cost Allocation** – Provides a review of the application of a simplified cost allocation methodology for determination of rates based on revenue requirements.

SECTION 2 - METHODOLOGY REVIEW

General Review

For Water, Wastewater, Stormwater and District Energy service, the methodology selected for the COS Manual and for rate setting is based on calculating the revenue requirements using the Handbook while cost allocations are based on the AWWA and WEF methodologies for water and wastewater. Stormwater rate setting will be based on using the framework from the NSUARB for determination of revenue requirements and the WEF approach for cost functionalization, classification and allocation. Rates for stormwater will be based on impervious area and will exempt customers that do not contribute stormwater from their property into Halifax Water's system. They will not provide for recognition of the indirect/common benefit individuals receive for stormwater management associated with the street right-of-way. District Energy rate setting will be based on the framework from the NSUARB for determination of revenue requirements and a similar approach to the other services for cost allocation.

Rate Setting Principles

For each of Halifax Water's utility services, rates and charges should reflect the balancing of basic, often conflicting, rate-setting principles. Referenced by the NSUARB in its deliberations, these basic principles of utility rate setting were outlined in seminal work by James Bonbright [3] and have been reformulated and made more accessible for use in guiding Halifax Water's rate setting as follows:

1) **Revenue adequacy** - Effectively yield the revenue requirements in a fair and reasonable manner from the customers of Halifax Water without undue capital spending while meeting service and quality objectives;

2) **Revenue stability** - Provide revenue stability and predictability for Halifax Water with minimum of unexpected changes;

3) **Rate continuity** - Provide stable and predictable rates with a minimum of unexpected changes that have adverse effect on Halifax Water's customers;

[3] Bonbright et al., *Principles of Public Utility Rates* (Columbia University Press, 1961), pp. 383-384

4) **Cost-based rates** - Establish rate structures that discourages the wasteful use of the service provided while promoting all justified uses and amounts;

5) **Fairness vs. Benefits** - Set rates that fairly reflect the benefits from the service provided;

6) **Defendable vs. Costs** - Set rates that are fair and equitable and that apportion costs of service among the different customer classes that are not arbitrary and capricious;

7) **Fairness by Class** - Set rate structures that avoid discrimination in rate relationships and that avoid inter-customer burdens;

8) **Adaptable to Changing Circumstances** - Set rate structures that are dynamic and promote innovation and that respond to changing demand and supply patterns;

9) **Simple and Acceptable** - Set rate structures that are simple to use and understand, convenient, economic to implement and maintain, and, are publicly acceptable while meeting the requirements of the Public Utilities Act;

10) **Understandable** - Set rate structures and rules and regulations that are unambiguous and easy to interrupt; and,

11) **Conservation** – Establish rate structure that promotes conservation while ensuring rates that are adequate to meet changing regulatory requirements.

Insofar as the AWWA/WEF methodologies were designed to reflect and further these rate design principles, the rate methodologies proposed likewise reflect these principles. Halifax Water's proposed rates are thereby guided by the Bonbright principles. For Halifax Water's Water, Wastewater, Stormwater and District Energy Systems cost allocation and rate setting process, a number of additional aspects of standard rate making principles and procedures are noteworthy.

Fixed vs. Variable Costs

Common to all four utility services is the fact that infrastructure investment requirements result in cost structures that feature relatively high, fixed costs from an accounting perspective. A fundamental principle of cost-of-service analysis however is to allocate costs on the basis of cost causation rather than on whether or not they are fixed or variable from an accounting perspective. For Water Service, therefore, most fixed

costs are allocated based on volume-related customer demand characteristics. Similarly, for Wastewater Service, a significant share of collection and treatment cost is distributed in proportion to flow and loading parameters. For Stormwater Service, fixed costs are allocated based on the determinants of stormwater flows from served parcels that must be managed by the public stormwater system. For District Energy, allocation of fixed costs will be established through the rate design process, potentially based on customer demand characteristics.

Growth-Related Capacity Costs

As a general proposition, the cost-of-service methodologies outlined below relate to calculation of unit costs by service characteristic and ultimately distribution of cost responsibilities to customers. Rates calculated for new customers within a class are the same as those for customers who have been served for an extended period of time. Regional Development Charges (previously referred to as Availability Charges) that are assessed upon new customers to the respective systems are used to require such customers to recover growth related capacity costs.

For District Energy, the majority of the infrastructure required to operate the system will be installed prior to any customers accessing the system. Initial investment costs will be accumulated in a revenue deficiency account and charged to new customers as they are ready to connect to the system by a method to be determined through the rate-design process.

Halifax Water Common Costs

An equally fundamental challenge that is common to all four utility Services is that a number of utility functions are shared across each utility Service. While Halifax Water has established a budgeting and accounting structure to segregate costs by Service, there are a number of functions that are performed with resources that are effectively shared across all four systems. Though most Halifax Water costs are incurred directly by an individual Service as discussed in subsequent sections of the COS Manual, cost-of-service rate setting requires allocation of common costs across Services (as discussed in detail in section 3 – Allocation of Requirements Across Utility Systems).

Given the establishment of revenue requirements by utility Service through the allocation of shared and specific Halifax Water costs to utility Services, the basic AWWA/WEF approaches to cost allocation may be applied for each Service.

Revenue Requirements

Accounting System Review

Halifax Water's corporate financial system is a fully integrated Enterprise Resource Planning (ERP) software system that was implemented in August 2023. Prior to 2023, Halifax Water utilized SAP as its financial software system. In 2020, payroll processing was moved from the previous ERP software to a more robust standalone system, VIP. The system is fully interactive providing a web portal for employees and managers alike. Finally, VIP allows Halifax Water improved functionality with the inclusion of modules in such areas as human capital management and pension administration.

The ERP system is a robust system consisting of over 300 cost centres and 250 general ledger accounts for revenues and expenses. Within the hierarchy and reporting structure of the system, cost centres can be created and maintained to track costs by Service and also for specific functions within each Service. Certain cost centres exist in which shared costs applicable to all Services are accumulated centrally, and then allocated to each Service as necessary. Distributions of these common costs are described further below. Finally, within the system is the capability to create and maintain work orders to track specific costs, either from a capital or operating perspective.

Audited financial statements are prepared on an annual basis. Internal unaudited financial statements are prepared monthly, on both a consolidated basis and an unconsolidated basis for each individual Service. Current year results are presented in comparison to the current year's budget and forecast, as well as historic actual results from the prior year. Unaudited financial statements are reviewed by Halifax Water's Board of Commissioners, and annual audited financial statements approved.

Budget Process Review

A new budgeting process was implemented in 2023/24 using an integrated system. The budgeting process involves the completion of budgets directly into the ERP by Halifax Water managerial staff responsible for specific utility functions. Budget templates are available in the system for all cost centres and require both quantitative and qualitative inputs. Once completed all budgets are reviewed by the appropriate Director before being forwarded to Finance. Finance staff review and validate the budget information for consistency and accuracy. Before being submitted to Halifax Water's Board of Commissioners for approval,

the budgets are reviewed by the Senior Management Team and Halifax Water's Audit and Finance Committee.

Revenue Requirement Format

The overall objective of the determination of revenue requirements is to provide Halifax Water sufficient operating revenues to cover the operating and non-operating costs for Water, Wastewater, Stormwater and District Energy Services for the test year(s) included in the application. As such, properly developed revenue requirements will ensure the financial sustainability and integrity of Halifax Water. Operating and non-operating costs supporting the application are derived from the operating budget(s) as compiled by Halifax Water, which are prepared annually and approved by Halifax Water's Board of Commissioners.

Key considerations in determining revenue requirements also include:

- Changes in the number of customers,
- Changes in annual volume of water sold,
- Changes in the amount of demand and energy consumed by District Energy customers, and
- Anticipating capital expenditures for the test years, and the associated costs with respect to depreciation and debt servicing.[4]

Revenue requirements for each Service are presented for rate application using a common format employed by the NSUARB. This general format is presented in Table 1 on the following page where Service-specific cost centres and line items are employed as applicable.

[4] This is based on the premise that these expenditures are included in revenue requirements if the infrastructure is "in service".

Table 1 Revenue Requirement Template

Halifax Water Utility System Statement of Operating Expenses and Revenue Requirements Fiscal Years ending March 31st	Historic Year Actual	Historic Year Actual	Historic Year Actual	Current Year Budget	Test Year Budget
OPERATING EXPENSES					
System-specific expenses #1					
System-specific expenses #2					
Engineering and Technology Services					
Regulatory Services					
Corporate Services					
Administration					
	0	0	0	0	0
Depreciation					
Total	**0**	**0**	**0**	**0**	**0**
ADD: FINANCIAL EXPENSES					
Interest on long term debt					
Repayment of long term debt					
Amortization of debt discount					
Dividend/ grant in lieu of taxes					
New - interest on long term debt					
New - repayment of long term debt					
New - interest on long term debt					
New - repayment of long term debt					
Total	**0**	**0**	**0**	**0**	**0**
LESS: OTHER OPERATING REVENUE					
System-specific revenues					
Late payment fees					
Miscellaneous					
Total	**0**	**0**	**0**	**0**	**0**
LESS: FINANCIAL REVENUE					
System-specific revenues					
Investment Income					
Miscellaneous					
Total	**0**	**0**	**0**	**0**	**0**
LESS: OTHER ADJUSTMENTS					
Pension adjustment					
Sponsorships and donations					
Miscellaneous					
Total	**0**	**0**	**0**	**0**	**0**
REVENUE REQUIRED FROM CUSTOMERS	**0**	**0**	**0**	**0**	**0**

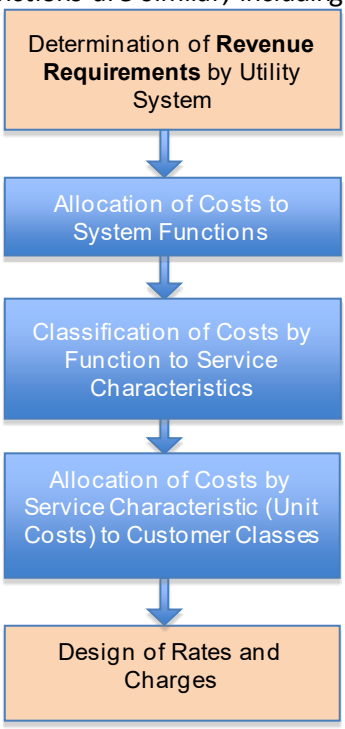
AWWA / WEF Cost Allocation Steps

The fundamental COS process across all four utility Services involves a three-step procedure for allocation of revenue requirements to customer classes. Costs are first distributed to system functions – often referred to as "functionalization", then to service characteristics – referred to as "classification", and finally to

customer classes – referred to as "allocation". Cost-of-service based rates recover revenues from customer classes based on those respective customer classes' proportionate share of system demands or use attributes.

Step 1: Allocate Costs to System Functions

Utilities incur varying levels of costs to perform the different functions needed to meet customer demands and deliver essential services (*e.g.*, fire protection). The functionalization process involves categorizing revenue requirements according to the functions in order to more appropriately assign costs to Customers. Water System functions typically include supply, treatment, storage, pumping, transmission, distribution, fire protection, and meter and Customer-related service. Wastewater functions are similar, including collection, transmission, treatment, wet weather flow management, solids handling, and customer related service. DES functions typically include energy generation, distribution, and transfer, metering and customer related service. Functions may be further refined to reflect particular attributes of the utility's system configuration. For example, some water systems use storage tanks while others may not; some wastewater systems may use solids digester facilities while others may not. Functions are defined to facilitate the distribution of expenses to utility service characteristics.



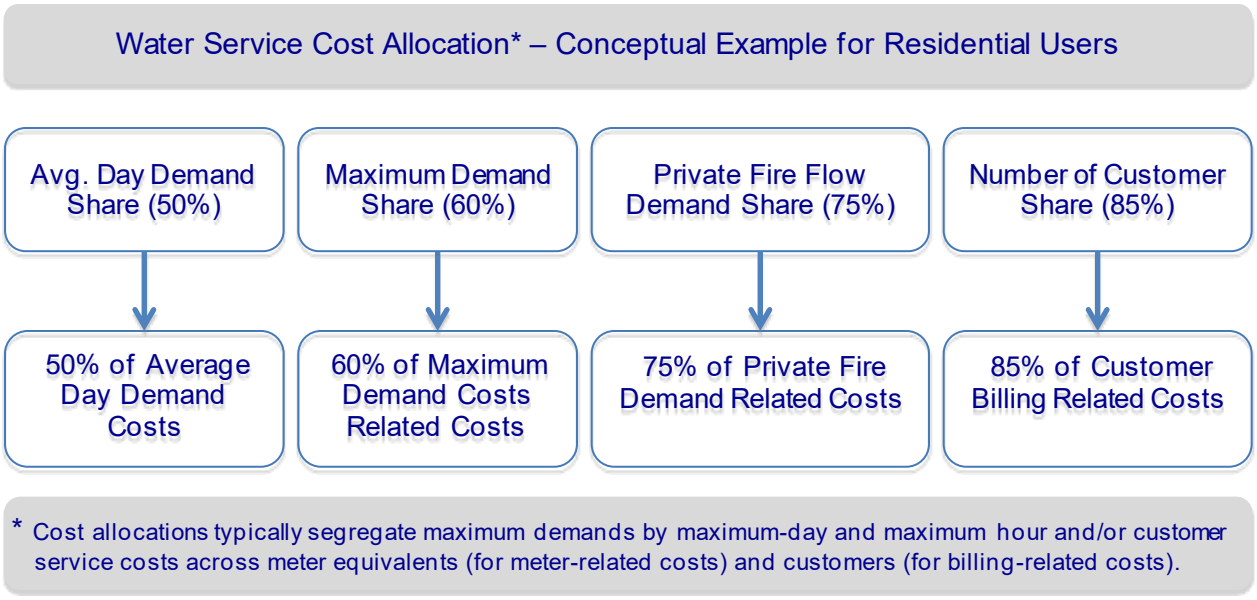
Step 2: Classify Costs by Service Characteristics

Following functionalization, a classification process is undertaken. A fundamental objective in developing a rate system is to price utility services so that each customer pays for the service they receive in proportion to their use or claim on system capacity. For Water Systems, some costs the utility incurs are a function of the water quantity used; other costs are associated with meeting peak usage demands, and others to enable fire protection. Similarly, for wastewater systems, some costs are incurred to handle dry weather flows while other costs are incurred for wet weather management, or to remove given pollutants. For the District Energy system, some costs the utility incurs are a function of the energy delivered to and used by ATDES customers, and other costs are associated with meeting peak energy demands for both heating and cooling. Customer related service, billing, and meter functional costs are generally a function of the number of customers

served, and the size and type of meter or service. The classification process involves distribution of functional costs to these service characteristics in a consistent manner that reflects cost causation.

Step 3: Allocate Costs to Customers (or Classes)

For Water and Wastewater, determination of the costs to deliver established service characteristics, whether they be peak water demands or the handling of wastewater strength loadings provides the foundation for calculation of unit costs to serve - and ultimately allocation of cost to customers based on their demands and uses of system facilities. Costs by service characteristic are simply divided by the projected level of service to be rendered to determine the unit costs of a given service parameter. For example, the system-wide cost per cubic meter of maximum hour demand is calculated by taking the costs determined to meet maximum hour demands divided by the projected (customer related) maximum hour demands for the system. Likewise, the cost per kilogram of total suspended solids (TSS) removed is determined by dividing the system-wide costs for TSS removal by the projected units of billable suspended solids. Costs are then allocated to customers (or more generally to customer classes) based on their use of these parameters. As a result, if residential users represent 50 percent of average day water demands, 60 percent of peak-day and maximum hour demands, 75 percent private of fire flow demands, and 85 percent



of the numbers of customers, they will be allocated 50 percent of average day demand related costs, 60 percent of peak demand related costs, 75 percent of fire protection costs, and 85 percent of customer billing expenses. In so doing, the basic objective of cost-of-service analysis is accomplished – namely the allocation

of costs to customers in proportion to their uses of the system. For water, wastewater, and district energy, data sources generally include customer billing information, system operations reports, and engineering studies.

For District Energy, determination of the costs to deliver established service characteristics, whether they be peak demand or energy consumption, will be developed through the rate design process. For example, the system-wide costs to meet peak energy demand are calculated by taking the costs determined to meet peak demand divided by the projected peak demand requirements.

SECTION 3 - ALLOCATION OF REQUIREMENTS ACROSS UTILITY SYSTEMS

Certain cost centres exist within the accounting system in which shared costs applicable to all Services have been accumulated centrally. In order to present costs properly for each Service, these common costs are allocated across Services. Most common costs are accounted for in a specific cost centre. However, as is evidenced with customer service detailed below, the allocation may involve a group of like cost centres. In several cases, a "primary allocation" is made to distribute costs between Water Services, Wastewater, Stormwater, and District Energy Services then a "secondary allocation" is made to apportion costs between Wastewater, Stormwater, and District Energy Services.

A summary of the allocations crossing Service boundaries is provided below for each of the Services provided by Halifax Water:

Water Service

There are no shared or common costs accumulated within Water Services that relate to other Halifax Water Services.[5] Any cost allocations performed are specific to Water Services, and are required for internal reporting purposes only, typically for sub-systems within Water Services.

Wastewater Service

Wastewater Treatment Plants

Halifax Water's wastewater treatment plants are designed based on regulations from Nova Scotia Environment and Climate Change (NSECC) and Environment Climate Change Canada (ECCC) who specify the wastewater discharge requirements aligning with the Wastewater Effluent System Regulations (WSER). The discharge requirements may vary based on the receiving waters.

Based on this design/approval procedure, Halifax Water's treatment plants only treat wastewater as approved by its regulator. There are no shared or common costs accumulated within Wastewater treatment relating to Water and Stormwater Services. Any cost allocations performed are specific to

[5] In the 2013 rate hearing, Halifax Water was asked whether the wastewater treatment plants ever treat stormwater? If so, should any of the cost of wastewater treatment be assigned to stormwater? If so, what portion? (IR-8MUL).

Wastewater Treatment, and are required for internal reporting purposes only, typically for sub-systems within Wastewater Services.

However, there may be some shared or common costs accumulated within Wastewater Treatment (specifically for the Halifax WWTF) relating to District Energy (e.g., staff time). These shared or common costs will be determined through the utility development and rate setting process and allocated appropriately to ensure ATDES costs do not affect water/wastewater/stormwater customers.

Halifax Water does not intend to directly compensate Wastewater customers for access to or the use of the thermal energy from Wastewater. As the DES utilizes the thermal energy remaining after the treatment process is complete, and prior to discharge to the harbour, there would not be any costs associated with the treatment of Wastewater allocated to the DES. Any shared costs between wastewater and the DES will be segregated by Service, and the specific costs of treating the wastewater will be charged to wastewater customers to recover the wastewater treatment costs. All costs to divert effluent to the DES energy centre and back to the harbour will be allocated to the DES.

Wastewater Collection

Allocations relating to common costs within Wastewater collection reflect the extent to which administrative activities are related to both Wastewater and Stormwater Services and the portion of the collection system served by combined sewers. Regional administration costs are allocated between Wastewater and Stormwater Services on an indirect basis using budgeted, direct operating costs for each Service for the test year(s). Other Wastewater collection costs are allocated to Stormwater Service based on the proportionate share of length of pipe that are combined sewers, and the portion of combined sewer flow related to stormwater.

Allocations using the fiscal year (FY) 2020/21 actuals as the basis are summarized in the table below:

Table 2

Wastewater Collection Allocation of Common Costs to Services				
Common Cost Centres	**Cost Centre No.**	**Water**	**Wastewater**	**Stormwater**
Regional Administration			90.0%	10.0%
Sanitary Mains – West, East & Central	12400, 22400, 32400		92.0%	8.0%[6] (40% of 20%)
Inspections – West, East & Central	12402, 22402, 32402		92.0%	8.0% (40% of 20%)
Sanitary Manholes – West, East & Central	12407, 22407, 32407		92.0%	8.0% (40% of 20%)
Buildings - East & Central	22409, 32409		92.0%	8.0% (40% of 20%)
Administration and Overheads– West, East & Central	12470, 22470, 32470		92.0%	8.0% (40% of 20%)

As can be seen in the above table, the regional administration cost centre under Wastewater Collection is a common cost centre for both Wastewater and Stormwater Services. Of the common costs contained in this cost centre, 10% are allocated to Stormwater Collection. The basis for this allocation was calculated using the actual, direct operating costs for each Service for 2020/21.

Secondary allocations are performed with respect to specific Wastewater collection cost centres as noted in the table above, to Stormwater collection. The purpose of these allocations is to recognize the existence of combined sewers within the collection system. Based on Halifax Water records, 20% of the entire collection system is comprised of combined sewers. Halifax Water[7] calculated that, on average, 40% of the capacity of the combined sewers relates to Stormwater flows. Using these percentages will allow a portion of the costs incurred in the Wastewater Service to be transferred to the Stormwater Service since the combined sewers handle stormwater together with wastewater. These allocations could change if the proportion of wastewater to stormwater changes over time, or the proportion of stormwater relative to sanitary sewer flows change in the combined sewers.

[6] Updated based on IR-28MUL, 2015 Rate Application, M06540

[7] Cost of Service Study, November 2009 by G. A. Isenor Consulting Limited in association with W.H. Gates Utility Consultants Limited and R. M. Loudon Limited

Technical Services (SCADA)

Technical Services (SCADA), a division under Engineering and Technology Services (TS) within the organizational hierarchy, contains three (3) common cost centres, each of which accumulate shared costs for the benefit of Water, Wastewater and Stormwater Services. It is expected there will also be shared costs for the benefit of ATDES. Costs are allocated to each Service are based on the number of data points (tags) monitored in each Service.

Allocations relating common costs within Technical Services (SCADA) are summarized in the table below:

Table 3

Technical Services (SCADA) Allocation of Common Costs to Services					
Common Cost Centres	**Cost Centre No.**	**Water**	**Wastewater**	**Stormwater**	**ATDES***
SCADA System	43598	32%	67%	1%	TBD
Regional Technical Services	43570	32%	67%	1%	TBD
Administration and Overheads	43592	32%	67%	1%	TBD
* Distribution to DES will be established as the system is developed and is operational.					

