Actuarial Valuation as at January 1, 2017 for the University of Waterloo Pension Plan

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Table of Contents

Executive Summary

An actuarial valuation has been prepared for the University of Waterloo Pension Plan (the "Plan") as at January 1, 2017 for the primary purpose of establishing a funding range in accordance with legislative requirements for the Plan until the next actuarial valuation is performed. This section provides an overview of the important results and the key valuation assumptions which have had a bearing on these results. The next actuarial valuation for the purposes of developing funding requirements should be performed no later than as at January 1, 2020. This valuation report is based on the Stage Two solvency relief measures for pension plans in the broader public sector pursuant to Ontario Regulation 178/11.

Summary of Principal Results

Financial Position

January 1, 2017	Going Concern	Solvency	Hypothetical Wind Up
Assets	$ 1,473,514,888[1]	$ 1,517,379,933[1]	$ 1,517,379,933[1]
Liabilities	1,585,567,596	1,744,213,228	2,551,998,731
Financial Position	**$ (112,052,708)**	**$ (226,833,295)**	**$(1,034,618,798)**

January 1, 2014	Going Concern	Solvency	Hypothetical Wind Up
Assets	$ 1,156,065,428	$ 1,194,275,607[1]	$ 1,194,275,607[1]
Liabilities	1,305,570,459	1,270,650,784	2,041,789,760
Financial Position	**$ (149,505,031)**	**$ (76,375,177)**	**$ (847,514,153)**

Legislative Ratios

	January 1, 2017	January 1, 2014
Solvency ratio	0.87	0.94
Transfer ratio	0.59	0.59

[1] Net of all estimated wind up expenses and smoothing adjustments and deferrals, where applicable

Normal Cost

	January 1, 2017	January 1, 2014
Total normal cost	$ 67,244,568	$ 53,202,405
Required member contributions	(31,234,780)	(25,986,716)
University normal cost	$ 36,009,788	$ 27,215,689
As a % of pensionable earnings	8.51%	7.66%
As a % of member contributions	115.3%	104.7%

Minimum Contribution Requirements

Considering the funding and solvency status of the Plan, the minimum University contributions for the period from January 1, 2017 to January 1, 2020 in accordance with legislative requirements and the University funding commitment, are as follows:

	2017	2018	2019
Total normal cost	$ 67,244,568	$ 69,934,351	$ 72,731,725
Required member contributions	(31,234,780)	(32,484,171)	(33,783,538)
University normal cost	$ 36,009,788	$ 37,450,180	$ 38,948,187
Special payments toward amortizing unfunded liability	12,684,720	12,684,720	12,684,720
Adjustments	0	0	0
Minimum Required University Contribution Under Regulation	**$ 48,694,508**	**$ 50,134,900**	**$ 51,632,907**
Additional contribution to bring University contribution to 163% of required member contributions	2,218,183	2,814,299	3,434,260
Total Required University Contribution under University Funding Commitment[1]	**$ 50,912,691**	**$ 52,949,199**	**$ 55,067,167**
As a % of required member contributions	163%	163%	163%

[1] The University has committed to contributing a minimum of 163% of required member contributions for the period covered by this valuation

Key Assumptions

The principal assumptions to which the valuation results are most sensitive are outlined in the following table.

Going Concern	**January 1, 2017**	**January 1, 2014**
Discount rate	5.50% per year	6.00% per year
Inflation rate[1]	2.00% per year	2.25% per year
Increase in pensionable earnings	4.00% per year	5.00% per year for one year; 4.25% per year thereafter
Mortality table	2014 Canadian Pensioners' Mortality ("CPM2014") table combined with mortality improvement Scale CPM-B	Same
Increase in Year's Maximum Pensionable Earnings (YMPE)	2.75% per year	3.00% per year
Increase in *Income Tax Act* maximum pension	2.75% per year	3.00% per year
Retirement rates	Age 64, but no earlier than one year after valuation date	Same