Engineering and Technology Services

Engineering and TS (excluding Technical Services (SCADA)) consists of five (5) common cost centres which contain shared costs for Water, Wastewater, Stormwater and District Energy Services. The percentage distribution between Services is determined by the Director of Engineering and TS based on budgeted costs and allocation of staff time employed for each respective Service.

Secondary allocations are performed of costs apportioned to Wastewater costs to provide for segregation between Wastewater and Stormwater Services. The basis for this allocation was calculated using the direct, operating costs for each Service for 2020/21.

Allocations relating to common costs within Engineering and TS are summarized in the table below:

Table 4

Engineering and Technology Services Allocation of Common Costs to Services					
Common Cost Centres	**Cost Centre No.**	**Water**	**Wastewater**	**Stormwater**	**ATDES****
Administration*	43525	33%	52%	15%	TBD
Record Information*	43532	33%	52%	15%	TBD
Information Services*	43565	33%	52%	15%	TBD
Energy Efficiency Programs	43526	39%	61%	0%	TBD
Asset Management *	42529	33%	52%	15%	TBD

* Distribution of costs shared across all systems is based on a primary apportionment of 51% to the Water System and 49% to Wastewater/Stormwater. Common costs across Wastewater and Stormwater Systems are apportioned 90% and 10% respectively.

** Distribution to DES will be established as the system is developed and is operational.

The basis for the allocation between Water and Wastewater has been calculated using the customer base for each Service. Whether using the customer base for allocating costs to District Energy is appropriate will be determined as the system is developed as there will be very few customers comparatively. The allocation between Water and Wastewater remains at 51/49 and has been confirmed using customer data as at March 31, 2023, which reported water and wastewater customers of 87,281 and 83,474 respectively.

Separate cost centres capture costs related to Water, Wastewater, Stormwater and District Energy Services. Budgeted operating costs are an appropriate basis for allocation between Water, Wastewater, Stormwater and District Energy Services. Wastewater and Stormwater services are administrated by the same operations group and operating costs reflect the direct costs imposed by the assets under management, their annual operating costs and indirectly the Engineering and TS provided to deliver these respective services. Allocation in this manner is reasonable as a method to reflect cost causation.

Regulatory Services

Regulatory Services consists of six (6) cost centres, with the primary allocations for each spread between Water, Wastewater, Stormwater and District Energy Services. The percentage distributions between Services are determined by the Director of Regulatory Services based on budgeted costs and staff time employed for each respective Service. For the 2013 application, Halifax Water indicated in response to IR-12MUL that it anticipated that the percentages shown in Table 5 will remain relatively stable from rate

case to rate case based on the work focus of Regulatory Services. Since that time, due to the implementation of stormwater billing and the process to review requests for stormwater exemptions, Halifax Water staff determined based on time tracking that the allocation to Stormwater should increase slightly to reflect the estimated increase in staff time dedicated to stormwater issues.

Allocations relating common costs within Regulatory Services are summarized in the table below:

Table 5

Regulatory Services Allocation of Common Costs to Services					
Common Cost Centres	**Cost Centre No.**	**Water**	**Wastewater**	**Stormwater**	**ATDES***
Administration and Overheads	42500	20%	35%	45%	TBD
Environmental Engineering	42501	10%	45%	45%	TBD
Regulatory Compliances	42502	65%	35%	0%	TBD
Stormwater Engineering	42504	0%	0%	100%	TBD
Environmental Management System	42505	40%	40%	20%	TBD
Development Approvals	43531	35%	35%	30%	TBD
* Distribution to DES will be established as the system is developed and is operational.					

Customer Service

Customer Service, a division under Corporate Services within the organizational hierarchy, consists of seven (7) cost centres in total, with the primary allocations for the collective costs split between Water and Wastewater Services based on the prorated number of total customers. Whether using the customer base for allocating costs to District Energy is appropriate will be determined as the system is developed as there will be very few customers comparatively. These shares have historically been consistent and system data as of March 31, 2023 affirms the apportionment to Water and Wastewater Services at 51% and 49% respectively.

Secondary allocations are performed for costs apportioned to Wastewater for five (5) of the above noted cost centres, to provide for segregation between Wastewater, Stormwater and District Energy Services. This apportionment is on an indirect basis and was calculated using actual direct operating costs for each Service, with the FY 2020/21 as the basis. For District Energy, an estimate of annual operating costs will

be reflected in future apportionments. Allocations for these cost centres within Customer Service are summarized as follows:

Water = 51%
Wastewater = 44% (49% x 90% wastewater share of Wastewater/Stormwater Costs)
Stormwater = 5% (49% x 10% stormwater share of Wastewater/Stormwater Costs)

District Energy = Distribution to ATDES will be established as the system is developed and is operational.

For the remaining two (2) cost centres, Water Meter Reading and Operation and Maintenance of Water Meters, combined costs within these cost centres are allocated between Water and Wastewater Services only, at 51% and 49% respectively. Meters are not employed within Stormwater Service in determining revenue, either as a base charge or volumetric rate perspective, nor is there evidence of cost causation. For District Energy, the meters are different than those used for Water Services and as such a new cost centre will be established to accumulate costs relating to District Energy and will be 100% allocated to the ATDES.

Corporates Services

Corporate Services (excluding Customer Service) consists of five (5) cost centres, with the primary allocations for the collective costs split between Water and Wastewater Services at 51% and 49% respectively.

Secondary allocations are performed for costs apportioned to Wastewater costs to provide for a segregation between Wastewater, Stormwater, and District Energy Services. This apportionment is on an indirect basis and was calculated using actual direct operating costs for each Service, with the FY 2020/21 as the basis. For District Energy, an estimate of annual operating costs will be reflected in future apportionments.

Allocations relating to common costs within Corporate Services are summarized as follows:

Water = 51%
Wastewater = 44% (49% x 90% wastewater share of Wastewater/Stormwater Costs)
Stormwater = 5% (49% x 10% stormwater share of Wastewater/Stormwater Costs)

District Energy = Distribution to ATDES will be establish as the system is developed and is operational.

Administration

Administration consists of twelve (12) cost centres in total, with the primary allocations for the collective costs split between Water and Wastewater Services based on the prorated number of total customers. Whether using the customer base for allocating costs to District Energy is appropriate will be determined as the system is developed as there will be very few customers comparatively. Excluding ATDES, these shares have historically been consistent and system data as of March 31, 2023 provides for apportionment to Water and Wastewater Services at 51% and 49% respectively.

Secondary allocations are performed of costs apportioned to Wastewater costs to provide for segregation between Wastewater, Stormwater, and District Energy Services. This apportionment is on an indirect basis and is calculated using actual direct operating costs for each Service, with the FY 2020/21 as the basis. For District Energy, an estimate of annual operating costs will be reflected in future apportionments.

Allocations relating common costs within Administration are summarized as follows:

Water = 51%
Wastewater = 44% (49% x 90% wastewater share of Wastewater/Stormwater Costs)
Stormwater = 5% (49% x 10% stormwater share of Wastewater/Stormwater Costs)

District Energy = Distribution to ATDES will be establish as the system is developed and is operational.

The twelve (12) cost centres are as follows, with a brief description of the costs captured in each:

- General Manager's Office

Costs include those related to the general administration of the utility as a whole, which cannot be directly attributed to particular Service or cost centre. Costs include those for administrative support staff and executive remuneration (30%) not assigned to general overheads (see below)

- Security Costs

Costs include those related to the safety and security of Halifax Water facilities and its employees. Major costs include labour, contract services and professional services;

- Payroll Interface (error collection)

This is a cost centre used to isolate or "red flag" errors that may occur with the interface between the payroll and accounting modules. Typically, this would retain no costs as posts contained therein would be corrected through re-allocation;

- Human Resources

This cost centre is for the sole purpose of Halifax Water's Human Resource department. Labour is a major cost within the department, which supports such functions as payroll, corporate wide training initiatives, hiring, job placements and other such functions;

- Employee Benefits

Costs recorded in this cost centre include pre-retirement leave pay and wages, benefits and recoveries relating to any employees on long-term disability (LTD) or workers' compensation (WCB). Other employee benefit costs are posted directly to the cost centres through the payroll system;

- Operation & Maintenance of Cowie Administration Building

Includes all costs associated with the operation and maintenance of the main administration building, located at 450 Cowie Hill Road. These costs are then allocated to the respective departments using the facility based on square footage of space occupied;

- Operation & Maintenance of Cowie Operations Building

Includes all costs associated with the operation and maintenance of the operations building, located at 455 Cowie Hill Road. These costs are then allocated to the respective departments using the facility based on square footage of space occupied;

- General Overhead Expenses

This cost centre captures 70% of executive remuneration and corresponding benefits, which in turn is recovered from other cost centres within the organization in the form of a general overhead recovery;

- Administration & Overheads

Includes lease/rent expenses, plus applied overheads.

- Communications

Includes costs associated with both the internal and external communications for the utility.

- Legal

Includes costs associated with legal and consulting services on various matters, insurance claims, and document management for the utility.

- Sponsorships and Donations

Includes costs associated with sponsorships and donations for the utility, considered unregulated expenditures by nature, and excluded from revenue requirements.

The costs captured under Administration differs from the Administrative costs for Engineering and TS, Corporate Services or Regulatory Services. The Administrative costs within Engineering and TS, Corporate Services or Regulatory Services are administration costs specific to those areas, and required for the performance of the functions of those units. Administration costs captured within Administration are incurred for and benefit the organization as a whole rather than one specific department or service.

Allocations of common overhead costs are imprecise and require judgments. In 2007, it was decided with the transfer of the Wastewater and Stormwater Systems to Halifax Water that customer base is a fair, equitable and consistent means to allocate these common costs. This judgment remains valid today, and

allocation based on customer base was accepted in the first COS Manual allocation of common costs based on the number of employees within each service is not a viable or appropriate option for several reasons:

- Varying the allocations based on changing staffing levels would provide inconsistencies, especially with respect to year-over-year comparisons and would unduly complicate variance analysis;
- Using the number of employees as a substitute for number of customers, requiring a deviation from historical practice, will not result in any greater precision or equity in cost distributions, given what needs to be accomplished; and
- Increasingly with system integration and enhanced efficiencies, employees will discharge their duties across service boundaries.

Recognition and Allocation of Unregulated Revenues

Halifax Water has revenues and expenses from unregulated activities. These are reported on Schedule D of Halifax Water's Audited Financial Statements. The unregulated activities include consulting services, operation of a dewatering facility at the Aerotech Park, treatment of effluent from airplanes, landfill leachate treatment, contract revenue, and treatment of septage sludge from septage haulers. Halifax Water also has various energy projects underway to explore expansion of business opportunities, deemed to be unregulated activities by NSUARB [8], and include wind energy, generation of electricity using solar, in-line turbines in the Water System, and combined heat and power generation using bio-solids or methane. The projects will be financed through un-regulated revenues with the objective of increasing non-operating revenues to reduce future revenue requirements from rate-regulated activities. Initially, financing any projects that proceed will result in some reduction of non-operating revenues available to reduce rate-regulated activities.

Net proceeds from unregulated businesses will be allocated in whole or in part back to the Services whose assets were employed in their generation.

[8] The NSUARB order W-HRWC-R-12 dated June 25, 2012 stated that it is hereby ordered that Halifax Water: "[7] assume its wind energy projects are an unregulated service unless subsequently determined by the Board to be otherwise." A letter from the NSUARB dated July 9, 2012 also directed that in-line turbine projects are unregulated business.

In the 2013 rate application Halifax Water proposed guiding principles for unregulated activities:

1. The rate base cannot be exposed to undue financial risk associated with capital financing.
2. Unregulated expenses must be funded by unregulated revenues.
3. Cost causation principles must be employed and there should be no subsidization of unregulated activities from regulated activities.
4. There should be a net return/benefit to the rate base from unregulated activities.

In its decision, the Board specifically addressed unregulated activities and reporting, and on page 65 of the decision had the following findings.

> [214] The Board directs Halifax Water to review the projected revenues for unregulated activities to ensure they are on a full cost recovery basis and report its findings by September 30, 2013.
>
> [215] In addition, the Board assumes that any supervisory time or use of common facilities is minimal. They should not distract senior staff from focusing on the effective, efficient and economic operation of the three systems. The Board directs Halifax Water to have senior staff record the time they are required to devote to unregulated activities and that this be reported on a percentage basis, annually.

Halifax Water complied with the Board order, conducted the review, and found that there were no material misstatements with respect to budget and reporting on unregulated activities, but there were some recommended improvements. The changes implemented include:

- Establishing separate cost centres to segregate and track costs for tower leases, energy projects, rental properties, contract revenue, and consulting.
- Creating statistical work orders in the new standalone payroll system to allow staff to record time directly to unregulated activities.
- Implementing a 1% mark-up to salaries and benefits charged to unregulated activities to recoup miscellaneous expenses.

Figures for overhead costs recovered from unregulated activities in 2013/14 and prior included salaries and benefits only. Expenses specifically identified as being unregulated, are charged as a direct unregulated

expense. Effective April 1, 2014, Halifax Water assigned an additional 1% mark-up to salaries and benefits charged to unregulated activities to recoup miscellaneous expenses such as office supplies, photocopying, telephone, etc. The 1% is based on the fact that unregulated revenues represent approximately 1% of total revenues; and overhead expenses are minimal.

As mentioned previously, in 2020 Halifax Water implemented a new standalone payroll system. The new system allows staff to record time spent related to unregulated activities directly into the payroll system using statistical work orders, which compiles costs and posts to the appropriate unregulated cost centre. This eliminates Excel spreadsheets which had been used as a tracking mechanism, requiring a manual entry of costs into the accounting system.

Capital Assets

Infrastructure and capital assets are of primary importance to Halifax Water, mainly due to the magnitude of investment required monetarily. With respect to rate applications, one of the major components in the determination of the revenue requirement is depreciation, which is directly associated with capital assets. Other expenditures closely linked to capital assets from an operational perspective are debt servicing, which again is a main contributor in the determination of the revenue requirement.

Tracking capital assets is an important function. Complexities can arise given the fact that capital not only is funded internally, but may also be contributed/ donated, so segregation is required from a tracking standpoint. This segregation not only applies to anticipated additions in the current year, but also for balances carried forward year over year with respect to both total cost and accumulated depreciation. Special attention is also given to additions in any given year. For example, for the purposes of the rate application, assets cannot be brought into Plant in Service unless the assets are or will be in service. Finally, from a continuity perspective, retirements/ disposals require proper treatment to ensure their capital cost and any associated accumulated depreciation is removed from the accounting records.

The calculation of depreciation is a relatively straightforward process and care must be exercised in that accounting policies and principles surrounding depreciation and capital assets are adhered to.

Capital assets associated with each utility Service are presented in the rate application using a standardized format that has been adopted from previous rate applications to the NSUARB. This general format is shown

in Table 6 below, where System-specific capital assets are presented on a line-by-line basis under the following common categories:

- Intangible Plant;
- Land and Land Rights;
- Structures and Improvements;
- Equipment;
- Mains and
- Other.

Additional categories will be added as required for each utility System to further capture other types of capital assets unique to that particular system.

Capital assets that are common to all four systems are allocated 51% to Water, 49% to Wastewater, with a secondary allocation of 10% from Wastewater to Stormwater and the allocation to District Energy will be established as the system is developed and is operational. This is consistent with the approach to sharing common operating costs between Wastewater, Stormwater, and District Energy Services noted previously. Direct allocation is employed when possible – such as allocating buildings based on square footage utilized by each Service.

Some examples of capital assets common to all four systems would include Administration Buildings and Corporate Enterprise Systems. Meters are capital assets common to three systems, with District Energy customers having a separate meter from water and wastewater specific to that service. Historically, Halifax Water has treated water meters entirely as Water assets. It was recognized in conjunction with investigation of future metering technology improvements, that the water meters are assets that serve both water and wastewater customers. Based on the March 31, 2021 customer data, a 51%/49% split between Water and Wastewater is appropriate for water meter capital costs. Capital costs related to District Energy meters will be allocated entirely to the ATDES.

Table 6 Capital Asset Template

Halifax Water
Utility System
Utility Plant in Service
Depreciation/Continuity Schedule
Test Year

	Funded Utility Plant in Service	Donated Utility Plant in Service	Total Utility Plant in Service	Work in Process approved in Prior Years	Utility Plant in Service Additions	Donated Utility Plant in Service Additions	Projected Retirements	Projected Utility Plant in Service	Accumulated Depreciation	Accumulated Depreciation on funded assets	Accumulated Depreciation on donated assets	Projected Retirement of Accumulated Depreciation	Projected Net Book Value before Depreciation	Depreciation on Donated assets	Depreciation expense on funded assets	Projected Net Book Value after Depreciation
	Opening Balance	Opening Balance	Opening Balance	Test Year	Test Year	Test Year	Test Year	Test Year	Opening Balance	Opening Balance	Opening Balance	Test Year	Test Year	Test Year	Test Year	Test Year
Intangible Plant																
Organization and Working Capital																
LAND AND LAND RIGHTS																
System Specific - Land																
System Specific - Right of Ways																
System Specific - Other Rights																
System Specific - Other																
STRUCTURES AND IMPROVEMENTS																
System Specific - Structures																
General																
Office Building																
Equipment																
System Specific - Pumping Equipment																
System Specific - Tools and Equipment																
System Specific - Transportation																
System Specific - Office Equipment																
System Specific - Computer Equipment																
System Specific - Other																
Mains																
System Specific - Mains and Laterals																
Other																
TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

SECTION 4 - WATER SYSTEM COST ALLOCATIONS

General Review – Base / Extra Capacity Methodology

Water system COS analyses employ a multi-step procedure to assign revenue responsibilities to customer classes in proportion to their respective shares of system demands and uses of system facilities (*e.g.*, standby for fire protection). Using the base-extra capacity method, COS is usually separated into four primary cost components: (1) base or average demand-related costs, (2) extra capacity costs - often further segregated into maximum-day and maximum-hour costs, (3) customer costs- often segregated into water meter-related costs and those incurred for billing, and (4) fire-protection costs.

- **Base costs** vary with the total quantity of water used or are those operations and maintenance (O&M) expenses and capital costs incurred to deliver services under average demand conditions.

- **Extra capacity costs** are associated with meeting demand requirements in excess of average and include O&M expenses and capital costs for system capacity beyond that required to meet average demands. These costs may be subdivided into costs necessary to meet maximum-day extra demand and maximum-hour demand in excess of maximum-day extra demand.

- **Customer costs** comprise those costs associated with serving customers, irrespective of the amount or rate of water use. They include water meter reading, billing, and customer accounting and collecting expense, as well as maintenance and capital costs related to water meters and services.

- **Fire-protection costs** include costs directly related to public fire hydrants and related branch mains and valves. It is noted that the costs allocated to the direct fire-protection cost component are usually only a small part of the total cost of fire protection. A significant portion of extra capacity costs can be allocated to fire protection in distributing costs to customer classes. Fire protection costs are primarily capital-related with relatively limited operational costs incurred to deliver this service attribute.

In the base-extra capacity method, the appropriate classification factors between base and extra capacity should be calculated using actual operating history or design criteria. The basic formulas are as follows:

- For functions classified to maximum-day and average day service characteristics:

Average Day % = Average Day Demand/ Maximum-Day Demand

Maximum-Day % = (Maximum-Day Demand – Average Day Demand)/ Maximum-Day Demand

- For functions classified to maximum-hour, maximum-day and average day service characteristics:

Average Day % = Average Day Demand/ Maximum-Hour Demand

Maximum-Day % = (Maximum-Day Demand – Average Day Demand)/ Maximum-Hour Demand

Maximum-Hour % = (Maximum-Hour Demand – Maximum-Day Demand)/ Maximum-Hour Demand

The classification of costs by function is based on the design and operation of the facilities used to perform the functions in question. For example, raw-and treated-water pumping and treatment facilities are typically classified to the average-day and maximum-day extra capacity cost components since these facilities are typically designed to meet maximum-day demands. In contrast, storage facilities are typically apportioned to each of the three demand-related components because storage tanks serve principally to assist utilities in meeting maximum-hour extra capacity requirements.

Fire Protection is classified between public fire protection and private fire protection based on the flows that each could potentially demand. The cross-sectional area of the pipe is used as a surrogate for this flow classification. All public hydrants are assumed to have a 150 mm (6 inch) connection to the Halifax Water System while all private connections are based on the recorded or observed size of the connection to the Halifax Water System. As noted in response to IR-IPOANS 1 during the 2013 rate application, the charge shall be based on the size of the line before the first point of use connection whether it be a hydrant line or a sprinkler line entering the building. The total cross-sectional area for all public hydrants is calculated along with the total cross-sectional area of all private hydrants and sprinkler connections. These areas are used to calculate the percentage of the fire protection charge to be recovered from the public system versus the percentage to be recovered from private connections.

In classifying costs to utility service characteristics, it is useful to develop as complete an accounting of utility system performance measures as is practicable. Accordingly, it is useful to develop a high-level reconciliation of system production data – identifying the shares of production associated with billed usage (by customer class) versus that associated with non-revenue water (*e.g.*, losses). The determination of shares of production that are billed and lost are among the measures that are used to manage non-revenue water (including non-metered water uses and water losses) as discussed in more detail in response to IR-IPOANS-18 of the general rate application of 2013. For cost-of-service analysis purposes, it is noteworthy that costs are incurred relative to water production, yet costs must be allocated to billable water demands. Understanding these relationships provides a more complete picture of cost causation and allocated revenue responsibilities.

The elements of the water production and billable volume data are compiled for Tables 7 & 8. Beyond the point noted above the relationship between production and billable volumes are not used directly in the cost-of-service analysis.

Classified costs are allocated to customers through the calculation of unit costs of service for each service characteristic, and apportionment of costs to customer classes based on the number of service units required by the respective customer classes. So, for example, if cost classification indicates that annual average-demand related costs are $10 million and average annual demands are 5 million cubic meters, the $2 per cubic meter unit cost is distributed to Customers by including in rates the $2 costs per cubic meter.

System and Customer Use Data (for Cost Allocation)

A map of the System is provided in the COS Manual Appendix and general system information may be referenced from Halifax Water's Annual Report. Water System production data, similar to that provided in the example format below using FY 2020/21 Halifax Water data, is used to develop cost classification percentages as outlined in section 2 Methodology Review.

Table 7

Water System Production

Development of Demand-Related Cost Classification Percentages

Halifax Water - Water System Production – FY 2020/21*							
Water Production	Average-Day Demand	Maximum-Day Demand	Max-Day Factor	Avg-Day / Max-Day Percent	Maximum-Hour Demand	Max-Hour Factor**	Avg-Day / Max-Day / Max-Hour Percent
Lake Major	33,198 M^3	44,910 M^3	1.35		56,302 M^3	1.70	
Lake Pockwock	78,736 M^3	97,040 M^3	1.23		145,415 M^3	1.70	
Bennery Lake	535 M^3	1,302 M^3	2.43		1,669 M^3	1.70	
System	112,469 M^3	143,252 M^3	1.27	79% / 21%	215,451 M^3	1.70	52%/14%/34%

* Halifax Water, Cost of Service Demand Analysis Report, prepared by M. E. Loudon Ltd., October 2009 – hereinafter, the Loudon Report – indicated a maximum-day factor of 1.22. This has been updated in 2014 by M.E. Loudon Ltd. Maximum-day factor is now 1.27. The Loudon report excludes Bennery Lake. The COS Manual includes Bennery Lake. The difference is not material as Bennery represents 0.7% of total production.

** Maximum hour production data is not available; the 1.70 maximum-hour factor based on the above-referenced Loudon report was applied uniformly for all water treatment plants.

Halifax Water does not calculate and compile maximum hour production from the treatment plants because there is a significant amount of storage in the distribution system such that maximum hour production is not driven by variability in customer demand patterns. The plants are designed and intended to operate at a constant rate on any given day with variations in consumption made up from storage. As a result, and notably different from the cost causation relationships contemplated in the AWWA M1, there is no significant relationship between plant operation and hourly variations in system consumption. Moreover, the system does not experience significant variations in demands. The Loudon Report concluded on page 19: "It is concluded that there is insufficient max hour differentiation by customer class to be a factor in allocating costs for rate setting purposes".

Halifax Water engaged R.M. Loudon to prepare an update to determine whether the 2009 findings were still valid. R.M. Loudon's 2014 Water Demand Analysis supports the findings in the 2009 report. Halifax Water engaged Raftelis in 2020/21 to complete a Water Demand Analysis using AMI data. The 2021 work concludes there may be sufficient differentiation in daily peaking characteristics by customer class now to

warrant using max hour as a factor in allocating costs for rate setting purposes, however the consumption data for the period under review was not normal as customer consumption patterns were impacted by the COVID-19 pandemic. At this time Halifax Water is not proposing to do further allocations to functionalize costs to customer classes. Raftelis also notes that "there is enough differentiation between the daily peaking characteristics by customer class that class-based volumetric water rates could be supported, although would not necessarily be required".

Additional information used for classification and allocation of System costs includes:

- Design criteria for all water related infrastructure that is included in the 2020 Design Specifications. The document is available online at https://halifaxwater.ca/halifax-water-specifications-forms. The document includes a table of contents that clearly defines the document content.
- Fire flow requirements are designed using the "Water Supply for Public Fire Protection – 1999, Fire Underwriters Survey for CGI." Typical fire flow requirements[9] are:
    - 880 usgpm for residential single family
    - 1,100 usgpm for townhouse developments
- Water Services and water meters are sized using AWWA Manual of Supply Practices – M-22 - Sizing Water Service Lines and Meters.

Finally, data employed for allocation to customer classes includes information on the distribution of water meters by size serving the class, billed usage, and measured or imputed maximum-day demand and maximum-hour demands based on estimated peaking factors. Provided in Table 8 below is an example format for presentation of these customer class usage characteristics:

[9] Actual requirements must be calculated for each circumstance.

Table 8

Customer Class User Characteristics

Water Accounts and Billed Usage by Meter Size and Customer Class (2020/21)				
		Billed Usage		
Meter Size	Accounts [1]	Residental	Non-Residential	Total
Unmetered	307	55,976	0	55,976
5/8" (15 MM)	80,973	13,673,987	185,667	13,859,654
3/4" (20 MM)	1,022	325,036	198,668	523,704
1" (25 MM)	1,563	978,447	595,033	1,573,480
1.5" (40 MM)	1,146	1,065,213	1,477,422	2,542,635
2" (50 MM)	818	2,221,729	2,431,751	4,653,480
3" (80 MM)	316	2,135,050	1,626,570	3,761,620
4" (100 MM)	77	597,942	842,276	1,440,218
6" (150 MM)	38	129,982	2,062,437	2,192,419
8" (200 MM)	26	12,724	1,511,705	1,524,429
10" (250 MM)	2	0	58,031	58,031
Total	86,288	21,196,086	10,989,560	32,185,646
Maximum-Day Peaking Factor [2]				1.24
Maximum-Day Demand				
Maximum-Hour Peaking Factor [2]				1.70
Maximum-Hour Demand				

1 - For cost allocation, account totals are used to allocate billing and other non-metered customer service costs; meter equivalencies based on account data by meter size are used to allocate meter-related costs.

2 - Pending the potential development of class peaking factor estimates with the implementation of new metering technologies, Louden Report estimates represent the best available data on class demand patterns. Maximum-Day and Maximum-Hour demand factors based on the Louden Report did not indicate material differences across classes, are applied to determine respective class claims on extra-capacity.

The Cost-of-Service Manual continues to rely on the Loudon report class demand projections. Halifax Water engaged Raftelis in 2020 and most recently in 2021 to perform a water demand analysis. In both, Raftelis determined differentiation in peaking characteristics could be reported between customer classes however, given the relatively young age of the advanced metering infrastructure (AMI), compounded by the continued effects of the COVID-19 pandemic on consumption patterns, delaying the introduction of class-based rates would be prudent. This would provide greater confidence in the data, and ensure changes to the rate structure are as accurate and justifiable as possible.

Water Systems Functions

Utilities incur varying levels of costs to perform the different system functions needed to meet customer demands and make services available. The functionalization process involves categorizing revenue requirements according to functions in order to more appropriately assign costs to customer classes. Water system cost functions and their definitions for both operating and capital are presented in Table 9.

Table 9

Water System Cost Allocation – System Functions

Water System Function	Operating Costs Definition	Capital Cost Definition
Watershed Management	Includes labour, materials, and programs to ensure the watershed is maintained in optimal condition.	Includes all capital expenditures for watershed management.
Dams	Includes labour, materials, and programs to ensure dams are maintained in optimal condition and meet all safety regulations.	Includes all capital expenditures for dams.
Water Quality	Includes labour, materials, and programs to ensure water quality is maintained pursuant to regulatory requirements.	Includes all capital expenditures related to water quality management.
Water Treatment	Includes the cost centre for treatment plants (including raw water pumping, emergency standby, on-site storage, and water quality.	Includes all buildings, structures including storage that is part of the treatment process, mechanical and electrical equipment to make a complete operating treatment plant including wet well water storage.
Transmission	Includes the cost centres for all mains 600 mm (24 inch) or larger, as well as other mains clearly designed to serve as transmission mains.	Includes the design and construction costs associated with all mains 600 mm (24 inch) or larger, as well as other mains clearly designed to serve as transmission mains.
Distribution	Includes the cost centres for distribution and for pressure reducing valves (PRV) and control valves	Includes the design and construction costs associated with all mains less than 600 mm (24 inch) in diameter except for those

	on the mains less than 600 mm (24 inch) in diameter.	designed to be transmission mains as identified and all associated valves and pressure regulating equipment.
Service Laterals	Includes the cost centre for water services.	Includes connection to the main and the piping from the main to the street line for water services.
Operation & Maintenance of Water Meters	Includes the cost centre for operation and testing of water meters (labour, materials, and programs).	Includes all capital expenditures for water meters.
Water Storage Tanks	Includes the cost centre for reservoirs/storage tanks. Water storage tanks that are part of a treatment plant are maintained as part of the treatment plant.	Includes all buildings, structures, control chambers, mechanical and electrical equipment to make a complete operating reservoir. Storage that is part of the treatment process is included in the capital cost of the Water Treatment Plant.
Hydrants	Includes the cost centre for hydrants.	Includes all hydrants and associated fittings and valves in the water system that are for the purpose of providing water for fire protection.
Regulatory Services	Includes Environmental Engineering, Regulatory Compliance, Stormwater Engineering, Environmental Management and Development Approvals cost centres.	Cost centres within Regulatory Services function as operating cost centres. Any capital costs related to the provision of this service (equipment, buildings, intangibles etc.) are allocated as assets in proportion of the other costs through depreciation.
Engineering and Technology Services	Includes the cost centres for Records Management; Energy and Business Development, and, Information Services.	Cost centres within Engineering and Technology Services function as operating cost centres. Any capital costs related to the provision of this service (equipment, buildings, intangibles etc.) are allocated as assets in proportion of the other costs through depreciation.
Technical Services (SCADA)	Operate the SCADA systems for water (both treatment and distribution).	Cost centres within Technical Services function as operating cost centres. Any capital costs related to the provision of this service (equipment, buildings, intangibles etc.) are allocated as assets in proportion of the other costs through depreciation.
Corporate Services	Includes the cost centres for Accounting, Finance and Procurement.	Cost centres within Corporate Services function as operating cost centres. Any capital costs related to the provision of this service (equipment, buildings, intangibles, etc.) are allocated as assets in proportion of the other costs through depreciation.
Customer Service	Includes the cost centres for Customer Care, Collecting, Supervision and Administration/Overheads.	Cost centres within Customer Service function as operating cost centres. Any capital costs related to the provision of this service (equipment, buildings, intangibles etc.) are allocated as assets in proportion of the other costs through depreciation.
Water Meter Reading and Billing	Includes the cost centres for Water Meter Reading and Customer Billing.	Cost centres within Water Meter Reading and Billing function as operating cost centres. Any capital costs related to the provision of this service (equipment, buildings, intangibles etc.) are allocated as assets in proportion of the other costs through depreciation.
Administration	Includes the cost centres for: Administration, Communications, Legal, Human Resources, Employee Benefits and General.	Cost centres within Administration function as operating cost centres. Any capital costs related to the provision of this service (equipment, buildings, intangibles etc.) are allocated as assets in proportion of the other costs through depreciation.

Cost Functionalization Considerations

The engineers and operators responsible for operation of the Water System review assignment of water assets and their associated operating and maintenance costs to system functions. Operating costs centres are set up to record financial information in categories that support functionalization.

The basis for the determination of functions is the operating cost centers that comprise the Water System from source of supply to delivery to the Customer. It includes the direct cost functions of providing the service as well as the common costs of providing support services across all utility Services that are assigned to Water Services. The following points are noted regarding the cost functions:

- Historically, there was no separation of transmission and distribution main operating costs as these operating cost centers were combined following municipal amalgamation in 1996. The cost-of-service model will separate these into two cost functions, one for transmission and one for distribution. The age of the system means that the role of mains has changed over time as new sources of supply were developed and the System expanded. For the purposes of cost functionalization, a designation between transmission and distribution costs is required. For the Halifax Water System, all mains 355 mm (14 inch) and greater in diameter may be designated as transmission mains, together with any mains less than this diameter which are clearly designed to be transmission mains.

- Transmission and distribution functions are distinguished due to fundamental differences in the design and operation of these Water System network assets. These assets deliver services to a broad diversity of customer types – residential, multi-residential, institutional, commercial, industrial – located across an array of physical configurations. These configurations are typically served by multiple feeds, providing redundancy that reinforces the security of water supply. Consistent with cost-of-service principles that call for distribution of costs based on cost causation, these functions do not recognize the density of customer concentrations. There is no evidence to suggest density of customer concentration will represent a material determinant of COS differentials across classes in that system redundancy and fire flow demand requirements almost certainly outweigh any potential density benefit, even in the event that such a benefit could be identified in light of the mix of land uses served across every sector of the Halifax Water

service area. As noted, industry standard practices for cost-of-service analysis principles do not recognize the density of customer concentrations.

- Given that density of customer concentration is one of a variety of factors impacting costs to serve a particular subsection of Halifax Water's service area – and is arguably less important than other factors, for example fire flow requirements referenced in system design – the potential to isolate and define density-based cost differentials is limited at best. Accordingly, Halifax Water has not developed – nor received from other sources - any studies or reports that provide evidence of density-based cost differentials. The nature of its Customer base located within its service area, as well as system design protocols used by Halifax Water supports its conclusion.

The Technical Services (SCADA) budget has been allocated based on the number of data points monitored in each cost function. Functionalization of O&M expenses is shown in Worksheet W-6 in Rate Studies, which is based on Table 9 as shown in this Manual. The percentages reported in Worksheet W-6 are back-calculations, derived from actual dollar values included in the test year operating expenditures. Functionalization is shown with both percentage allocation and actual dollar values.

For Customer Service, input values (dollar costs) for the functions of water meters and water meter reading and billing are obtained from specific cost centres within Customer Service:

- <u>Water Meters</u>
  Operation and Maintenance of Water Meters

- <u>Water Meter Reading and Billing</u>
  Water Meter Reading
  Customer Billing

Once costs have been identified for the above functions, costs applicable to the Customer Service function are merely the residual amount.

The concept for transmission is the same as Customer Service outlined above. Each region has a separate cost centre for transmission, and these combined costs were used to back-calculate the percentages allocations in the functionalization report. The percentages represent the prorated values for

transmission costs compared to total transmission and distribution costs for each of the cost element groups.

The dollar value report for functionalization is the primary worksheet for input and balancing, the percentage report is supplemental in nature and useful to illustrate changes.

Classification of Functional Costs

Following the distribution of water system revenue requirements to designated functions, costs are distributed to Water System service characteristics. Following AWWA procedures outlined above, these service characteristics include water demand metrics, uses of system facilities, and customer service attributes. Water demand estimates include average-day, maximum-day and maximum-hour estimates; uses of facilities include fire protection (and potentially other standby/emergency) service; and customer service attributes relate to the numbers of equivalent water meters and accounts served. Classification of system costs (by function) distributes costs to the characteristics of service that distinguish customer classes.

Halifax Water's functionalized costs are classified to the following Water Service characteristics:

- Average Day Demand
- Maximum Day Demand
- Maximum Hour Demand
- Equivalent Water Meters
- Customer Service
- Fire Protection
- Indirect

O&M Cost Classification

Functionalized Water System costs are classified to service characteristics separately for O&M expenses and capital costs. O&M costs are classified as summarized in Table 10, explanations of which are provided in the subsequent notes. Supporting calculations are documented in the final section of the COS Manual section on Water System Allocations.

Table 10

Water System O&M Cost Classification Summary

O&M Cost Classifications								
Water System Functions	Average-Day Demand	Max-Day Demand	Max-Hour Demand	Equivalent Meters	Customer Service	Fire Protection	Indirect	Notes
Watershed Management	100%							1
Dams	100%							2
Water Quality	100%							3
Water Treatment	91%	9%						4
Transmission	91%	9%						5
Distribution	28%	16%	25%			31%		6
Water Storage Tanks	52%	5%	14%			29%		7
Hydrants						100%		9
Service Laterals				100%				8
Technical Services (SCADA)	25%	25%	25%			25%		10
Customer Service					100%			11
Operation & Maintenance of Meters				100%				12
Meter Reading and Billing					100%			13
Engineering and Technology Services							100%	14
Regulatory Services							100%	14
Corporate Services							100%	14
Administration							100%	14

Notes on Water System O&M Cost Classification

1. Watershed management is assigned 100% to base capacity or average day. Watersheds are designed and managed to provide average day flow, consistent with AWWA M1.
2. Dams are assigned 100% to base capacity or average day, the same as watershed management.
3. Water Quality is assigned 100% to base capacity or average day, the same as watershed management.
4. Water Treatment allocation is consistent with the methodology on page 52 of M1. This also includes the suggestion in M1 that variable costs which in this case are electricity, chemical and sludge management costs are allocated to base capacity or average day. Halifax Water used 2020/21 flows from the three large plants (Lake Major, Pockwock and Bennery Lake) and calculated the percentage that maximum day exceeds average day. While M1 suggests the electrical demand charge may be allocated to max day, Halifax Water did not do that because there is so little variability in the electrical demand charge (the difference in demand charge between the highest and lowest months is calculated to be $400 out of a $60,000 bill). Based on this review costs are assigned 91% to average day and 9% to max day.
5. Transmission is distributed the same as water treatment, 9190% to average day and 910% to max day.
6. For distribution Halifax Water followed the method on page 52 of M1. To determine peak hour based on the factors developed in Exhibit 34 of the Loudon [10] Report. This resulted in the following distribution:

    1. Base Component (Average Day)= 28%
    2. Max Day Component = 16%
    3. Peak Hour Component = 25%
    4. Fire Protection Component = 31%

7. For water storage tanks Halifax Water took the total distribution storage of all 17 facilities and applied the formula for storage tank (reservoir) sizing found in the Atlantic Canada guidelines

[10] Halifax Regional Water Commission, Cost of Service Demand Analysis Report, prepared by M. E. Loudon Ltd., October 2009

manual[11]. Fire demand in the service area varies from 800 to 5,000 igpm. Halifax Water calculated (see attached notes) the following distribution:

1. Base Component (Average Day) = 52%
2. Max Day Component = 5%
3. Peak Hour Component = 14%
4. Fire Protection Component = 29%

8. Service Laterals are assigned 100% to equivalent water meters as services are totally dedicated to Customers.

9. Hydrants are to be assigned 100% to fire protection. Fire protection is to be divided between private fire protection service and public fire protection service. Private fire protection is to be recovered from the customers who benefit. The charge for public fire protection is to be recovered from HRM. This calculation[12] indicates 67% of the fire protection charge should be recovered from the public sector with the remaining 33% recovered from the private fire connections.

10. Technical Services operating costs are distributed based on the number of data points (tags) monitored in each activity. The result of this allocation is shown in the table below:

Table 11

Function	Number of Data Points Monitored	Allocation percentage
WW Treatment	24,356	45.0%
WW Collection	11,954	22.0%
SW CSOs	456	0.8%
Water Distribution	5,204	9.6%
Water Treatment	12,265	22.6%
District Energy*	TBD	TBD
Total	54,235	100.0%
*Allocation to DES will be established as the system is developed and is operational.		

[11] Atlantic Canada Guidelines for Supply, Treatment, Storage, Distribution and Operation of Drinking Water Supply Systems, Atlantic Canada Water & Wastewater Association, September 2004

[12] Provided in final section of Water System Cost Allocations providing customer classification calculations.

Technical Services has been allocated equally between average day, max day, max hour, and fire protection.

11. Customer Service at Halifax Water is comprised of seven (7) cost centres, which include customer care (call center), billing, collections, water meter reading, operation and maintenance of water meters, supervision, and administration/overheads. These functions are shared by the four Services: Water, Wastewater Stormwater, and District Energy Services with the exception that no water meter related costs are allocated to Stormwater. Water meter related costs are distributed to Wastewater as billings are based on water consumed and related meter size for base charges. Energy meter related costs are distributed to District Energy as billings are expected to be, at least in part, based on energy consumed. The customer service costs are assigned either on a Customer basis or an equivalent meter basis. Costs for supervision, customer care, collections and administration/overheads are assigned on a Customer basis. Water Meter reading and billing costs are included as a separate cost function but assigned on a Customer basis while the costs for operation and maintenance of water meters are assigned on an equivalent water meter basis as these costs are generally higher per meter as the size of the water meter increases.

12. Operation and maintenance of water meters is assigned 100% to equivalent water meters.

13. Water Meter reading and billing are the cost of water meter reading and billing costs that are part of Customer Service. They are assigned 100% to Customer Service.

14. Engineering and Technology Services, Regulatory Services, Corporate Services and Administration are indirect costs that are distributed in proportion to direct costs.

Capital Cost Classification

Functionalized Water System costs are classified to service characteristics separately for O&M expenses and capital costs. Capital costs are classified as summarized in Table 12, explanations of which are provided in the subsequent notes. Supporting calculations are documented in the final section of the COS Manual section on Water System Allocations.

Table 12

Water System Capital Cost Classification Summary

Capital Cost Classifications								
Water System Functions	Average-Day Demand	Max-Day Demand	Max-Hour Demand	Equivalent Meters	Customer Service	Fire Protection	Indirect	Notes
Watershed Management	100%							1
Dams	100%							2
Water Quality	100%							3
Water Treatment	81%	19%						4
Transmission	81%	19%						5
Distribution	30%	14%	27%			29%		6
Water Storage Tanks	52%	5%	14%			29%		7
Hydrants						100%		8
Service Laterals				100%				9
Technical Services (SCADA)								10
Customer Service					100%			11
Operation and Maintenance of Meters				100%				12
Engineering and Technology Services (excluding TS)							100%	13
Regulatory Services								14
Meter Reading and Billing					100%			15
Corporate Services							100%	16
Administration							100%	16

Notes on Water System Capital Cost Classification

1. Watershed management assigned 100% to base capacity or average day. Watersheds are designed and managed to provide average day flow, consistent with AWWA M1.

2. Dams are assigned 100% to base capacity or average day, the same as watershed management.

3. Water Quality is assigned 100% to base capacity or average day, the same as watershed management.

4. Water Treatment: Halifax Water used 2020/21 flows from the three large plants (Lake Major, Pockwock and Bennery Lake) and calculated the percentage that maximum day exceeds average day. The treatment plants have been designed with standby capacity to treat water for the average day as well as the maximum day. Based on this analysis the capital costs have been distributed 81% to average day and 19% to maximum day.

   Halifax Water calculated the percentage of operating costs for average day and max day which results in a distribution of 91% to average day and 9% to maximum day.