Solvency/ Hypothetical Wind-Up	**January 1, 2017**	**January 1, 2014**
Discount rate – Solvency	Annuity purchases: 3.12% per year Transfers: 2.30% per year for 10 years; 3.70% per year thereafter	Annuity purchases: 3.83% per year Transfers: 3.10% per year for 10 years; 4.60% per year thereafter
Discount rate – Hypothetical wind-up (Pre-2014 Benefits)	Annuity purchases: -0.09% per year Transfers: 1.30% per year for 10 years; 1.60% per year thereafter	Annuity purchases: 0.15% per year Transfers: 1.70% per year for 10 years; 2.30% per year thereafter
Discount rate – Hypothetical wind-up (Post-2013 Benefits)	Annuity purchases: 0.71% per year Transfers: 1.50% per year for 10 years; 2.10% per year thereafter	Annuity purchases: n/a Transfers: n/a
Mortality table	CPM2014 table combined with mortality improvement Scale CPM-B	1994 Uninsured Pensioner Mortality Table with generational improvements using Scale AA

[1] Pensions in payment and deferred pension amounts accrued prior to January 1, 2014 are assumed to increase at 100% of inflation rate. Pensions accrued on and after January 1, 2014 are assumed to increase at 75% of inflation rate.

Section 1: Introduction

Purpose and Terms of Engagement

We have been engaged by the University of Waterloo (the "University") Pension and Benefits Committee (the "Committee") to conduct an actuarial valuation of the Plan, registered in Ontario, as at January 1, 2017 for the general purpose of determining the minimum and maximum funding contributions required by pension standards, based on the actuarial assumptions and methods summarized herein. Specifically, the purposes of the valuation are to:

- Determine the financial position of the Plan on a going concern basis as at January 1, 2017;
- Determine the financial position of the Plan as at January 1, 2017 on a solvency and hypothetical wind up basis;
- Determine the funding requirements of the Plan as at January 1, 2017; and
- Provide the necessary actuarial certification required under the *Pension Benefits Act (Ontario)* (the "*Act*") and the *Income Tax Act.*

The results of this report may not be appropriate for accounting purposes or any other purposes not listed above.

Solvency Funding Relief Applicable to Pension Plans in the Broader Public Sector

On June 23, 2017, the University submitted an application for the Plan to participate in Stage Two of the two-stage solvency funding relief measures applicable to broader public sector pension plans. In November, 2017, the Plan was accepted into Stage Two through amended Regulation 178/11.

In accordance with Section 9(4) of the Ontario Regulation 178/11 the University has made an election to liquidate any solvency deficiency determined in this report using the three-year deferral/seven-year amortization option. In accordance with regulation, the University will also defer the start of the deferral period by twelve months until January 1, 2018.

In accordance with Section 9(5) of the Ontario Regulation 178/11, the next required valuation will be as at January 1, 2020.

Summary of Changes Since the Last Valuation

The last such actuarial valuation in respect of the Plan was performed as at January 1, 2014. Since the time of the last valuation, we note that the following events have occurred:

- The real return bonds were sold in October 2014 at a market value of $216,935,034 compared to an actuarial value of $172,569,989, a gain of $44,365,045. This gain will be held as a reserve in the going concern valuation at January 1, 2017 until such time as the proceeds are fully deployed into the investment strategy.

- Effective October 1, 2015, the commuted value basis prescribed under Section 3500 (Pension Commuted Values) of the Canadian Institute of Actuaries' ("CIA") Standards of Practice was updated, including the use of the CPM2014 table combined with mortality improvement Scale CPM-B. This basis will be used for calculating commuted values for the purposes of Section 21 of the *Act*. This change has been reflected in this valuation.
- The solvency and hypothetical wind up assumptions guidance published by the CIA on November 3, 2015 for valuations with effective dates on or after September 30, 2015, recommended the use of the new promulgated mortality table and projection scale for the annuity purchase proxy basis. The solvency and hypothetical wind-up results at January 1, 2017 contained in this report reflect this change.
- Effective with this valuation, a number of changes have been made to the going concern assumptions and methods including:
  - Changes to key economic assumptions (i.e. discount rate, inflation, increase in pensionable earnings);
  - Changes to the determination of actuarial value of assets to defer the gain from the sale of the real return bonds.

University Information and Inputs

In order to prepare our valuation, we have relied upon the following information:

- A copy of the previous valuation report as at January 1, 2014;
- A copy of the Statement of Investment Policies and Procedures for the University;
- Membership data compiled as at January 1, 2017 by the University;
- Asset data taken from the Plan's unaudited and audited financial statements; and
- A copy of the latest Plan text and amendments up to and including January 1, 2017.

Furthermore, our actuarial assumptions and methods have been chosen to reflect our understanding of the University's desired funding objectives with due respect to accepted actuarial practice and regulatory constraints.