5. Transmission is distributed the same as water treatment, 81% to average day and 19% to max day.

6. For distribution, Halifax Water followed the method on page 52 of M1. To determine peak hour based on the factors developed in Exhibit 34 of the Loudon [13] Report. This resulted in the following distribution:

   a. Base Component = 30%
   b. Max Day Component = 14%
   c. Peak Hour Component = 27%
   d. Fire Protection Component = 29%

7. For water storage tanks, Halifax Water took the total distribution storage of all 16 facilities and applied the formula for storage tank (reservoir) sizing found in the Atlantic Canada guidelines

[13] Halifax Regional Water Commission, Cost of Service Demand Analysis Report, prepared by M. E. Loudon Ltd., October 2009

manual[14]. While fire demand in the service area varies Halifax Water utilized a design fire flows for each service area to determine the percentage of total storage and allocated that to fire protection. Halifax Water calculated balancing storage at 25% of max day and allocated that to peak hour. The remaining capacity was assumed to be emergency storage and was allocated to average and maximum day. From the attached calculations, the capital cost has been distributed based on 30% to fire protection, 14% to peak hour, 51% to average day and 5% to maximum day.

8. Hydrants are assigned 100% to fire protection.

9. Service laterals are assigned 100% to equivalent water meters as service laterals are totally dedicated to the customers.

10. Technical Services (SCADA) are charged directly to capital cost based on work performed. There is no separate allocation for capital for this item.

11. Customer Service is assigned 100% to customer service.

12. Operation and maintenance of water meters are assigned 100% to equivalent water meter

13. Engineering and Technology Services related with capital works are assigned to the capital cost of the works and are included in the capital items. All other costs such as databases and other intangibles are assigned to indirect costs.

14. Regulatory Services are assigned to the capital cost of the works and are included in the capital items. There is no separate assignment for capital for this item.

15. Water Meter reading and billing costs are part of Customer Service. They are assigned 100% to customer service as water meters are totally dedicated to the customers.

16. Corporate Services and Administration are assigned to indirect costs that are distributed in proportion to direct costs.

Allocation to Customer Classes

Costs are distributed to Customers (either by classes or individually) based on similarities and differences

[14] Atlantic Canada Guidelines for Supply, Treatment, Storage, Distribution and Operation of Drinking Water Supply Systems, Atlantic Canada Water & Wastewater Association, September 2004

in their water demand patterns, fire protection requirements, and types/sizes of service connections. For Halifax Water, given the general similarities in water use patterns, customer classifications may be reasonably truncated based on an evaluation of potential classification options. This evaluation typically involves examination of metered billing-cycle usage data by Customer type and calculation of Customer class peaking factors. Applicable peaking factors include non-coincident factors that simply divide class maximum-month usage by average-day usage with selected adjustments. Alternatively, coincident peaking factors may be developed using imputation formulas as offered in the AWWA M1, Appendix A.

Costs by Service characteristic are simply divided by the projected level of service to be rendered to determine the unit costs of a given Service parameter. For example, the system-wide cost per cubic meter of maximum-day demand is calculated by taking the costs determined to meet maximum-day demands divided by projected maximum-day demands (based on system peaking factors). In this manner, costs are distributed to customers in proportion to their respective demands and uses of the System. If Customer classifications are homogenized, unit costs by Service characteristic may be combined to establish rates for Service (typically where demand related costs convert to the volumetric rate).

This procedure is illustrated in Tables 13 and 14 that offer example templates for these types of calculations. As noted, the distribution of costs by function, and subsequent classification of these costs by Service characteristic (*e.g.*, average and maximum demands, fire flow requirements, equivalent water meters and customer accounts) results in the expression of each component of the utility's revenue requirements in terms of these Service characteristics. Accordingly, in Table 13, Lines 1, 4 and 7 list the outcomes of the cost classification by each major revenue requirement component. Because some of these costs are distributed on an indirect basis, a calculation is made whereby the indirect costs are distributed to directly classified costs based on those costs share of total directly classified costs. So, for example, if average-day demand related O&M costs represent 40 percent of directly classified O&M costs, 40% of indirect O&M costs are apportioned to average-day demand related costs. This is the procedure employed in Lines 2, 5 and 8 – to yield complete cost classifications by cost component (Lines 3, 6, and 9) – that are summed (Line 10) to present total costs by Service characteristic.

Among other measures, determination of the total costs of fire protection provides the basis for determination of public fire protection costs to be billed to HRM as described in section 4 Water System Cost Allocations (p. 30), supporting calculations which are provided in the Water System Section Appendix. Application of the percentage of the fire protection costs to be distributed to public versus private

connections is presented in Line 11. Lines 10 and 11 represent the costs by service characteristics to be recovered from Customers in proportion to their respective demands – their allocated COS – through COS based rates and charges as calculated using procedures outlined in Table 13.

Table 13

Water System – Unit COS Calculation Template

Line	Revenue Requirement Component	Average-Day Demand Related Costs	Maximum-Day Demand Related Costs	Maximum-Hour Demand Related Costs	Fire Protection Related Costs	Meter Equiv. Related Costs	Billing Related Costs	Indirect Costs
1	Operations & Maintenance	$$ (%)	$$ (%)	$$ (%)	$$ (%)	$$ (%)	$$ (%)	$$
2	Allocated Indirect O&M	$$	$$	$$	$$	$$	$$	
3	Operations & Maintenance (Net)	$$	$$	$$	$$	$$	$$	
4	Depreciation	$$ (%)	$$ (%)	$$ (%)	$$ (%)	$$ (%)	$$ (%)	$$
5	Allocated Indirect Depr.	$$	$$	$$	$$	$$	$$	
6	Depreciation (Net)	$$	$$	$$	$$	$$	$$	
7	Return on Rate Base	$$ (%)	$$ (%)	$$ (%)	$$ (%)	$$ (%)	$$ (%)	$$
8	Allocated Indirect Return	$$	$$	$$	$$	$$	$$	
9	Return on Rate Base (Net)	$$	$$	$$	$$	$$	$$	
10	Total Revenue Requirements Lines (3,6,9)	$$	$$	$$	$$	$$	$$	
11	Private Fire Protection (% Share of Allocated Fire Protection)			$$	Public Fire Protection Share (xx%)		$$$ (Billed to HRM	

The ultimate allocation of costs to Customer classes employs the service characteristic by customer class data developed in the "System and Customer Use Data (for Cost Allocation) – Table 14." Unit COS by characteristic (Line 3) are calculated by dividing total revenue requirements by Service characteristic (Line 1) by total system demands, capacity requirements, meter equivalents and customer accounts served (Line 2). Costs are then allocated to Customer classes simply by multiplying these unit costs by the demands, fire flows, meter equivalents and accounts served for each Customer class. This is accomplished for residential customers in lines 4 & 5; for non-residential customers in lines 7 & 8. The sum of line 5 (across service characteristics) is therefore the fully allocated cost-of-service for the residential class; the sum of line 8 is that for the non-residential. COS-based rates are those that recover these sums from respective Customer classes. While many rate designs may accomplish these ends, a basic rate design option is to recover volume-related costs, including average and maximum-demand related costs from volumetric rates while fixed charges (graduated by meter size) recover metering related costs and customer account related costs. Fire protection costs may be recovered from either volumetric rates or fixed charges. This rate design calculation is presented in the template example in lines 6 & 9.

Table 14

Water System – Allocation of Costs to Customer Classes and Uniform Volume with Fixed Charge Rate Calculations (System and Customer Use Data for Cost Allocation)

Line	Revenue Requirement Component	Average-Day Demand Related Costs	Maximum-Day Demand Related Costs	Maximum-Hour Demand Related Costs	Fire Protection Related Costs	Meter Equiv. Related Costs	Billing Related Costs
1	Total Revenue Requirements Lines (3,6,9)	$$	$$	$$	$$	$$	$$
2	System Demands						
3	Unit Cost of Service Characteristic						
4	Residential Demands						
5	Residential Cost of Service (Line 3 x 4)						
6	Residential Rates*						

7	Non-Residential Demands						
8	Non-Residential Cost of Service (Line 3 x 7)						
9	Non-Residential Rates**						

* Residential rates (line 6) featuring uniform volume rates and fixed charges may be calculated by summing the first three columns of line 5 and dividing by projected billable residential water use (line 4, first column) to determine the volumetric rate. The fixed charge is the sum of meter equivalent costs (line 5, column 5) divided by residential meter equivalents (line 4, column 5) plus the billing and non-meter customer service costs (line 5, column 6) divided by residential accounts (line 4, column 6).
**Similarly, non-residential rates (line 9) are calculated using the same procedures where line 7 is substituted for line 4, and line 8 is substituted for line 5.

Water System Appendix: Supplemental Cost Classification and Allocation Calculations

Water Treatment/Water Quality

For the purpose of distributing water treatment and water quality costs to demand related service characteristics, first the cost of the three large water supply plants, plus the Water Quality (WQ) section, plus Water Treatment (WT) Regional Administration.

The total cost for WT and WQ includes the operating costs for the Lake Major (LM) WSP, the J.D. Kline (JDK) WSP, Bennery Lake WSP, the WQ section, and WT Regional Administration costs. The values are taken from SAP for the 2020/21 FY.

WT Regional Administration (43413)	$649,225
WQ Section (43415)	$1,050,347
Lake Major WSP (23410)	$3,732,138
J.D. Kline WSP (13414)	$3,900,955
Bennery Lake WSP (33444)	$599,171
Total	**$9,931,836**

The following costs are allocated to average day based on cost causation (as affirmed by stakeholder discussions):

- Dams
- WQ

Similarly, consistent with the AWWA M1 manual, the following truly variable costs should be allocated to average day. These include:

- Chemicals
- Electricity (consumption charges) *
- Sludge costs

*Consumption charges are, on average, 70% of the electricity bill.

Determine amount to allocate directly to average day:

WQ Section	$1,050,347
JDK Chemicals	$1,348,878
JDK Electricity *	$695,092
JDK Sludge **	$150,000
LM Chemicals	$1,421,483
LM Electricity *	$575,159
LM Sludge **	$100,000
Bennery Chemicals	$53,532
Bennery Electricity *	$53,552
Bennery Sludge ***	$15,000
Dams (estimated)	$50,000
Total to Allocate directly to Average Day	**$5,513,043**

* 70% of bill representing consumption.

** Average annual cost based on actual costs for the period 2018-2021.

*** Budget contains $150,000 but sludge has never been removed before: Assume costs are averaged over a ten-year return cycle.

$5,513,043 is allocated directly to average day

$9,931,836 - $5,513,043 = $4,418,793 is allocated to base – extra capacity

Base extra capacity portion: Treatment plant costs are classified to average day and max day Service characteristics.

Average day is 79% of max day (see System and Customer Use Data (for cost allocation))

$4,418,793 X 0.79 = $3,490,846 to average day

$4,418,793 – $3,490,846 = $927,947 to max day

Percentage to average day, combining directly allocated and classified costs.

($5,513,043 + $3,490,846)/ $9,931,836 = 91% to average day

= 9% to Max Day

Storage:

According to Atlantic Canada guidelines, tanks are sized as follows:

S = A + B + C

Where: A = Fire Storage

B = Peak Balancing Storage

C = Emergency Storage

There may also be another component, D (Dead Storage), which is essentially water holding up the other storage volume and in excess of S.

A: Fire Storage:

- Allocate all this volume to fire protection
- Fire demands can range from 800 – 5,000 IGPM
- Each tank must supply the maximum fire demand in its area
- According to 1993 report by CBCL "Metropolitan area of Halifax County Regional Water Supply Study – Engineering and Financing" storage is required as follows:

Halifax: 5,000 IGPM

Dartmouth: 3,500 – 4,000 IGPM – use 4,000

Bedford/Sackville: 3,000 – 3,500 IGPM – use 3,500

That study did not consider the Bennery Lake/Airport System. Its fire demands are 5,000 IGPM.

From Insurance Advisory Organization, fire durations are:

5,000 IGPM = 5 hours

4,000 IGPM = 4.5 hours

3,500 IGPM = 3.5 hours

Calculation based on 16 tanks

Total volume = 243,183 M^3

Of the 16 tanks

5 are Halifax + Airport: 5,000 IGPM = 1,362 M^3/hr X 5hrs

5 X 1,362 X 5 = 34,050 M^3

3 are Dartmouth: 4,000 IGPM = 1,090 M^3/hr X 4.5hrs

3 X 1,090 X 4.5 = 14,715 M^3

8 elsewhere (Bedford/Sackville): 3,500 IGPM = 953 M^3/hr X 3.5hrs

8 X 953 X 3.5 = 26,684 M^3

Total Fire Storage (A) = 34,050 M^3

14,715 M^3

<u>26,684</u> M^3

75,449 M^3

B: Based on previous calculations:

Max Day = 1.27 X Avg Day

Avg Day = 33,198 + 78,736 + 535 M^3

= 112,469 M^3

Max Day = 1.27 X 112,469 M^3 = 142,836 M^3

Balancing storage (B) is 25% of Max Day

142,836 M^3 X 25% = 37,655 M^3

The 25% is based on the Atlantic Canada Guidelines for the Supply, Treatment, Storage, Distribution and Operation of Drinking Water Supply Systems.

C: Emergency storage:

This is system specific and there are no firm guidelines regarding the amount of storage designated as emergency or the treatment of back-up systems, of which Halifax Water has several. Given Halifax Water's System configuration, a reasonable metric of emergency storage is 24 hours at maximum day, which equals 142,836 M^3

S = A + B + C

A = Fire Storage 75,449 M^3 (29%)
B = Balancing Storage 37,655 M^3 (15%)
C = Emergency Storage 142,836 M^3 (56%)
S = 255,940 M^3

S is greater than the total tank volume in the system (243,183 M^3) so there is no dead storage. The calculation still serves as a sound basis for allocation.

Allocate as follows:

Fire Storage	=>	100% to Fire Protection
Balancing Storage	=>	100% to Peak Hour
Emergency Storage	=>	To Avg Day and Max Day in same proportion as Base extra capacity

Fire Protection	=30%
Max Hour	=14%
Avg Day = 0.91 X 56%	= 51%
Max Day = 0.09 X 56%	= 5%

Distribution:

Distribution system delivers max day and fire or peak hour.

According to "Water Supply for Public Fire Protection" by the Fire Underwriters Survey, for populations greater than 250,000 the system should be able to supply two simultaneous fires. Using data from the Storage section consider one fire of 5,000 IGPM and one of 4,000 IGPM

4,000 IGPM + 5,000 IGPM = 9,000 IGPM = 41,000 L/Min = 59,000 M^3/Day

Based on methodology on page 52 of M1

Avg Day for 2020/21	=	33,198 M^3 (Lake Major)
		78,736 M^3 (Pockwock)
		535 M^3 (Bennery)
		112,469 M^3

Maximum Day and Maximum Hour Factor are 1.27 and 1.70 respectively.

Maximum Day = 1.27 X 112,469 M^3 = 142,836 M^3

Maximum Hour = 1.7 X 112,469 M^3 = 191,197 M^3

Maximum Day plus Fire = 142,836 M^3 + 59,000 M^3 = 201,836 M^3

Fire Component 59,000 M^3/ 191,197 M^3 = 31%

Base Component (Avg Day) = (112,469 M^3 – 59,000 M^3)/ 191,197 M^3 = 28%

Maximum-Day Component = 142,836 M^3 – 112,469 M^3/ 191,197 M^3 = 16%

Maximum-Hour Component = 191,197 M^3 – 142,836 M^3/ 191,197 M^3 = 25%

Summary:

Water Treatment	Avg Day		= 91%
	Max Day		= 9%
Storage	Fire Protection	= 29%	
	Max Hour		= 14%
	Max Day		= 5%
	Avg Day		= 52%
Distribution	Avg Day		= 28%
	Max Day		= 16%

1249	Max Hour	= 25%
1250	Fire Protection	= 31%

Table 15

Public versus Private Fire Protection Cost Distribution

Calculation of % Split between Public and Private Fire Protection

(based on the diameter of the pipe)

Description	Diameter Inches	Diameter mm	Cross Sectional Area (square mm)	Ratio of Area to Reference (A)	Actual Number (B)	Total Equivalents (A) x (B)
Reference Size	1	25	490.87	1	0	0
Reference Size	2	50	1,963.49	4	16	64
Reference Size	3	75	4,417.86	9	0	0
Reference Size	4	100	7,853.98	16	82	1,312
Public Hydrants	6	150	17,671.44	36	8,476	305,136
Reference Size	6	150	17,671.44	36	1,161	41,796
Reference Size	8	200	31,415.90	64	775	49,600
Reference Size	10	250	49,087.34	100	156	15,600
Reference Size	12	300	70,685.78	144	16	2,304
					Total	**415,812**

Number of Equivalent Units			
	Public	305,136	**73%**
	Private	110,676	**27%**
		415,812	

SECTION 5 - WASTEWATER SYSTEM COST ALLOCATION

General Review

Wastewater costs as used in this COS Manual are costs for the provision of Wastewater Service after the allocation of a portion of the combined sewer costs to Stormwater Service. Wastewater System COS analyses employs a multi-step procedure to assign revenue responsibilities to Customer classes in proportion to their respective shares of billable flows, allocated responsibility for wet weather-related expenses, and uses of System facilities. Service characteristics typically include (1) flows – often separated as dry and wet weather flows (2) pollutant loadings by constituent – biochemical oxygen demand (BOD), total suspended solids (TSS) and (3) customer costs - often segregated into metering and billing related costs.

1) **Dry Weather costs** are those that vary with the total quantity flows or are those O&M expenses and capital costs incurred to deliver services under average demand conditions.

2) **Wet Weather costs** are associated with handling flows in excess of dry weather flow volumes and include O&M expenses and capital costs for system capacity beyond dry weather flow levels.

3) **Pollutant Loading by Constituent costs** are treatment costs associated with removal of specific pollutant loadings including BOD and TSS.

4) **Customer costs** comprise those costs associated with serving Customers, irrespective of the amount or rate of water use. They include meter reading, billing, and customer accounting and collecting expense, as well as maintenance and capital costs related to meters and services.

Appropriate classification factors between dry and wet weather flows should be calculated using actual operating history or design criteria. The basic formulas are as follows:

Dry Weather % = Dry Weather Flow / Total Flow

Wet Weather % = Wet Weather Flow / Total Flow

For classification of costs to pollutant strength loadings (as well as customer service characteristics), the design and performance of system facilities are referenced to apportion costs between different service parameters. In general, operational performance is referenced in classification of O&M expenses; design

parameters govern classifications of capital costs.

Wastewater System Data and Customer Use Data (for Cost Allocation)

A map of the Wastewater System is provided in the COS Manual Appendix II and general system information may be referenced from Halifax Water's Annual Report. Wastewater System plant influent data, similar to that provided in the example format below using Halifax Water data for the calendar year 2019, is used to develop cost classification percentages as outlined in Section 2 Methodology Review. Data for 2020 or 2021 was not used due to the continuing effects the COVID-19 pandemic on plant loadings.

Table 16

Wastewater Plant Influent

Development of Flow-Related Cost Classification Percentages

Wastewater Treatment Plant Loadings: January 1, 2019 - December 31, 2019							
WWTF	**Dry Weather Flow (m3)**	**Wet Weather Flow (m3)**	**Total Flow (m3)**	**Annual Average TSS Loading (kg/d)**	**Annual Average BOD Loading (kg/d)**	**% Dry Weather Flow (m3)**	**% Wet Weather Flow (m3)**
Halifax	28,474,141	4,315,150	32,789,291	14,578	14,985	87	13
Dartmouth	15,947,691	3,999,858	19,947,549	6,717	5,501	80	20
Herring Cove	3,129,113	876,656	4,005,769	1,191	660	78	22
Eastern Passage	4,329,168	1,019,014	5,348,182	2,680	2,884	81	19
Mill Cove	9,864,785	1,534,914	11,399,699	6,280	3,715	87	13
Lakeside/Timberlea	835,584	134,084	969,668	303	275	86	14
Lockview/MacPherson	49,116	8,522	57,638	29	40	85	15
North Preston	175,119	55,767	230,886	120	133	76	24
Springfield Lake	119,878	33,016	152,894	88	80	78	22
Middle Musquodoboit	30,716	7,421	38,137	22	20	81	19
Wellington	6,373	545	6,918	4	4	92	8
Frame	7,866	1,206	9,072	5	5	87	13
Uplands	23,325	13,523	36,848	21	19	63	37
Aerotech	295,707	34,212	329,918	335	211	90	10
Totals	**63,288,582**	**12,033,887**	**75,322,469**				

Data employed for assignment to Customer classes includes information on the distribution of meters by size serving the class, billable sewer flows, and measured or imputed pollutant strength loadings (*e.g.*, BOD, TSS) - often based on industry reference values in the absence of available sampling data. Provided in Table 17 below is an example format for presentation of these Customer class usage characteristics by class:

Table 17

Wastewater Accounts and Billed Usage by Meter Size (2020/21)		
Meter Size	**Accounts**	**Billed Usage**
Unmetered	956	166,354
5/8" (15 MM)	76,706	13,091,414
3/4" (20 MM)	1,006	511,842
1" (25 MM)	1,547	1,542,339
1.5" (40 MM)	1,158	2,493,467
2" (50 MM)	816	4,374,824
3" (80 MM)	310	3,468,068
4" (100 MM)	77	1,427,278
6" (150 MM)	35	1,992,164
8" (200 MM)	24	1,506,125
10" (250 MM)	2	35,171
Total	82,637	30,609,046
BOD Concentration		220 [1]
BOD Loading		
TSS Concentration		220 [1]
TSS Loading		

1 - These values are hypothetical and are shown as common across residential and non-residential classes as HRWC does not presently have data to adequately differentiate strength loading concentrations across customer types. In the event that strength differentiated customer class rates are subject to consideration, HRWC rate analysis modeling provides for conduct of a plant balance analysis to reconcile plant influent loadings and strength loading assignments by source (i.e.industrial waste monitored users, septic tank hauls, billed general customer classes, inflow and infiltration).

The development of strength differentiated Customer class rates could be considered by Halifax Water in the event that the resultant rate differentials would demonstrably and unambiguously advance the equitable distribution of cost responsibilities across Customer classes – the fundamental objective of COS

analysis. These criteria will require substantial evaluation of strength loading attributes of Customer class sub-populations, an assessment of high-strength cost recovery through Halifax Water industrial waste charges, and consideration of multi-use Non-Residential user billing protocols.

Rate analysis modeling referred to in Table 17 refers to Halifax Water's integrated collection of spreadsheets presented in the COS Manual that was developed to conduct COS rate analyses for Halifax Water using the proposed AWWA/WEF/NSUARB methodology. COS rate models have been developed for water, Wastewater and Stormwater rate setting – each of which provide formats for determination of rate revenue requirements, COS allocations, calculations of unit charges, development of resultant rate schedules and calculation of sample bill impacts.

A high-level plant balance analysis is provided in Halifax Water's rate application submission in Worksheet WW-1: User Characteristics and Plant Balance Analysis. This form of analysis is useful for ensuring that assigned strength loading attributes of individual customer classes result in overall values for influent strengths that are consistent with actual plant influent values such that user rates charged are based on actual system flow/loading characteristics. In the event that strength differentiated classifications were considered, assigned strength loading differences would need to maintain consistency with overall plant influent loading values to ensure resultant rates reflect true costs of service.

Wastewater System Functions

Utilities incur varying levels of costs to perform the different system functions needed to meet customer demands and make services available. The functionalization process involves categorizing revenue requirements according to functions in order to more appropriately assign costs to Customer classes. Wastewater System cost functions and their definitions for both operating and capital are presented in Table 18.

Table 18

Wastewater System Cost Allocation – System Functions

Wastewater System Function	Operating Costs Definition	Capital Cost Definition
Mains	Includes cost centres for sanitary mains and sanitary manholes.	Includes the design and construction costs associated with all gravity mains, forcemains/pressure sewers, and manholes.
Pump Stations	Includes cost centres for pump stations, forcemains and pressure sewers cost centres.	Includes all pumping, mechanical and electrical equipment, internal piping, buildings, and structures, forcemains pressure sewers including all associated valves and fittings.
Service Laterals	Includes the cost centres for wastewater services.	Includes connection to the main and the piping from the main to the street line for Wastewater Services.
Meters	Includes the cost centre for operation and maintenance of meters (labour, materials, and programs).	All capital expenditures for meters, including installation cost.
Advanced Primary Treatment	Includes cost centres for all the advanced primary treatment plants.	Includes all buildings, structures, mechanical and electrical equipment to make a complete, operating treatment plant.
Secondary Treatment	Includes cost centres for all the secondary treatment plants.	Includes all buildings, structures, mechanical and electrical equipment to make a complete, operating treatment plant.
Tertiary Treatment	Includes cost centres for all the tertiary treatment plants.	Includes all buildings, structures, mechanical and electrical equipment to make a complete, operating treatment plant.
Regulatory Services	Includes the Environmental Engineering, Regulatory Compliance, Stormwater Engineering, Environmental Management System and Development Approvals cost centres.	Cost centres within Regulatory Services function as operating cost centres. Any capital costs related to the provision of this service (equipment, buildings, intangibles etc.) are allocated as assets in proportion of the other costs through depreciation.
Engineering and Technology Services	Includes the cost centres for Records Management, Energy and Business Development, and Information Services.	Cost centres within Engineering and Technology Services function as operating cost centres. Any capital costs related to the provision of this service (equipment, buildings, intangibles etc.) are allocated as assets in proportion of the other costs through depreciation.
Technical Services (SCADA)	Operate the SCADA systems for water (both treatment and distribution).	Cost centres within Technical Services function as operating cost centres. Any capital costs related to the provision of this service (equipment, buildings, intangibles etc.) are allocated as assets in proportion of the other costs through depreciation.
Corporate Services	Includes the cost centres for Accounting, Finance and Procurement.	Cost centres within Corporate Services function as operating cost centres. Any capital costs related to the provision of this service (equipment, buildings, intangibles, etc.) are allocated as assets in proportion of the other costs through depreciation.
Customer Service	Includes the cost centres for Customer Care, Collecting, Supervision, and Administration/Overheads.	Cost centres within Customer Service function as operating cost centres. Any capital costs related to the provision of this service (equipment, buildings, intangibles etc.) are allocated as assets in proportion of the other costs through depreciation.
Meter Reading and Billing	Includes the cost centres for meter reading and Customer billing.	Cost centres with meter reading and billing function as operating cost centres. Any capital costs related to the provision of this service (equipment, buildings, intangibles etc.) are allocated as assets in proportion of the other costs through depreciation
Administration	Includes the cost centres for Administration, Communications, Legal, Human Resources, Employee Benefits and General.	Cost centres within Administration function as operating cost centres. Any capital costs related to the provision of this service (equipment, buildings, intangibles etc.) are allocated as assets in proportion of the other costs through depreciation

The engineers and operators responsible for operation of the Wastewater System review assignment of wastewater assets and their associated operating and maintenance costs to system functions. Operating costs centres are set up to record financial information in categories that support functionalization.

Forcemains and pressure sewers are typically connected to pump stations, have similar operating characteristics, and are maintained by the same operational staff. Costs are budgeted and recorded in a common cost centre. The costs associated with forcemains and pressure sewers are tracked under pump stations cost centres.

The capital costs associated with forcemains and pressure sewers are tracked under the pump stations cost centre for mains within the pump stations and outside the pump stations as force mains and pressure sewers. The only difference is the force mains and pressure sewers outside the pump stations which are recorded separately as capital assets due to the nature of capital asset accounting but included with the pump stations for operational cost accounting.

Cost Functionalization Considerations

The basis for the determination functions is the operating cost centres that comprise the Wastewater System from collection to discharge to the receiving environment. It includes the direct cost functions of providing the service as well as the common costs of providing support services across all utility services that are assigned to Wastewater Service. The following points are noted in regard to the cost functions:

- Mains include cost centres for sanitary mains and sanitary manholes of the collection system.
- Forcemains and pressure sewers, excluding Combined Sewer Overflows (CSOs) are included with pump stations for budgeting and reporting purposes. CSOs are a function of the Stormwater System, found in Section 6 of the COS Manual.
- Pump stations costs that are part of a Wastewater treatment facility are included with the treatment plant costs for budgeting and reporting purposes.

Functionalization of O&M expenses is shown in Worksheet WW-6 in Rate Studies, which is based on Table 18 as shown in this COS Manual. The percentages reported in Worksheet WW-6 are back-calculations, derived from actual dollar values included in the test-year operating expenditures. Functionalization is shown with both percentage allocation and actual dollar values. Generally, inputs in the dollar value report

drive back-calculations in the percentage report. Rounding on the percentage report would be expected compared to the dollar value report, since the dollar values are absolute and balance to revenue requirements.

- For Customer Service, input values (dollar costs) for the functions of meters and meter reading and billing are obtained from specific cost centres within Customer Service:

- Meters
  Operation and Maintenance of Meters

- Meter Reading and Billing
  Meter Reading
  Customer Billing

Once costs have been identified for the above functions, costs applicable to the Customer Service function is merely the residual amount.

Classification of Functional Costs

Following the distribution of Wastewater System revenue requirements to designated functions, costsare distributed to Wastewater System service characteristics. Following WEF procedures outlined above, these service characteristics include flow and pollutant loading metrics, and customer service attributes. Wastewater estimates include dry weather and wet weather estimates, pollutant loadings include BOD and TSS, and customer service attributes relate to the numbers of equivalent meters and accounts served. Classification of system costs (by function) distributes costs to the characteristics of service that distinguish Customer classes.

Halifax Water functionalized costs are classified to the following Wastewater Service characteristics:

Dry weather flow
Wet weather flow
BOD
TSS
Equivalent meters

Customer service

Indirect

General Assumptions for Cost Classification

The following cost classifications for annual operating cost and capital cost have been prepared for the three treatment systems used by Halifax Water, namely advanced primary treatment, secondary treatment and tertiary treatment.

The calculations and assignment of "contributors" to the annual operating budget were based on specific representative Wastewater treatment facilities currently in operation within Halifax Water, namely:

- Advanced primary treatment - Halifax WWTF (this facility was selected as it is the largest of the three advance primary treatment plants);
- Secondary treatment - Mill Cove WWTF (this facility was selected as it is the largest secondary treatment facility operated by Halifax Water); and
- Tertiary treatment - Fall River WWTF (this facility was selected as representative of the tertiary treatment plants operated by Halifax Water).

The calculations and assignment of "contributors" to capital costs were based on specific representative Wastewater treatment facilities currently in operation within Halifax Water, namely:

- Advanced primary treatment – The Halifax Wastewater Treatment Facility (WWTF) was selected as it is the largest of the three advance primary treatment plants;
- Secondary treatment – The Eastern Passage WWTF was selected as it was the most recent facility to be constructed; and
- Tertiary treatment – Aerotech was selected as it was completed in 2018, with costs adjusted to remove treatment of external flows and loads (lagoon, septage and external sludge dewatering).

Wet weather conditions were determined to exist 18% of the time based on the average from the three (3) Halifax Harbour Solution treatment plants.

O&M Cost Classifications

Functionalized Wastewater System costs are classified to service characteristics separately for O&M expenses and capital costs. O&M costs are classified as summarized in Table 19, explanations of which are provided in the subsequent notes. Supporting calculations are documented in the final section of the COS Manual section on Wastewater System Allocations.

Table 19

Wastewater System O&M Cost Classification Summary

O&M Cost Classifications								
Wastewater System Functions	Dry Weather Flow	Wet Weather Flow	BOD	TSS	Equivalent Meters	Customer Service	Indirect	Notes
Treatment								
Advanced Primary	30.9%	19.1%	25.0%	25.0%				1
Secondary	54.0%	16.0%	12.0%	18.0%				1
Tertiary	45.2%	12.8%	16.8%	25.2%				1
Collection								
Mains	95.0%	5.0%						2
Pump Stations	90.0%	10.0%						2
Service Laterals					100.0%			3
Technical Services (SCADA)	82.0%	18.0%						5
Customer Service						100.0%		6
Meters					100.0%			4
Meter Reading and Billing						100.0%		7
Engineering and Technology Services							100.0%	9
Regulatory Services							100.0%	8
Corporate Services							100.0%	11

Administration							100.0%	10

Capital Cost Classifications

Functionalized Wastewater System costs[15] are classified to service characteristics separately for O&M expenses and capital costs. Capital costs are classified as summarized in Table 20, explanations of which are provided in the subsequent notes. Supporting calculations are documented in the final section of the COS Manual section on Water System Allocations.

Table 20

Wastewater System Capital Cost Classification Summary

Capital Cost Classifications								
Wastewater System Functions	Dry Weather Flow	Wet Weather Flow	BOD	TSS	Equivalent Meters	Customer Service	Indirect	Notes
Treatment								
Advanced Primary	37.5%	12.5%	25.0%	25.0%				1
Secondary	29.0%	21.0%	25.0%	25.0%				1
Tertiary	25.0%	15.0%	30.0%	30.0%				1
Collection								
Mains	75.0%	25.0%						2
Pump Stations	75.0%	25.0%						2
Service Laterals					100.0%			3
Technical Services (SCADA)								5
Customer Service						100.0%		6
Meters					100.0%			4
Meter Reading and Billing						100.0%		7
Engineering and Technology Services (excluding TS)							100.0%	9

[15] The primary treatment category has not been included as the only primary treatment plant, Eastern Passage is in the process of being upgraded to secondary and will be completed when the rate structure from this COS Manual will be implemented.

Regulatory Services							100.0%	8
Corporate Services							100.0%	11
Administration							100.0%	10

Notes on Wastewater Cost Classification (O&M and Capital)

1. Treatment

Advanced Primary Treatment

Halifax Water did a review of the percentage of the costs for the four main contributors (chemicals, contract services, power and staffing) of the advanced primary treatment plant operation and used these percentages with the dry weather/wet weather flow information to calculate percentage of operating costs required for dry weather flow, wet weather flow, TSS removal and BOD removal as follows:

- Dry weather flow 30.9%
- Wet weather flow 19.1%
- TSS removal 25.0%
- BOD removal 25.0%

For assignment of capital costs Halifax Water used data from the Halifax WWTF to arrive at the following assignment.

- Dry weather flow 37.5%
- Wet weather flow 12.5%
- TSS removal 25.0%
- BOD removal 25.0%

Detailed calculations are included in the Wastewater System Appendix within Section 5.

Secondary Treatment

Halifax Water did a review of the percentage of the costs for the four main contributors (chemicals, contract services, power and staffing) of the secondary treatment plant operation and used these percentages with

the dry weather/wet weather flow information to calculate percentage of operating costs required for dry weather flow, wet weather flow, TSS removal and BOD removal as follows:

- Dry weather flow 54.0%
- Wet weather flow 16.0%
- TSS removal 18.0%
- BOD removal 12.0%

For assignment of capital costs Halifax Water used data from the Eastern Passage WWTF to arrive at the following assignment:

- Dry weather flow 29.0%
- Wet weather flow 21.0%
- TSS removal 25.0%
- BOD removal 25.0%

Detailed calculations are included in the Appendix to this section.

Tertiary Treatment

Halifax Water did a review of the percentage of the costs for the four main contributors (chemicals, contract services, power and staffing) of the tertiary treatment plant operation and used these percentages with the dry weather/wet weather flow information to calculate percentage of operating costs required for dry weather flow, wet weather flow, TSS removal and BOD removal as follows:

- Dry weather flow 45.2%
- Wet weather flow 12.8%
- TSS removal 25.2%
- BOD removal 16.8%

For assignment of capital costs Halifax Water used data prepared by Halifax Water staff to arrive at the following assignment

- Dry weather flow 25.0%

- Wet weather flow 15.0%
- TSS removal 30.0%
- BOD removal 30.0%

Detailed calculations are included in the Wastewater System Appendix within Section 5.

2. Mains and Pump Stations

To arrive at assignment of operating costs Halifax Water did a review of the rain data verses overflow events together with the duration of the selected pump stations. Typically, Halifax Water experiences overflows at specific locations whenever rain events exceed 25 mm. From this Halifax Water identified the number of staff hours required for selected events and compared this to the overall staff hours worked and determined the following.

Mains – 95% dry weather flow / 5% wet weather flow
Pump stations – 90% dry weather flow / 10% wet weather flow

Capital costs are assigned based on design flow that is calculated from Halifax Water's Design and Construction Standards. These formula result in the following:

Mains – 75% dry weather flow / 25% wet weather flow
Pump stations – 75% dry weather flow / 25% wet weather flow

3. Service Laterals

Assigned 100% to equivalent meters for both operating and capital as services are dedicated to Customers.

4. Meters

Meters are assigned 100% to equivalent meter for both operating and capital.

5. Technical Services (SCADA)

Assigned to the capital cost of the works and are included in the capital items.

Function	Number of Data Points Monitored	Allocation percentage
WW Treatment	24,356	45.0%
WW Collection	11,954	22.0%
SW CSOs	456	0.8%
Water Distribution	5,204	9.6%
Water Treatment	12,265	22.6%
District Energy*	TBD	TBD
Total	54,235	100.0%

*Allocation to DES will be established as the system is developed and is operational.

Operating costs are assigned based on the number of data points (tags) monitored in each activity. The result of this allocation is TS has been allocated based on the split between dry weather and wet weather flows (82% to dry and 18% to wet) based on the average flows for all Wastewater treatment facilities.

Table 21

Please note that Table 21 does not relate to the 82%/18% split. The table was included to demonstrate how much of the TS budget was allocated to Wastewater treatment, Wastewater collection, Stormwater CSOs, water distribution and water treatment. The reference to the 82%/18% is how the Wastewater items (treatment and collection) are further apportioned and assigned.

6. Customer Service

Assigned 100% to Customer Service for both operating and capital as these services are all customer related.

7. Meter Reading and Billing

Meter reading and billing costs are part of the Customer Service group of cost centres. They are assigned 100% to Customer Service as meters are totally dedicated to Customers.

8. Regulatory Services

For operating costs, and capital costs not assigned to specific assets, these costs are classified as indirect costs and are allocated in proportion to directly allocated costs.

9. Engineering and Technology Services

For operating costs, and capital costs not assigned to specific assets, these costs are classified as indirect costs and allocated in proportion to directly allocated costs.

10. Administration

For operating costs, and capital costs not assigned to specific assets, these costs are classified as indirect costs and allocated in proportion to directly allocated costs.

11. Corporate Services

For operating costs, and capital costs not assigned to specific assets, these costs are classified as indirect costs and allocated in proportion to directly allocated costs.

Allocation to Customers

Costs are distributed to Customers (either by classes or individually) based on similarities and differences in their Wastewater flow patterns, pollutant loadings, and types/sizes of service connections. For Halifax Water, given that Customer accounts are generally not distinguished by land use type facilitating strength-differentiation across Customer types, Customer classifications are effectively limited to residential, non-residential, and industrial waste Customers pending further evaluation of Customer classification options. This evaluation would require examination of Customers by land use type and use of industry reference data regarding strength characteristics of different Customer types.

Costs by service characteristic are simply divided by the projected level of service to be rendered to determine the unit costs of a given service parameter. For example, the system-wide cost per cubic meter of wet weather flow is calculated by taking the costs determined to handle weather flows divided by projected system wet weather flows (based on system flow factors). In this manner, costs are allocated to Customers in proportion to their respective demands and uses of the system. If Customer classifications are homogenized, unit costs by service characteristic may be combined to establish rates for service (typically where demand related costs convert to the volumetric rate).

This procedure is illustrated in Tables 22 and 23 that offer example templates for these types of calculations. As noted, the distribution of costs by function, and subsequent classification of these costs by service characteristic (*e.g.*, dry-weather and wet-weather flows, BOD and TSS strength loadings, equivalent meters and accounts) results in the expression of each component of the utility's revenue requirements in terms of these service characteristics. Accordingly, in Table 22, Lines 1, 4 and 7 are listed the outcomes of the cost classification by each major revenue requirement component. Because some of these costs are allocated on an indirect basis, a calculation is made whereby the indirect costs are distributed to directly classified costs based on those costs share of total directly classified costs. So, for example, if dry-weather flow related O&M costs represent 40% of directly classified O&M costs, 40% of indirect O&M costs are apportioned to dry-weather flow related costs. This is the procedure employed in Lines 2, 5 and 8 – to yield complete cost classifications by cost component (Lines 3, 6, and 9) – that are summed (Line 10) to present total costs by service characteristic.

Table 22

Wastewater System – Unit Costs of Service Calculation

Line	Revenue Requirement Component	Dry-Weather Flow Related Costs	Wet-Weather Flow Related Costs	BOD Related Costs	TSS Related Costs	Meter Equiv. Related Costs	Billing Related Costs	Indirect Costs
1	Operations & Maintenance	$$ (%)	$$ (%)	$$ (%)	$$ (%)	$$ (%)	$$ (%)	$$
2	Allocated Indirect O&M	$$	$$	$$	$$	$$	$$	
3	Operations & Maintenance (Net)	$$	$$	$$	$$	$$	$$	
4	Depreciation	$$ (%)	$$ (%)	$$ (%)	$$ (%)	$$ (%)	$$ (%)	$$
5	Allocated Indirect Depr	$$	$$	$$	$$	$$	$$	
6	Depreciation	$$	$$	$$	$$	$$	$$	
7	Return on Rate Base	$$ (%)	$$ (%)	$$ (%)	$$ (%)	$$ (%)	$$ (%)	$$

8	Allocated Indirect Return	$$	$$	$$	$$	$$	$$	
9	Return on Rate Base (Net)	$$	$$	$$	$$	$$	$$	
10	Total Revenue Requirements Lines (3,6,9)	$$	$$	$$	$$	$$	$$	

The allocation of costs to Customer classes employs the service characteristic by Customer class data developed in the "System and Customer Use Data (for Cost Allocation) – Table 23. Unit COS by characteristic (Line 3) are calculated by dividing total revenue requirements by service characteristic (Line 1) by total system flows, pollutant loadings (BOD, TSS), meter equivalents and accounts served (Line 2). Costs are then allocated to Customer classes simply by multiplying these unit costs by the flows, pollutant loadings, meter equivalents and accounts served for each Customer class. This is accomplished for Residential customers in Lines 4 and 5; for Non-Residential customers in Lines 7 and 8. The sum of Line 5 (across service characteristics) is therefore the fully allocated COS for the Residential class; the sum of Line 8 is that for the Non-Residential. COS based rates are those that recover these sums from respective Customer classes. While many rate designs may accomplish these ends, a basic rate design option is to recover volume-related costs; including dry- and wet-weather flow costs and pollutant loading related costs from volumetric rates while fixed charges (graduated by meter size) recover metering related costs and Customer account related costs. This rate design calculation is presented in the template example in Lines 6 and 9.

Table 23

Wastewater System – Allocation of Costs to Customer Classes and Uniform Volume with Fixed Charge Rate Calculations (System and Customer Use Data for Cost Allocation)

		1	2	3	4	5	6
Line	Revenue Requirement Component	Dry-Weather Flow Related Costs	Wet-Weather Flow Related Costs	BOD Related Costs	TSS Related Costs	Meter Equiv. Related Costs	Billing Related Costs
1	Total Revenue Requirements Lines (3,6,9)	$$	$$	$$	$$	$$	$$

2	Wet Weather Flow Allocation (%)	%		%	%	%	%
3	Wet Weather Flow Allocation	$$		$$	$$	$$	$$
4	Total Revenue Requirements Allocated to Billing Parameters (Row 1+3)	$$		$$	$$	$$	$$
5	Billable Flows & Loading						
6	Unit Cost of Service Characteristic						
7	Residential Flows & Loading						
8	Residential Cost of Service						
9	Residential Rates*						
10	Non-Residential Flows & Loadings						
11	Non-Residential Cost of Service						
12	Non-Residential Rates**						

- Residential rates (Line 9) featuring uniform volume rates and fixed charges may be calculated by first distributing wet weather-related costs to dry weather flow, equivalent meter and Customer related costs (as shown in Rows 2 and 3). The resulting unit costs by billing parameter are calculated by dividing the allocated revenue requirements (Line 4) by billable flows and loadings (Line 5) to determine unit costs of service by characteristic (Line 6). Residential costs of service (Line 8) are then calculated by multiplying the unit costs of service (Line 6) by the billable residential flows and loadings (Line 7). Residential rates are derived by summing Columns 1,3, and 4 of Line 8 and dividing by projected billable residential sewer flows (Line 7, Column 1) to determine the volumetric rate. The fixed charge is the sum of meter equivalent costs (Line 8, Column 5) divided by residential meter equivalents (Line 4, column 5) plus the billing and non-meter customer service costs (Line 8, Column 6) divided by residential accounts (line 7, column 6).
- Non-Residential volumetric rates (Line 12) are calculated using the same procedures where Line 10 is substituted for Line 7 and Line 11 is substituted for Line 8.
- Note – fixed charges for meter sizes with meter equivalencies greater than 1, the fixed charge is calculated by the unit cost per equivalent meter times the relevant meter unit equivalency plus the per account customer charge.

Wet weather-related costs are allocated to dry weather flow, equivalent meter, and customer – to determine unit costs by billing parameter. Wet weather, or Inflow and Infiltration (I&I) allocations have not changed since the first COS Manual and 2013 rate application as there have been no significant changes in the past two years that would support proposing a change to the allocation which the NSUARB had previously approved. The nature, amount, and causes of I&I have not changed.

I&I is allocated 10% to dry weather flow, 45% to the meter equivalent charge, and 45% to Customer connections. Halifax Water recommended this option based on the premise that some portion of the I&I

(10%) is related to flows in the system and should be recovered as a flow-related charge regardless of the number of Customers connected. The second allocation to the meter equivalent charge (45%) recognizes that larger diameter pipes increase the risk of leakage due the increased surface area of joints in larger pipes. The final allocation, 45% to Customer connections relates to leakage that is associated with the connections to the service pipe to Halifax Water's collection network and the potential for the Customer to discharge other flows from sump pumps and roof drains to the system.

Wastewater System Appendix: Supplemental Cost Classification and Allocation Calculations

Based on a review of data from several representative treatment plants updated to 2019, Halifax Water determined that, on average, the Wastewater treatment facilities are in wet weather conditions approximately 18% of the time. A review of flow data from a representative sample of the plants operated by Halifax Water including Halifax, Mill Cove, Fall River and North Preston was conducted in order to confirm this estimate, the criteria used was percentage of the flow that the respective facilities were above design average daily flow. The data is as follows:

- North Preston - 24%
- Fall River - 15%
- Mill Cove - 13%
- Halifax - 13%

The Fall River sewershed is very tight and not affected by I&I, the North Preston sewershed is the opposite and other sewersheds are also highly variable so a representative value of 15% was arrived at for these facilities.

Halifax Water used a sample operating cost of $5,000,000/ year for the purpose of this cost classification and for calculating the percentages for the three Wastewater treatment functions:

Advanced primary treatment

Secondary treatment

Tertiary treatment

1. Advanced Primary Treatment:

Assumed Annual Operating Cost - $5,000,000

Based on averages from the three (3) Halifax Harbour Solution plants, 82% of the time these facilities experience dry weather conditions, and 18% of the time wet weather conditions. If there was no impact to the operating budget that could be attributed to wet weather conditions, Halifax Water could assign 82% of the yearly operating budget to dry weather flows and 18% of the assumed annual operating cost for wet weather flows. However, there is an impact to the operating cost that can be directly attributed to wet weather flows, and this impact is based on an increase in power consumption, and an increase in chemical demand.

For the advanced primary treatment facilities, the four main contributors to the annual operating budgets, and the associated percentages of the overall budgets, assigned to each of these contributors are as follows:

1) Chemicals - 19%
2) Contract services - 35%
3) Power - 14%
4) Staffing and miscellaneous - 32%

For the advanced primary treatment facilities, considering these four contributors, only chemical addition (19%), power, pumping costs and UV disinfection costs, (14%), increase significantly during wet weather flows versus dry weather flows.

Contract services, which mainly consists of biosolids transportation and biosolids processing, is not impacted significantly by wet weather flow, and accounts for approximately 35% of the overall cost. Staffing and miscellaneous costs are not impacted significantly by wet weather flows and account for 32% of the overall budget.

Halifax Water calculated the amount of the assumed annual operating cost that would be assigned to power (14%) and chemicals (19%) would be: $5,000,000 x 33 % = $1,650,000.

If wet weather did not impact power and chemical consumption, Halifax Water would calculate that, $1,650,000 x 82% = $1,353,000 would be spent during dry weather and the remaining 18% (or $297,000) would be spent during wet weather. However wet weather does impact these contributors.

Based on wet weather flows being experienced 18% of the time, Halifax Water calculated $1,650,000 x 18% = $297,000 to be the amount spent from the operating budget to cover chemical and power costs during wet weather flow. Because these two components are impacted by wet weather an additional 18% has been added to this number to account for the extra power and chemicals consumed during wet weather periods ($297,000 + ($297,000 x 18%) = $350,460). Of this, 19/(19+14) X $350,460 = $201,780 is chemicals and 14/(19+14) X $350,460 = $148,680 is for power.

This increase ($350,460 - $297,000 = $53,460) must be subtracted from the dry weather portion of the annual budget assigned to chemicals and power. ($1,353,000 - $53,460 = $1,299,540).

The assumed annual operating cost ($5,000,000) excluding power and chemicals is ($5,000,000 - $1,650,000 = $ 3,350,000).

Based on an 82% dry weather versus 18% wet weather

Dry weather flow
$3,350,000 x 82% = $2,747,000
$2,747,000 + $1,299,540 = $4,046,540
Dry weather flow - $4,046,540/ $5,000,000 x 100% = 81%
Wet weather flow - 100% - 81% = 19%

Based on the above calculation 81% of yearly budget can be attributed to dry weather flow, and 19% of the overall budget can be attributed to wet weather flow. Of these two functions, the amount attributed to TSS and BOD removal must be allocated from these amounts based on the percentage of the budget attributed to TSS and BOD removal.

The two main contributors to costs for TSS and BOD removal are: chemicals (19%), and contract services (biosolids transportation and treatment) (35%). The costs for chemicals are expended both during dry weather and wet weather conditions. The level of BOD and TSS removal achieved during wet weather conditions is minimal in most instances. However, the additional chemicals and power used is accounted for where a deduction is made to the dry weather component**.** Contract services is primarily for transporting and treatment of biosolids produced during dry-weather.[16]

[16] Exhibit MCI-1 from Mr. Whalen's Direct Evidence 2013 general rate application

The amount spent for chemicals during dry weather is the total amount of $950,000 ($5,000,000 X 19%) less the $201,780 assigned to wet weather, or $748,220. This is added to the amount paid for contract services 100% of the $1,750,000 or ($5,000,000 X 35%) paid for Contract Services.

$748,220 + $1,750,000 = $2,498,220

$2,498,220/ $5,000,000 x 100% = 50%

For advanced primary treatment the cost for TSS and BOD removal are equal. Based on this Halifax Water will assign 25% for TSS removal and 25% for BOD removal.

The 81% of the assumed operating cost assigned to dry weather flow must be adjusted for the amount assigned to TSS and BOD removal with a corresponding adjustment in the wet weather flow percentage. The assigning of a portion of costs of BOD and TSS removal requires an adjustment to wet weather flow costs to account for the fact that BOD and TSS removal costs are all dry weather-related costs. If the adjustment was not made, then wet weather flow would be receiving a portion of the BOD and TSS removal costs.

81% / (81% – adjusted wet weather flow portion) = 25% / (adjusted wet weather flow portion).

The formula above lowers the portion of costs assigned to wet weather flow to account for the fact that BOD and TSS removal costs are dry weather flow costs based on the proportion of costs in the example related to the removal of TSS and BOD.

Therefore, adjusted wet weather flow portion = 19.1%

Conclusion:

- Dry weather flow accounts for 100% - (19.1% + 25.0% + 25.0%) = 30.9%
- Adjusted wet weather flow portion = 19.1% (from calculation above)
- TSS removal accounts for = 25.0% (see above)
- BOD removal accounts for = 25.0% see above)

2. Secondary Treatment:

Assumed annual operating cost **-** $5,000,000

Based on the Eastern Passage wastewater treatment facility, 81% of the time this facility experiences dry weather conditions, and 19% of the time wet weather conditions. The secondary treatment facility operating budget is not significantly impacted by wet weather flows versus dry weather flows (no additional Chemicals required, no additional pumping (power costs) on site, and no additional BOD or TSS loadings, etc.).

Therefore, the total assumed annual operating budget can be broken down based on 81% dry weather and 19% wet weather or $5,000,000 x 81% = $4,050,000 dry weather, and $5,000,000 x 19% = $ 950,000 wet weather.

For the secondary treatment facilities, the four contributors to the annual operating budgets, and the associated percentages of the overall budgets, assigned to each of these contributors are as follows:

1)	Chemicals	- 8%
2)	Contract services (biosolids costs)	- 27%
3)	Power	- 15%
4)	Staffing and miscellaneous	- 50%

Total power consumption for the plant accounts for 15% of the overall operating cost. Of this 15%, Halifax Water analysis attributes 54% of the power consumption (based on a review of the power consumption) for the equipment used for the treatment process. Additional equipment in the plant would relate to items such as heating and ventilation, air scrubbing, disinfection, etc.) to TSS and BOD removal, therefore Halifax Water assigns 8% (15% x 54% = 8%) to power consumption directly related to TSS and BOD removal.

For the secondary treatment process the main contributors from the operating costs for TSS and BOD removal are: biosolids costs (27%), power (8%), and heating fuel (Digester heating) (2%) = total 37% (These are percentages of total operating budget for secondary treatment.)

The calculated cost for TSS and BOD removal based on the dry weather flow portion of the total yearly operating cost as follows:

Cost of TSS and BOD removal - $4,050,000 X 37% = $1,498,500/year.

$1,498,500/$5,000,000 = 30% (of assumed annual operating cost)

For secondary treatment the amount for TSS removal and BOD removal are not equal because additional process equipment required for biological treatment (IE: secondary clarifiers, aeration basins, blowers etc., sludge pumps, etc.) is required. To account for this, the amount assigned for TSS removal and BOD removal has been changed from advanced primary at 50/50 split to a 60/40 split based on operator experience and professional judgment.

Therefore 30% X 60% = 18% is assigned to TSS removal, and 30% -18% = 12% to BOD removal.

The 81% of the assumed operating cost assigned to dry weather flow must be adjusted for the amount assigned to TSS and BOD removal with a corresponding adjustment to the wet weather flow percentage.

81% / (81% – adjusted wet flow portion) = 19% / (adjusted wet weather flow portion)

Therefore, the adjusted wet weather flow portion = 16%

Conclusion:

- Dry weather flow accounts for 100.0% - (18.0% + 12.0% + 16.0%) = 54.0%
- Wet weather flow accounts for 16.0% (from calculations above)
- TSS removal accounts for 18.0% (see above)
- BOD removal accounts for 12.0% (see above)

3. Tertiary Treatment:

Assumed annual operating cost **-** $3,000,000

85% of the time these facilities experience dry weather conditions, and 15% of the time wet weather conditions. The tertiary treatment facility operating budget is not significantly impacted by wet weather flows versus dry weather flows (no additional chemicals required, no additional pumping (power costs) on site, and no additional BOD or TSS loadings, etc.).

Therefore, the total assumed operating cost can be broken down based on 85% dry weather and 15% wet weather or $3,000,000 x 85% = $2,550,000 dry weather, and $3,000,000 x 15% = $450,000 wet weather.

For the tertiary treatment facilities, the four contributors to the annual operating budgets, and the associated percentages of the overall budgets, assigned to each of these contributors are as follows:

1) Chemicals - 11%
2) Contract services (Biosolids costs) - 33%
3) Power - 9%
4) Staffing and miscellaneous - 47%

Total power consumption for the plant accounts for 9% of the overall operating budget. Of this 9%, we can attribute 54% of the power consumption to TSS and BOD removal, therefore we can assign (9% x 54% = 5%) to power consumption directly related to TSS and BOD removal

For the tertiary treatment process the main contributors from the operating budgets for TSS and BOD removal are: biosolids costs (33%), power (5%), chemicals (11%) = total 49% (These are percentages of total operating budget).

The calculated cost for TSS and BOD removal based on the dry weather flow portion of the total yearly operating costs as follows:

Cost of TSS and BOD removal - $2,550,000 x 49% = $1,249,500/year.

$1,249,500/ $3,000,000 = 42% (of assumed annual operating budget)

For tertiary treatment the amount for TSS and BOD removal are not equal because additional process equipment (*i.e.*, secondary clarifiers, aeration basins, blowers, sludge pumping, filters, chemical feed systems, equalization etc.) are required. To account for this, we have adjusted the amount assigned for TSS removal and BOD removal from a 50/50 split to a 60/40 split.

Therefore 42% x 60% = 25.2% is assigned to TSS removal, and 42% - 25.2% = 16.8% BOD removal.

The 85 % of the assumed operating cost assigned to dry weather flow must be adjusted for the amount assigned to TSS and BOD removal with a corresponding adjustment in the wet weather flow percentage.

85% / (85% – adjusted wet flow portion) = 15% / (adjusted wet weather flow portion)

Therefore, the adjusted wet weather flow portion = 12.8%

Conclusion:

- Dry weather flow accounts for 100% - (12.8% + 16.8 + 25.2%) = 45.2%

- Wet weather flow accounts for 12.8% (from calculation above)
- TSS removal accounts for 25.2% (see above)
- BOD removal accounts for 16.8% (see above)

Notes on Wastewater Capital Cost Classification

1. Based on a review of data from several representative treatment plants, Halifax Water determined that, on average, the Wastewater treatment facilities are in wet weather conditions approximately 18% of the time. A review of flow data from a representative sample of the plants operated by Halifax Water including Halifax, Mill Cove, Fall River and North Preston was conducted in order to confirm this estimate, the criteria used was percentage of the flow that the respective facilities were above design average daily flow. The data is as follows:

- North Preston - 24%
- Fall River - 15%
- Mill Cove - 13%
- Halifax - 13%

The Fall River sewershed is very tight and not affected by I&I, the North Preston sewershed is the opposite, other sewersheds are also highly variable so an average value of 15% was arrived at for these facilities.

2. Mains are designed based on a design flow that is calculated from an established formula in Halifax Water's Design and Construction Standards. The formulas were revised in 2012 and will result in a ratio of 75% dry weather flow and 25% wet weather flow for an average size and density development which will be used in the COS allocation. The calculation of the 75% is derived from the Design and Construction Standards and is shown below.

The flow Q, in the Wastewater sewer system used for pipe sizing shall be as follows:

$$Q = [\text{dry weather}] + \text{wet weather (I/I)}$$

$$Q = [\,[1.25 \times (a \times M)] + (b \times \text{area})]/\,86.4$$

where:

1.25 is a safety factor;

M is Harmon Peaking Factor

a is identified here as the average dry weather flow. The allowance is 0.30 m^3 per person per day for residential development;

b is the future degradation of pipe long-term I/I allowance. The allowance is 24 m^3 per gross hectare/day;

Using the formula above and assuming a 1% slope on the pipes, the dry weather and wet weather components of the pipe capacity were determined.

Table 1 illustrates the dry weather versus wet weather flows for a development density of 45 people/ha (ppha). Typical greenfield development is 45 ppha, and constitutes 17% of non-infill development.

Table 1

Pipe Diameter (mm)	Dry Weather (m3/day)	Wet Weather (m3/day)	Total (m3/day)	Dry Weather %
250	3710	1428	5138	72
300	5933	2422	8355	71
350	8800	3803	12603	70
400	12350	5642	17993	69
450	16624	8009	24633	67
Average				**70**

Using the above methodology, the dry weather flows were determined for other development densities and the relative percentages are shown in Table 2:

Table 2

Pipe Diameter (mm)	60 ppha (14% of non-infill Development)	100 ppha (9% of non-infill Development)	200 ppha (5% of non-infill Development)
250	77%	85%	92%
300	76%	84%	91%
350	75%	83%	91%
400	74%	82%	90%
450	73%	82%	90%
Average	**75%**	**83%**	**91%**

Using the relative percentage of each density, the weighted average of dry weather flow is 77%, for rounding purposes, Halifax Water used 75%.

3. **Pump stations** are allocated similar to mains resulting in an allocation to dry weather of 75% and to wet weather is 25%.

4. Advanced Primary Treatment

Wastewater treatment plants are designed for dry weather flow based on plant loadings and are hydraulically sized for wet weather flow. In the case of the three Halifax Harbour Solution plants that are advanced primary they were designed to handle four times dry weather flow based on regulatory approval. The plants treat the flow up to four times the dry weather flow with the flow in excess of that being directed to the overflow at the treatment plant or to one of several Combined Sewer Overflows (CSO) located throughout the collection system. The plants are designed on a design criteria three-times average dry weather flow to account for daily peaks during dry weather conditions and four-times average day for wet weather flow based on regulatory requirements. Based on that ratio, 75 % of design flow is related to dry weather flow and 25% to wet weather flow. BOD and TSS are all related to dry weather flow as there is no addition treatment provided for BOD and TSS removal during wet weather flows. Therefore, the allocation to BOD and TSS are allocated from the dry weather flow component.

A review of the capital costs for the Harbour Solutions Plants indicates that approximately 66% of capital costs are related to the treatment process. Applying the 66% to the 75% allocated to dry weather flow indicates that approximately 50% of capital costs should be allocated to BOD and TSS and would be deducted from the dry weather flow portion. The 50% is allocated equally between BOD and TSS thus providing an allocation for advanced primary treatment is as follows:

Dry weather flow	= 37.5% (50%*75%)
Wet weather flow	= 12.5% (50%*25)
BOD	= 25.0% (66%*75%)/2
TSS	= 25.0% (66%*75%)/2

As previously noted, BOD and TSS are all related to dry weather flow. There is no additional BOD and TSS removal during wet weather flows.

5. Secondary Treatment

The Eastern Passage WWTF was designed based on a regulatory approval for a dry weather flow of 25,000 m^3 per day with a peak daily flow of 75,000 m^3 per day and a bypass flow with screening and grit removal of 120,000 m^3 per day. Using an estimated peak of 2.5 times dry weather flow would result in an estimated peak daily flow of 62,500 (2.5 x 25,000). The estimated peak daily flow would then yield an

allocation of 83% for dry weather flow (62,500/75,000) and 17% to wet weather flow. This amount was adjusted by 4% to recognize the wet weather flow bypass that is being built into the plant to handle wet weather flows. This amount was transferred from dry weather flow to wet weather flow to allow for the cost of the head works. Therefore, the adjusted allocation was dry weather flow = 79% (83%-4%) and wet weather flow = 21% (17%+4%).

The contract cost of the treatment portion of the Eastern Passage Treatment Plant was determined to be $33 M of the total construction cost of $52 M or 63% (33/52). This relates to the allocation of BOD and TSS and all relates to dry weather flow. Therefore 63% of the total cost allocated to dry weather flow (79%) is allocated to BOD and TSS (63% X 79%) = 50%. The 50% are equally allocated to BOD and TSS and therefore the revised allocations for Secondary Treatment are:

Dry weather flow	= 29%
Wet weather flow	= 21%
BOD	= 25%
TSS	= 25%

As previously noted, BOD and TSS are all related to dry weather flow. There is no additional BOD and TSS removal during wet weather flows.

6. Tertiary Treatment:

The Aerotech WWTF was designed based on a regulatory approval for a dry weather flow of 3,000 m^3 per day with a peak daily flow of 6,000 m^3 per day. The contract cost of the treatment portion of the facility was determined to be $16 M of the total construction cost of $24 M or 67% (16/24). This relates to the allocation of BOD and TSS and all relates to dry weather flow. Therefore 67% of the total cost allocated to dry weather flow (90%) is allocated to BOD and TSS (67% X 90%) = 60%. The 60% is equally allocated to BOD and TSS and therefore the revised allocations for tertiary treatment are:

Dry weather flow	= 25%
Wet weather flow	= 15%
BOD	= 30%
TSS	= 30%

As previously noted, BOD and TSS are all related to dry weather flow. There is no additional BOD and TSS removal during wet weather flows.

SECTION 6 - STORMWATER SYSTEM COST ALLOCATION

General Review

Pursuant to the 2007 Transfer Agreement with HRM, Halifax Water owns municipal stormwater systems in municipal HRM streets and roads and off-street drainage easements located within the Stormwater Boundary as defined in the Transfer Agreement. There are other stormwater systems within the Stormwater Boundary that are not owned by Halifax Water, including systems owned by the Province of Nova Scotia, bridges owned by HRM, and stormwater systems owned by private property owners, including Canadian National Railways, the Department of National Defense and others.

The operation of the Water and the Wastewater Systems are financed from revenues based on water consumption. This methodology clearly would not be representative of the amount of stormwater discharged from properties and managed by Halifax Water-owned infrastructure. Halifax Water is financing its Stormwater System by implementing new cost of service-based rates.

Stormwater is defined within the Halifax Water Regulations as "water from precipitation of all kinds, and includes water from the melting of snow and ice, groundwater discharge and surface water". Halifax Water's Stormwater Charge is comprised of two parts - a Right-of-Way Charge and a Site Related Flow Charge both on the basis of Impervious Area measures. Impervious Area is defined within the Halifax Water Regulations as "an area or surface which prevents or limits the entrance or passage of stormwater, including asphalt, concrete, bricks, roofs and gravel surfaces if they are hard packed, and all which are denoted as impervious by the satellite imagery utilized by the Commission in that determination". Impervious surfaces generate a much higher rate and volume of stormwater runoff than do pervious surfaces. While some municipalities and utilities impose stormwater charges based upon both impervious and pervious surfaces, doing so is substantially more complex and costly from an administrative perspective. Accordingly, Halifax Water will charge stormwater rates on the basis of Impervious Area associated with street right-of-way and individual parcels.

Halifax Water is responsible for the Stormwater Systems located in and associated with all HRM streets within the Stormwater Service Boundary. All owners and users of properties located within the Stormwater Service Boundary benefit from Halifax Water's Stormwater System through their ability to access their property using HRM streets which are drained by Halifax Water's Stormwater System. Stormwater

management within the street network helps enable safe transportation of people and goods, and provision of services. Most of the properties within the Stormwater Service Boundary receive one or both of the following services from Halifax Water:

- Processing and/or management of any amount of Stormwater from the property entering into Halifax Water's Stormwater System.
- The property is accessed directly by a driveway which crosses over a Halifax Water owned and maintained culvert within the road right-of-way.

To allow for some recognition of differentiation of the service provided, the rate is divided into two parts; one for street right-of-way related flows; and one for site related flows.

"Site Related Flow Charge" refers to the charge for the services and benefits the customer is receiving including, access to a property over a Halifax Water owned culvert, and management of stormwater, of any amount, from a property that enters any part of Halifax Water's Stormwater System.

"Right-of-Way Charge" refers to the charge to HRM for the Impervious Area in the street right-of-way.

In the first COS Manual and associated Stormwater rate application, Halifax Water proposed that all Stormwater Customers pay the right-of-way charge based on the Impervious Area of their property regardless of where they discharge their Stormwater. In doing so, this rate would recover revenues based on the respective benefit provided by Stormwater management in the rights-of-way. The NSUARB decision[17] determined that HRM as the owner of the streets receives the benefit of the service and must pay for the cost that it imposes for Halifax Water's services, like any other Customer.[18]

Halifax Water uses the provincial property tax authority administered by Property Valuation Services Corporation's (PVSC) assessment data to determine if a property should be billed as Residential or Non-Residential. PVSC identifies every property using an assessment number (AAN). PVSC regularly reviews property use and assesses which category properties fit into, such as residential, commercial, resource or a

[17] M05463 2013 NSUARB 127

[18] Feb. 2014 HRM Council passed a motion imposing a per lot charge of $39 per property for properties receiving Halifax Water's Site Related Flow Charge and asked Halifax Water to collect it on HRM's behalf. In June 2015 Halifax Council passed a motion to bill a $41 per property charge to all taxable properties within the Stormwater Service Boundary effective April 1, 2016 (replacing the $39 charge currently billed by Halifax Water on behalf of Halifax). Effective July 1, 2018, the charge is $40 per year.

combination of commercial and residential and/or resource (mixed use). In addition, Halifax Water uses HRM's building use data, which provides the number of dwelling units in a building.

A property is identified as Residential for Stormwater purposes if it meets any of the following criteria:

- Any property that has been assessed by PVSC as residential only and has three or less dwelling units.
- Any property that has been assessed by PVSC with a combination of residential and resource and has three or less dwelling units.

A property is identified as Non-Residential for Stormwater purposes if it meets any of the following criteria:

- Any property that has any commercial assessed value by PVSC.
- Any property considered as mixed use (having commercial assessment along with residential and/or resource assessment).
- Any property having more than three dwelling units.
- Any property having more than three residential assessments associated with it.
- Any property having a multi-residential, institutional, commercial and/or industrial (MICI)use.

Any property categorized by Halifax Water as unknown or resource is not billed for Stormwater services.

Residential properties shall pay a Site Related Flow Charge based on the tier amount of Impervious Area in which the property falls. If part of a property is located outside Halifax Water's Stormwater Service Boundary, the Impervious Area located outside the Boundary is not used in determining the tier amount of the Impervious Area. However, if part of the property is located outside the Stormwater Catchment Boundary, the entire Impervious Area of the property is used in determining the relevant tier. As Residential properties are generally smaller and are not charged on the basis of the actual Impervious Area, billing on the basis of an average or a tier, based upon "Equivalent Residential Units" (ERUs) provides sufficient equity in cost effective manner.

Non-Residential customers pay the Site Related Flow Charge based on site specific measurement of the Impervious Area. Non-Residential customers include MICI properties. If part of a property is located outside Halifax Water's Stormwater Service Boundary and/or the Stormwater Catchment Boundary, that part of the property located outside either Boundary is exempt from the charge. As Non-Residential Customers are

billed on the basis of actual Impervious Area and the properties in question are often large, this mechanism enhances equity.

System Data (for Allocation of Costs to Customers)

In 2012 and 2014, Halifax Water retained the services of EXELIS-VIS (formerly ITT) to provide satellite imagery for the stormwater billing project, including delineation of impervious surfaces on lands within the Stormwater Service Boundary. The impervious areas delineated using the imagery were used as the basis for developing the rates for both the Right-of-Way Charge and the Site Related Flow Charge in past rate applications. Updated high-resolution satellite imagery was acquired in May 2020 from Maxar, with the imagery processed/classified by Applied Geomatics Research Group (AGRG). This updated satellite imagery is currently being used for billing purposes and Right-of-Way and Site Related Flow Charges in the rate application.

Stormwater System Functions

Utilities incur varying levels of costs to perform the different system functions needed to adequately manage stormwater flows to keep street rights-of-way accessible and mitigate impacts of flood waters. The functionalization process involves categorizing revenue requirements according to functions to assign costs more appropriately to individual served parcels. Stormwater System cost functions and their definitions for both operating and capital are presented in Table 24.

1936 Table 24

Stormwater System Function	Operating Costs Definition	Capital Cost Definition
Pipes, Manholes and Retention Ponds	Includes the cost centres for stormwater pipes, manholes and retention ponds.	Includes the design and construction costs associate with all gravity mains, manholes and retention ponds.
Combined Sewer Overflows	Includes all costs associated with maintaining the combined sewer overflows.	Includes the design and construction costs associated with all combined sewer overflows.
Ditches and Culverts	Includes the cost centre for ditches and culverts.	Includes the design and construction costs associated with all ditches and culverts.
Catchbasins	Includes the cost centre for catchbasins.	Includes the design and construction costs associated with all catchbasins.
Regulatory Services	Includes the Environmental Engineering, Regulatory Compliance, Stormwater Engineering, Environmental Management System and Development Approvals cost centres.	Cost centres within Regulatory Services function as operating cost centres. Any capital costs related to the provision of this service (equipment, buildings, intangibles etc.) are allocated as assets in proportion of the other costs through depreciation.
Engineering and Technology Services	Includes the cost centres for Records Management; Energy and Business Development, Engineering Information, Information Services.	Cost centres within Engineering and Technology Services function as operating cost centres. Any capital costs related to the provision of this service (equipment, buildings, intangibles etc.) are allocated as assets in proportion of the other costs through depreciation.
Technical Services (SCADA)	Operate the SCADA systems for water and wastewater (both treatment and distribution)	Cost centres within Technical Services (SCADA) function as operating cost centres. Any capital costs related to the provision of this service (equipment, buildings, intangibles etc.) are allocated as assets in proportion of other costs through depreciation.
Corporate Services	Includes the cost centres for Accounting, Finance and Procurement.	Cost centres within Corporate Services function as operating cost centres. Any capital costs related to the provision of this service (equipment, buildings, intangibles, etc.) are allocated as assets in proportion of the other costs through depreciation.
Customer Service	Includes the cost centres for Customer Care and Collecting.	Cost centres within Customer Service function as operating cost centres. Any capital costs related to the provision of this service (equipment, buildings, intangibles etc.) are allocated as assets in proportion of the other costs through depreciation.

Administration	Includes the cost centres for Administration, Communications, Legal, Human Resources, Employee Benefits, and General.	Cost centres with Administration function as operating cost centres. Any capital costs related to the provision of this service (equipment, buildings, intangibles etc.) are allocated as assets in proportion of the other costs through depreciation.

Stormwater System Cost Allocation – System Functions

Cost Functionalization Considerations

The engineers and superintendents, responsible for the Stormwater System review assignment of Stormwater assets and their associated operating and maintenance costs to System functions. Operating costs centres are set up to record financial information in categories that support functionalization.

The basis for the determination of functions is the operating cost centres that comprise the Stormwater Service from collection to discharge to the receiving environment. It includes the direct cost functions of providing the service as well as the common costs of providing support services across all utility Services that are assigned to Stormwater Service. The following point is noted in regard to the cost functions:

Retention ponds are budgeted and reported with pipes as the maintenance costs have historically been minimal. These are combined with pipes and manholes for COS reporting.

Functionalization of O&M expenses are shown in Worksheet SW-6 in Rate Studies, which is based on Table 24 as shown in this COS Manual. The percentages reported in Worksheet SW-6 are calculated based on actual dollar values included in the test year operating expenditures. Functionalization is shown with both percentage allocation and actual dollar values. Generally, inputs in the dollar value report are used to calculate in the percentages used in the report. Rounding on the percentage report would be expected compared to the dollar value report, since the dollar values are absolute and balance to revenue requirements.

Classification of Functional Costs

Following the distribution of Stormwater System revenue requirements to designated functions, costs are distributed to Stormwater System service characteristics. Following WEF procedures outlined above for Wastewater Service applied in the Stormwater Service context, these service characteristics include flows from street rights-of-way and individual parcels and customer service attributes. Classification of system costs (by function) distributes costs to the characteristics of service that distinguish customer classes.

Halifax Water functionalized costs are classified to the following stormwater service characteristics:

- Street right-of-way flow
- Site related flow
- Customer Service
- Indirect

O&M Cost Classification

Functionalized Stormwater System costs are classified to service characteristics separately for O&M expenses and capital costs. O&M costs are classified as summarized in Table 25, explanations of which are provided in the subsequent notes. Supporting calculations are documented in the final section of the COS Manual section on Wastewater System Allocations.

Table 25

Stormwater System O&M Cost Classification Summary [19]

Stormwater System Functions	Street Right-of-Way Flow	Site Related Flow	Customer Service	Indirect	Notes
Pipes, Manholes and Retention Ponds	33.6%	66.4%			2
Combined Sewer Overflows	33.6%	66.4%			3
Ditches and Culverts	33.6%	66.4%			4
Catchbasins	100.0%				5
Technical Services (SCADA)	33.6%	66.4%			6
Customer Service (less Metering Costs			100.0%		7
Regulatory Services				100.0%	8
Engineering and Technology Services (excluding Technical Services (SCADA))				100.0%	8
Corporate Services				100.0%	8
Administration				100.0%	8

[19] The cost and reduction in revenues associated with the implementation of a credit program would be added to revenue requirements and allocated 100% to site related flow.

Notes on Stormwater O&M Cost Classification

1) Updated high-resolution satellite imagery was acquired in May 2020 from Maxar, with the imagery processed/classified by AGRG. This updated satellite imagery resulted in a further refinement of the billable Impervious Area as follows:

   Street Right-of-Way Area = 33.6%

   Impervious Area of Developed Lots = 66.4%

2) Pipes, manholes and retention ponds are allocated 29% to street right-of-way and 71% to site related flow. This allocation reflects the source of the Stormwater to be directed to the pipes, manholes and retention ponds.

3) Combined Sewer Overflows are allocated 29% to street right-of-way and 71% to site related flow. This allocation reflects the source of the Stormwater to be directed to the combined sewer overflows.

4) Ditches and Culverts are allocated 29% to street right-of-way and 71% to site related flow. This allocation reflects the source of the Stormwater to be directed to the ditches and culverts.

5) Catchbasins are allocated 100% to street right-of-way. This allocation reflects the fact that catchbasins are generally designed with an inlet capacity that matches the flow generated in the street.

6) Technical Services (SCADA) operating costs are allocated based on the number of data points (tags) monitored in each activity. The result of the allocation is summarized in Table 26.

Table 26

Function	No. of Data Points Monitored	Allocation percentage
WW Treatment	24,356	45.0%
WW Collection	11,954	22.0%
SW CSOs	456	0.8%
Water Distribution	5,204	9.6%
Water Treatment	12,265	22.6%
District Energy*		
Total	54,235	100.0%

*Allocation to DES will be established as the system is developed and is operational.

Technical Services has been allocated 29% to street right-of-way and 71% to site related flow.

7) Customer Service less metering costs is allocated 100% to Customer Service as these services are all Customer related.
8) Regulatory Services, Engineering and Technology Services, Corporate Services and Administration are allocated to indirect costs which are allocated in proportion to direct costs.

Capital Cost Classification

Functionalized Stormwater System costs are classified to service characteristics separately for O&M expenses and capital costs. Capital costs are classified as summarized in Table 27, explanations of which are provided in the subsequent notes. Supporting calculations can be found in the final section of the COS Manual section on Stormwater System Allocations in Table 27.

Stormwater System Capital Cost Classification Summary

Stormwater System Functions	Right-of-Way Flow	Site Related Flow	Customer Service	Indirect	Notes
Pipes, Manholes and Retention Ponds	33.6%	66.4%			2
Combined Sewer Overflows	33.6%	66.4%			3
Ditches and Culverts	33.6%	66.4%			4
Catchbasins	100.0%				5
Technical Services (SCADA)					6
Customer Service (less Metering Costs			100.0%		7
Regulatory Services					8
Engineering and Technology Services (excluding Technical Services (SCADA))				100.0%	9
Corporate Services				100.0%	10
Administration				100.0%	10

Notes on Stormwater Capital Cost Classification

1) The street right-of-way flow and the site related flow percentages has been developed based on the measured Impervious Area of each as prepared for Halifax Water from satellite imagery for

billing purposes. Updated high-resolution satellite imagery was acquired in May 2020 from Maxar, with the imagery processed/classified by AGRG. This updated satellite imagery resulted in a further refinement of the billable Impervious Area as follows:

Street Right-of-Way Area = 29%

Impervious Area of Developed Lots = 71%

2) Pipes, manholes and retention ponds allocated 29% to street right-of-way and 71% to site related flow. This allocation reflects the source of the Stormwater to be directed to the pipes, manholes and retention ponds.
3) Combined Sewer Overflows are allocated 29% to street right-of-way and 71% to site related flow. This allocation reflects the source of the Stormwater to be directed to the combined sewer overflows.
4) Ditches and culverts allocated 29% to street right-of-way and 71% to site related flow. This allocation reflects the source of the Stormwater to be directed to the ditches and culverts.
5) Catchbasins allocated 100% to street right-of-way. This allocation reflects that catchbasins are generally designed with an inlet capacity that matches the flow generated in the street.
6) Technical Services (SCADA) are charged directly to capital cost based on work performed. There is no separate allocation for capital for this item.
7) Customer Service is allocated 100% to Customer Service.
8) Regulatory Services are charged directly to capital cost based on worked performed. There is no separate allocation for capital for this item.
9) Engineering and Technology Services (excluding Technical Services (SCADA)) are charged to capital cost based on work performed. Other costs such as databases and other intangibles are allocated to indirect costs.
10) Corporate Services and Administration are allocated to indirect costs that are allocated in proportion to direct costs.

Allocation to Parcel Owners (Customers)

The Stormwater Charge proposed by Halifax Water is comprised of two parts - a Site Related Flow Charge, and a Right-of-Way Charge.

- Halifax Water's Site Related Flow Charge is a charge for the services and benefits the Customer is receiving including access to a property over a Halifax Water owned culvert, and management of Stormwater from a property that enters any part of Halifax Water's Stormwater System.
- The Right-of-Way Charge has been developed using the Impervious Area associated with all the municipal streets within the Stormwater Service Boundary. Per the NSUARB's 2013 rate application decision, the Right-of-Way Charge is billed to HRM who then determine how it is collected from residents. This procedure is illustrated in Table 28 that offers an example template for these types of calculations. As noted, the distribution of costs by function, and subsequent classification of these costs by service characteristic (*e.g.*, site related and right-of-way flows, and customer service related and indirect costs) results in the expression of each component of the utility's revenue requirements in terms of these service characteristics. Accordingly, in Table 28, Lines 1-3 list the outcomes of the cost classification by each major revenue requirement component. Because some of these costs are allocated on an indirect basis, calculations are made to distribute these costs to directly classify site related and right-of-way flow related costs based on those costs' share of total directly classified costs (for indirect costs) and the number of parcels billed (for Customer account related costs). So, for example, if site related flow costs represent 55% of directly classified costs, 55% of indirect costs are apportioned to site related flow costs. This is the procedure employed in Lines 1, 2 and 3 to yield complete cost classifications by cost component (Line 4) – that are summed (Line 5) to present total cost by service characteristic.

Table 28

Line	Revenue Requirement Component	Street Right-of-Way Flow Related Costs	Site Related Flow Related Costs	Customer Service Related Costs	Indirect Costs
1	Operations and Maintenance	$$ (%)	$$ (%)	$$	$$
2	Depreciation	$$ (%)	$$ (%)	$$	$$
3	Return on Rate Based	$$ (%)	$$ (%)	$$	$$
4	Allocated Customer Service and Indirect Costs*	$$$	$$$		
5	Total Cost-of-Service by Service Type	$$$	$$$		
6	Billable Impervious Area	XXX	XXX		

7	Charges per Unit	$$	$$	
8	Assigned Residential Tiers based on Square Metre / Lot	XX	XX	
9	Residential Parcel Bills			

- Indirect Costs in the column to the far right are distributed to site related and right-of-way flow related costs in proportion to their respective shares of directly allocated costs (exclusive of Customer Service-related costs). Customer Service-related costs are distributed to site related and right-of-way flow related costs in proportion to the respective numbers of parcels billed.

The respective rate calculations are then simply these costs (Line 5) divided by the amount of billable Impervious Area associated with site related or right-of-way flows (Line 6) to determine the charges per unit (Line 7). Residential bills are then determined based on a tier. The tiered rate structure is based upon an Equivalent Residential Unit, or "ERU". This concept is very similar to how "Equivalent Metres" are used in water and wastewater cost of service. The ERU is established based on the average residential impervious area and is calculated based on the Impervious Area associated with Residential Properties divided by the number of residential parcels. The tiers are based on the ERU, and the threshold limits established in a similar manner to those adopted by other entities. The example below shows tiers based on an ERU of 200 m^2 as the representative median value for the typical Residential Property or the ERU.

Table 29

Tier	From	To
1	0	50 m^2
2	50 m^2	200 m^2
3	210 m^2	400 m^2
4	410 m^2	800 m^2
5	810 m^2	Or greater

Properties with Impervious Area falling within a tier are billed the assigned charge for that tier, with Customers billed based on Impervious Area rounded to the nearest 10 m^2.

The revenue requirement per ERU or standard median charge billing unit is the total revenue requirement allocated to site related flow, divided by the total ERUs for the System, both Residential and Non-Residential Properties. ERUs for Residential Properties are those as described above using the tiered methodology, whereby the number of properties in each tier are assigned an equivalency factor as outlined in Table 30, which is then multiplied by the ERU to determine total ERUs for Residential

Properties. Non-Residential Properties ERUs are calculated by dividing the total Impervious Area for Residential and Non-Residential Properties divided by the median Impervious Area ERU of 200 m^2.

Table 30

Line	Tier	Equivalent Residential Unit "ERU"	Revenue Requirement (RR) per ERU	Rate Adjustment	Tier Rate	Standard Annual Charge
1	1	X m^2	$X per m^2	0%	RR per ERU X Rate Adjustment	$0X
2	2	X m^2	$X per m^2	50%	RR per ERU X Rate Adjustment	$.5X
3	3	X m^2	$X per m^2	100%	RR per ERU X Rate Adjustment	$1X
4	4	X m^2	$X per m^2	200%	RR per ERU X Rate Adjustment	$2X
5	5	X m^2	$X per m^2	300%	RR per ERU X Rate Adjustment	$3X

The standard median charge, when divided by the ERU determines the billing rate per ERU. For Non-Residential Properties this billing rate becomes the rate charged per square meter of billable Impervious Area. For Residential Properties this billing rate, multiplied by the ERU, multiplied by the rate adjustment associated with each individual tier within the Residential grouping, determines the annual charge for properties falling within each respective tier.

Stormwater Service Delivery Via Ditches

The Stormwater Service area is a mixture of urban, suburban, and rural properties. The primary service objective of a Stormwater System is to manage Stormwater so as to protect municipal roads and streets and nearby private properties. The Stormwater System intercepts or diverts flows from a property, enables access to a property over a Halifax Water owned culvert, and/or manages stormwater from a property if it enters any part of Halifax Water's Stormwater System. This level and nature of service provided by Halifax Water varies depending on the location, the amount of stormwater generated and the surrounding properties. In some cases, Stormwater Service is provided by ditches and culverts and in others, pipes and in still others, a combination of pipes and ditches.

Special Considerations for Rural Areas

Rural properties are different than urban properties in the context of Stormwater Service. Rural properties tend to have: larger Impervious Area often characterized by longer driveways, lower overall Impervious Area, and a higher proportion of Stormwater cost related directly to roadway related drainage.

Cost of Providing Service to Rural Customers

The cost of providing Stormwater Services on a per-person or per-unit of revenue generated basis is significantly higher in rural areas than in urban areas. While the density of drainage system is far less, the density of revenue generation is even less. The revenue generated from rural areas is less than the cost to Halifax Water to service those areas.

Halifax Water typically provides Stormwater Service using either a piped storm sewer system or a Ditch and culvert system. Properties in rural areas typically are served by an open ditch configuration and have a driveway culvert. Currently the majority of operating costs for Stormwater Service pertain to providing service in rural areas – cleaning and repairing Ditches and replacing driveway culvert or cross culverts in the street. Ditches and culverts are the largest functions when Halifax Water's Stormwater O&M expenses are functionalized [20]. Given that Stormwater-only Customers represent 18% of Stormwater Customers, this illustrates that currently the revenue generated in rural areas does not match the cost of providing Service in those areas. The majority of service requests and work orders for Stormwater Service pertain to Customers served by a ditch and culvert, thereby attracting a higher allocation of customer service costs.

Halifax Water does not calculate rates for piped storm sewer systems versus ditch and culvert systems, as the rates for Service for rural Customers would be higher than the rates for Customers on a piped storm sewer system, and this would be contrary to the regional approach the utility employs, and akin to calculating different COS for different types of water production and distribution or wastewater treatment and collection.

[20] 28.5% of O&M costs (M07147 Exhibit H-1 page 250)

Stormwater System Appendix: Site Related Flow and Credit Calculations

Calculation of Site Related Flow

To arrive at the percentage of flow to be allocated to site related verses street right-of-way, Halifax Water retained a professional company to scan satellite images of the area and provide data on impervious area. The most current impervious area data is:

Halifax Water
Stormwater Rate Study

Service Area and Customer Balancing

Customer Data		
System Data		
Total Impervious Area within the Stormwater Boundary (in square meters)		98,809,690
Less:		
Non-qualifying impervious area in parcels flagged as "Excluded"		
Parcels outside the stormwater catchment	3,225,460	
SRF Exempted parcels	2,245,350	
Parcels identified as resource inside catchment	1,357,670	
Parcels identified as unknown inside catchment	452,110	
Non-qualifying impervious area in parcels flagged as "MICI"		
Parcels over 50m^2	3,724,430	
Parcels under 50m^2	394,265	
Parcels under 50m^2, having a culvert	14,500	
SRF Excempted Parcels within stormwater catchment having a culvert	7,030	
Parcels outside the stormwater catchment, having a culvert	4,460	
Non-qualifying impervious area in parcels flagged as "Not Applicable"		
Road parcel - arbitary	20,200,900	
Road parcel	8,695,070	
Railroad Parcel	994,050	
Water lot	113,820	
Interim iarcel	24,510	
Water parcel	9,310	
Unresolved parcel PID	4,910	
Non-qualifying impervious area in parcels flagged as "Residential"		
SRF Excempted Parcels within stormwater catchment having a culvert	109,270	
Parcels outside the stormwater catchment, having a culvert	65,940	
Interim parcel	1,390	(41,644,445)
Qualifying impervious area associated with Site Related Flow (SRF)		**57,165,245**
Qualifying impervious area associated with street rights-of-way, consists of:		
Road parcel - arbitary		20,200,900
Road parcel		8,695,070
		28,895,970
Less: impervious area of the following stakeholders		
Other		(14,780)
Billable impervious area associated with Right-of-Way (ROW)		**28,881,190**
Billable impervious area breakdown as follows:		
Halifax (HRM)	23,564,330	
Province of Nova Scotia	5,243,630	
Halifax Dartmouth Bridge Commission	73,230	**28,881,190**

This data was then used to calculate the percentage that street right-of way and site related flow represented of the total of billable Impervious Area.

- 28,881,190/ (57,165,245 + 28,881,190) = 33.6% right-of-way allocation
- 57,165,245/ (57,165,245 + 28,881,190) = 66.4% site related flow allocation

The Impervious Area data is based on satellite imagery from April 2020 during "leaf-off" conditions and represents an improvement in accuracy because a) it reflects new development and additional Impervious Area since the original data, and b) it is "leaf off", therefore there is less vegetation obscuring the measurements. The Impervious Area has increased by 4% since the previous update, with the Impervious Area in the street right-of-way increasing by 16% and the site related Impervious Area decreasing by 1%.

Given the large number of Residential Properties and the relatively small variation in the Impervious Area for these properties Halifax Water will develop a system wide median residential Impervious Area which will be used as the ERU to develop residential tiers that will recognize some differentiation between properties so that properties with less Impervious Area pay less than properties with more Impervious Area.

The table below and the information contained therein, including rates, is for illustrative purposes only. Revenue requirements, Impervious Area and number of parcels will change each time Halifax Water applies to adjust rates for Stormwater Service in the future.

Worksheet SW-11

October 26, 2016

Halifax Regional Water Commission
Stormwater Rate Study

Residential Charges and Revenue Reconciliation

Calculation of Rates for Residential Customers

Tier	Tier Parameters (in units) Each unit equals 10 square meters		Equivalent Residential Unit (ERU)	Rate per Billing Unit	Rate Adjustment	Tier Rate	Standard Annual Charge
Label			**A**	**B**	**C**	B X C	A X B X C, rounded to the nearest $
1	less than	5 units	200	$0.135	0%	$0.000	$0.000
2	6 units	20 units	200	$0.135	50%	$0.068	$14.000
3	21 units	40 units	200	$0.135	100%	$0.135	$27.000
4	41 units	80 units	200	$0.135	200%	$0.270	$54.000
5	81 units	or more	200	$0.135	300%	$0.405	$81.000

Reconciliation of Revenue Requirement

	Impervious Area	Number of Parcels	Billing Rate	Revenue Requirement
Street Right-of Way (ROW), levied to HRM				$3,835,012
Site Related Flow (SRF)				
Industrial, Commercial, Institutional (ICI)	34,748,200		$0.135	$4,691,007
Residential				
Tier 1	33,330	2,326	$0.000	$0
Tier 2	6,695,740	44,710	$14.000	$625,940
Tier 3	8,409,710	31,041	$27.000	$838,107
Tier 4	4,201,480	7,768	$54.000	$419,472
Tier 5	3,489,120	2,123	$81.000	$171,963
Preliminary Revenue Total				$10,581,501
Less: Revenue Requirement				($10,663,017)
Excess (deficiency) compared to Revenue Requirement				($81,516)

Exemptions

The Impervious Area associated with any properties deemed to be exempt from Stormwater charges pursuant to the Halifax Water Regulations is deducted in the calculation of billable Impervious Area and rates. Properties with an Impervious Area less than 50 m^2 are exempt.[21]

All properties are treated the same, with exemptions only considered based on specific circumstances on or near the property, including when part of a Non-Residential Property is outside of the Stormwater Service Boundary[22].

Credits

Any customer who pays charges for Non-Residential Properties may be eligible for a credit not less than 30% but not exceeding 50% of the Site Related Flow Charge if they are undertaking certain qualified Stormwater best management practices that detain peak stormwater flow on an on-going basis in accordance with the parameters and application process set out in the Commission's Stormwater Credit Manual[23] (COS Manual Appendix III).

[21] M07147 NSUARB Decision May 12, 2016, page 17, paragraph [55]
[22] M07147 NSUARB Decision May 12, 2016, page 19, paragraph [64]
[23] M07731 NSUARB Decision April 12, 2017 , page 24, paragraph [19]

SECTION 7 – DISTRICT ENERGY SYSTEM COST ALLOCATIONS

General Review

District Energy system COS analyses employs a multi-step procedure to assign revenue responsibilities to customer classes in proportion to their respective shares of system demands. Using a similar approach to the commodity demand method used for Water Systems, ATDES COS can be separated into four primary cost components: (1) connection costs, (2) energy costs, (3) demand costs, and (4) customer costs - often segregated into meter-related costs and those incurred for billing.

- **Connection costs** are associated with the recovery of a portion of the costs for the construction of the ATDES.
- **Energy costs** are those operating and maintenance (O&M) costs incurred to deliver energy and energy related services to customers.
- **Demand costs** are those capital costs incurred to deliver services under peak demand conditions.
- **Customer costs** comprise those costs associated with serving customers, irrespective of the amount or rate of energy use. They include energy meter reading, billing, and customer accounting and collecting expense, as well as maintenance and capital costs related to meters and services.

The classification of costs by function is based on the design and operation of the facilities used to perform the functions in question. District Energy functions typically include energy generation, distribution, energy transfer, metering, and customer related service.

In classifying costs to utility service characteristics, it is useful to develop as complete an accounting of utility system performance measures as is practicable. Accordingly, it is useful to develop a high-level reconciliation of system production data – identifying the shares of production associated with billed usage (by customer class).

Classified costs are allocated to customers through the calculation of unit costs of service for each service characteristic, and apportionment of costs to customer classes based on the number of service units required by the respective customer classes.

System and Customer Use Data (for Cost Allocation)

A map of the System is provided in the COS Manual Appendix. District Energy System production data, which will be established as the system is developed and is operational, is used to develop cost classification percentages as outlined in section 2 Methodology Review.

Table 31

District Energy System Production

Development of Demand-Related Cost Classification Percentages

Halifax Water – District Energy System Production*				
	Annual Heating Consumption	Annual Cooling Consumption	Peak Heating Demand	Peak Cooling Demand
System	TBD	TBD	TBD	TBD
*The allocations will be established as the system is developed and is operational.				

Additional classifications and allocation of System costs related to the ATDES will be established as the system is developed and is operational.

Finally, data employed for allocation to customer classes includes information on the distribution of piping serving the class, i.e., the distribution piping serving the customers within the Mandatory Zone versus the distribution outside of the Mandatory Zone, their designed energy transfer station capacity, and their billed usage. Provided in Table 32 below is an example format for presentation of these customer class usage characteristics:

Table 32

Customer Class User Characteristics

Energy Accounts and Usage			
Customer Class*	**Accounts****	**Total Billed Usage*****	**Total Capacity*****
Mandatory Zone			
Non-mandatory Zone			

*Customer class has been used as the metering strategy has not yet been defined. The number of customers classes has yet to be defined.

**The number of accounts has yet to be determined.

***Usage and Capacity are not yet known as the system is still under development and approval has not yet been received to expand the ATDES zoning to include a non-mandatory connection zone.

District Energy Systems Functions

Utilities incur varying levels of costs to perform the different system functions needed to meet customer demands and make services available. The functionalization process involves categorizing revenue requirements according to functions in order to more appropriately assign costs to customer classes. District Energy system cost functions and their definitions for both operating and capital are presented in Table 33. Further refinements to the list may be made as the system is established.

Table 33

District Energy System Cost Allocation – System Functions

District Energy System Function	Operating Costs Definition	Capital Cost Definition
Energy Centre	Includes the operations and maintenance costs for the energy centre and the delivery of energy to the distribution system.	Includes the design and construction costs associated with the energy centre.
Distribution	Includes the cost centres for distribution costs.	Includes the design and construction costs associated with all mains and any other capital costs associated with ATDES mains established as the system is developed and is operational.
Service Laterals	Includes the cost centre for district energy services.	Includes connection to the ATDES mains and the piping from the mains to the street line for District Energy services.
Energy Transfer Station	Includes the cost centre for operations and maintenance costs for the energy transfer stations.	Includes the design and construction costs associated with the connection between the service laterals and the customer interconnection.

Operation & Maintenance of Meters	Includes the cost centre for operation and testing of meters (labour, materials, and programs).	Includes all capital expenditures for meters.
Regulatory Services	Includes Environmental Engineering, Regulatory Compliance, Stormwater Engineering, Environmental Management and Development Approvals cost centres.	Cost centres within Regulatory Services function as operating cost centres. Any capital costs related to the provision of this service (equipment, buildings, intangibles etc.) are allocated as assets in proportion of the other costs through depreciation.
Engineering and Technology Services	Includes the cost centres for Records Management; Energy and Business Development, and, Information Services.	Cost centres within Engineering and Technology Services function as operating cost centres. Any capital costs related to the provision of this service (equipment, buildings, intangibles etc.) are allocated as assets in proportion of the other costs through depreciation.
Technical Services (SCADA)	Includes the costs to operate the SCADA systems for District Energy and costs will be apportioned	Cost centres within Technical Services function as operating cost centres. Any capital costs related to the provision of this service (equipment, buildings, intangibles etc.) are allocated as assets in proportion of the other costs through depreciation.
Corporate Services	Includes the cost centres for Accounting, Finance and Procurement.	Cost centres within Corporate Services function as operating cost centres. Any capital costs related to the provision of this service (equipment, buildings, intangibles, etc.) are allocated as assets in proportion of the other costs through depreciation.
Customer Service	Includes the cost centres for Customer Care, Collecting, Supervision and Administration/Overheads.	Cost centres within Customer Service function as operating cost centres. Any capital costs related to the provision of this service (equipment, buildings, intangibles etc.) are allocated as assets in proportion of the other costs through depreciation.
Energy Meter Reading and Billing	Includes the cost centres for Energy Meter Reading and Customer Billing.	Cost centres within Energy Meter Reading and Billing function as operating cost centres. Any capital costs related to the provision of this service (equipment, buildings, intangibles etc.) are allocated as assets in proportion of the other costs through depreciation.
Administration	Includes the cost centres for: Administration, Communications, Legal, Human Resources, Employee Benefits and General.	Cost centres within Administration function as operating cost centres. Any capital costs related to the provision of this service (equipment, buildings, intangibles etc.) are allocated as assets in proportion of the other costs through depreciation.

Cost Functionalization Considerations

The engineers and operators responsible for operation of the District Energy System review assignment of District Energy assets and their associated operating and maintenance costs to system functions. Operating cost centres are set up to record financial information in categories that support functionalization.

The basis for the determination of functions is the operating cost centers that comprise the District Energy System from source of supply to delivery to the Customer. It includes the direct cost functions of providing

the service as well as the common costs of providing support services across all utility Services that are assigned to District Energy Services. Any considerations regarding cost functionalization will be established as the system is developed and is operational.

For Customer Service, input values (dollar costs) for the functions of energy meters and energy meter reading and billing are obtained from specific cost centres within Customer Service:

- Energy Meters
  Operation and Maintenance of Energy Meters

- Energy Meter Reading and Billing
  Energy Meter Reading
  Customer Billing

Once costs have been identified for the above functions, costs applicable to the Customer Service function are merely the residual amount.

Classification of Functional Costs

Following the distribution of District Energy system revenue requirements to designated functions, costs are distributed to District Energy System service characteristics. Service characteristics include energy demand metrics and customer service attributes. Classification of system costs (by function) distributes costs to the characteristics of service that distinguish customer classes.

Halifax Water's functionalized costs will be classified to the District Energy Service characteristics after additional analysis is completed and the system is developed, but may include:

- Annual heating consumption
- Annual cooling consumption
- Peak heating demand
- Peak cooling demand
- Customer Service
- Indirect

O&M Cost Classification

Functionalized District Energy System costs are classified to service characteristics separately for O&M expenses and capital costs. O&M costs are classified as summarized in Table 34, explanations of which are provided in the subsequent notes.

Table 34

District Energy System O&M Cost Classification Summary

District Energy System Functions	Annual Heating*	Annual Cooling*	Peak Heating **	Peak Cooling **	Equivalent Energy Meters	Customer Service	Indirect	Notes
Energy Centre								1
Distribution								1
Service Laterals								1
Energy Transfer Station								1
Technical Services (SCADA)								2
Customer Service								3
Operation & Maintenance of Energy Meters								4
Energy Meter Reading and Billing								3
Engineering and Technology Services								5
Regulatory Services								5
Corporate Services								5
Administration								5
* Total Energy Consumption ** Peak Demand								

Notes on District Energy System O&M Cost Classification

1. Energy Centre, Distribution, Service Laterals, and Energy Transfer Station O&M cost allocations will be determined as the system is developed and is operational.

2. Technical Services operating costs are distributed based on the number of data points (tags) monitored in each activity. The result of this allocation is shown in the table below:

Table 35

Function	Number of Data Points Monitored	Allocation percentage
WW Treatment	24,356	45.0%
WW Collection	11,954	22.0%
SW CSOs	456	0.8%
Water Distribution	5,204	9.6%
Water Treatment	12,265	22.6%
District Energy*	TBD	TBD
Total	54,235	100.0%
*The number of data points will be established as the system is developed and is operational.		

Technical Services has been allocated based on a methodology that will be established as the system is developed and is operational.

3. Customer Service functions are shared by the four Services: Water, Wastewater, Stormwater, and District Energy, with the exception that no meter related costs are allocated to Stormwater. The customer service costs may be assigned either on a Customer basis or an equivalent energy meter basis, to be determined as the system is established and is operational. Energy Meter reading and billing are the cost of energy meter reading and billing costs that are part of Customer Service. They are assigned 100% to Customer Service.

4. Operation and maintenance of energy meters is assigned 100% to equivalent energy meters.

5. Regulatory Services, Engineering and Technology Services, Corporate Services and Administration are indirect costs that are distributed in proportion to direct costs.

Capital Cost Classification

Functionalized District Energy System costs are classified to service characteristics separately for O&M expenses and capital costs. Capital costs are classified as summarized in Table 36, explanations of which are provided in the subsequent notes.

Table 36

District Energy System Capital Cost Classification Summary

District Energy System Functions	Annual Heating*	Annual Cooling*	Peak Heating **	Peak Cooling **	Equivalent Energy Meters	Customer Service	Indirect	Notes
Energy Centre								1
Distribution								1
Service Laterals								2
Energy Transfer Station								1
Technical Services (SCADA)								3
Customer Service								4
Operation & Maintenance of Energy Meters								5
Energy Meter Reading and Billing								6
Engineering and Technology Services								7
Regulatory Services								8
Corporate Services								9
Administration								9
* Total Energy Consumption ** Peak Demand								

Notes on District Energy System Capital Cost Classification

The following is a description of how capital costs may be classified but will be developed further as the system is developed and is operational.

1. Energy Centre, Distribution, and Energy Transfer Station capital cost allocations will be determined as the system is developed and is operational.
2. Service laterals are assigned 100% to equivalent energy meters as service laterals are totally dedicated to the customers.
3. Technical Services (SCADA) are charged directly to capital cost based on work performed. There is no separate allocation for capital for this item.
4. Customer Service is assigned 100% to customer service.
5. Operation and maintenance of energy meters are assigned 100% to equivalent energy meter.
6. Energy Meter reading and billing costs are part of Customer Service. They are assigned 100% to customer service as energy meters are totally dedicated to the customers.
7. Engineering and Technology Services related with capital works are assigned to the capital cost of the works and are included in the capital items. All other costs such as databases and other intangibles are assigned to indirect costs.
8. Regulatory Services are assigned to the capital cost of the works and are included in the capital items. There is no separate assignment for capital for this item.
9. Corporate Services and Administration are assigned to indirect costs that are distributed in proportion to direct costs.

Allocation to Customer Classes

Costs are distributed to Customers (either by classes or individually) based on customer classification. For Halifax Water, there will likely be two customer classifications, mandatory and non-mandatory. Mandatory capital costs will be based on the cost of the energy center, DPS, laterals, energy meters, etc. within the mandatory connection zone. Non-mandatory will be based on the cost of the energy center, DPS piping

within both the mandatory and non-mandatory zones, plus the laterals and meters in the non-mandatory zone. Capital costs would be allocated based on peak demands for each customer.

Costs by Service characteristic are simply divided by the projected level of service to be rendered to determine the unit costs of a given Service parameter. Costs are distributed to customers in proportion to their respective demands and uses of the System.

This procedure is illustrated in Tables 37 and 38 that offer example templates for these types of calculations. As noted, the distribution of costs by function, and subsequent classification of these costs by Service characteristic results in the expression of each component of the utility's revenue requirements in terms of these Service characteristics.

Accordingly, in Table 37, Lines 1, 4 and 7 list the outcomes of the cost classification by each major revenue requirement component. Because some of these costs are distributed on an indirect basis, a calculation is made whereby the indirect costs are distributed to directly classified costs based on those costs share of total directly classified costs.

So, for example, if peak heating demand related O&M costs represent 40 percent of directly classified O&M costs, 40% of indirect O&M costs are apportioned to peak heating demand related costs. This is the procedure employed in Lines 2, 5 and 8 – to yield complete cost classifications by cost component (Lines 3, 6, and 9) – that are summed (Line 10) to present total costs by Service characteristic.

Table 37

District Energy System – Unit COS Calculation Template

Line	Revenue Requirement Component	Annual Heating Consumption Related Costs	Annual Cooling Consumption Related Costs	Peak Heating Demand Related Costs	Peak Cooling Demand Related Costs	Meter Equiv. Related Costs	Billing Related Costs	Indirect Costs
1	Operations & Maintenance	$$ (%)	$$ (%)	$$ (%)	$$ (%)	$$ (%)	$$ (%)	$$
2	Allocated Indirect O&M	$$	$$	$$	$$	$$	$$	
3	Operations & Maintenance (Net)	$$	$$	$$	$$	$$	$$	
4	Depreciation	$$ (%)	$$ (%)	$$ (%)	$$ (%)	$$ (%)	$$ (%)	$$
5	Allocated Indirect Depreciation	$$	$$	$$	$$	$$	$$	
6	Depreciation (Net)	$$	$$	$$	$$	$$	$$	
7	Return on Rate Base	$$ (%)	$$ (%)	$$ (%)	$$ (%)	$$ (%)	$$ (%)	$$
8	Allocated Indirect Return	$$	$$	$$	$$	$$	$$	
9	Return on Rate Base (Net)	$$	$$	$$	$$	$$	$$	
10	Total Revenue Requirements Lines (3,6,9)	$$	$$	$$	$$	$$	$$	

The ultimate allocation of costs to Customer classes employs the service characteristic by customer class data developed in the "System and Customer Use Data (for Cost Allocation) – Table 31". Unit COS by characteristic (Line 3) are calculated by dividing total revenue requirements by Service characteristic (Line 1) by total system demands, capacity requirements, meter equivalents and customer accounts served (Line 2). Costs are then allocated to Customer classes simply by multiplying these unit costs by the demands, meter equivalents and accounts served for each Customer class.

COS-based rates are those that recover these sums from respective Customer classes. While many rate designs may accomplish these ends, a basic rate design option is to recover volume-related costs, including average and maximum-demand related costs from volumetric rates while fixed charges (graduated by meter size) recover metering related costs and customer account related costs. This rate design calculation is presented in the template example in lines 6 & 9.

Table 38

District Energy System – Allocation of Costs to Customer Classes (System and Customer Use Data for Cost Allocation)

Line	Revenue Requirement Component	Annual Heating Consumption Related Costs	Annual Cooling Consumption Related Costs	Peak Heating Demand Related Costs	Peak Cooling Demand Related Costs	Meter Equiv. Related Costs	Billing Related Costs
1	Total Revenue Requirements Lines (3,6,9)	$$	$$	$$	$$	$$	$$
2	System Demands						
3	Unit Cost of Service Characteristic						
4	Mandatory Zone Demands						
5	Mandatory Zone Cost of Service (Line 3 x 4)						
6	Mandatory Zone Rates						
7	Non- Mandatory Zone Demands						
8	Non- Mandatory Zone Cost of Service (Line 3 x 7)						
9	Non- Mandatory Zone Rates						

Figure 1 - Cogswell DES Map - Mandatory Connection Zone