Subsequent Events

As of the date of this report, we have not been made aware of any subsequent events which would have an effect on the results of this valuation. However, the following points should be noted in this regard:

- Actual experience deviating from expected after January 1, 2017 will result in gains or losses which will be reflected in the next actuarial valuation report.
- To the best of our knowledge, the results contained in this report are based on the regulatory and legal environment in effect at the date of this report and do not take into consideration any potential changes that may be currently under review. To the extent that actual changes in the regulatory and legal environment transpire, any financial impact on the Plan as a result of such changes will be reflected in future valuations.

Section 2: Going Concern Valuation Results

Going Concern Financial Position of the Plan

The going concern valuation provides an assessment of the Plan's financial position at the valuation date on the premise that the Plan continues on into the future indefinitely.

The selection of the applicable actuarial assumptions and methods reflect the Plan's funding objectives, as communicated by the University, actuarial standards of practice, and pension standards.

On the basis of the Plan provisions, membership data, going concern assumptions and methods, and asset information described in the Appendices, the going concern financial position of the Plan as at January 1, 2017 is shown in the following table. The results as at January 1, 2014 are also shown for comparison purposes.

Going Concern Financial Position

	January 1, 2017	January 1, 2014
Assets		
Market value of assets[1]	$ 1,517,879,933	$ 988,945,217
Actuarial value of real return bonds	0	167,120,211
Smoothing/deferral adjustment	(44,365,045)	0
Actuarial Value of Assets	**$ 1,473,514,888**	**$ 1,156,065,428**
Going Concern Liabilities		
Active members	$ 861,751,361	$ 702,327,498
Disabled and suspended members	13,322,113	17,175,900
Deferred vested members	32,000,324	27,199,975
Retired members and beneficiaries	666,888,709	551,387,278
Additional voluntary contribution balances	744,583	959,189
Member flex contributions	1,164,723	1,251,748
Cost of living increase effective May 1st	9,695,783	5,268,871
Total Liabilities	**$ 1,585,567,596**	**$ 1,305,570,459**
Going Concern Position	**$ (112,052,708)**	**$ (149,505,031)**
Prior year credit balance	0	0
Surplus/(Unfunded Liability)	**$ (112,052,708)**	**$ (149,505,031)**
Funded Ratio	**0.93**	**0.89**

[1] Market value of assets other than real return bonds at January 1, 2014

On the basis of the Plan provisions, membership data, going concern assumptions and methods and asset information described in the Appendices, the going concern normal cost of the Plan as at January 1, 2017 is shown in the following table. The normal cost as at January 1, 2014 is also shown for comparison purposes.

Going Concern Normal Cost

	January 1, 2017	January 1, 2014
Normal Cost		
Total current service cost	$ 67,244,568	$ 53,202,405
Required member contributions	(31,234,780)	(25,986,716)
University Normal Cost	**$ 36,009,788**	**$ 27,215,689**
Total pensionable earnings[1]	$ 423,325,493	$ 355,351,815
University Normal Cost		
As a % of total pensionable earnings	8.51%	7.66%
As a % of member contributions	115.3%	104.7%

[1] In year following the valuation date

Change in Financial Position

The major components of the change in the surplus/(unfunded liability) for the period from January 1, 2014 to January 1, 2017 are summarized in the following table (in millions of dollars).

	2014	2015	2016
Surplus/(Unfunded Liability) at January 1	**$ (149.5)**	**$ (112.1)**	**$ (106.1)**
University contributions	42.4	45.0	47.7
Member contributions	26.0	27.6	29.2
Total normal cost	(53.3)	(56.5)	(61.9)
Interest at discount rate	(8.5)	(6.0)	(5.6)
Expected Surplus/(Unfunded Liability) at End of Year	**$ (142.9)**	**$ (102.0)**	**$ (96.7)**
Change in liabilities due to experience gains/(losses):			
Return on actuarial value of assets	$ 82.2	$ (4.4)	$ 19.1
Increase in salaries	1.5	1.6	2.5
Increase in ITA maximum pension/YMPE	0.7	0.6	0.2
Indexation of benefits	2.0	5.5	4.0
Retirement experience	4.2	5.0	6.2
Mortality experience	(1.1)	(1.8)	(1.0)
Termination experience	(2.4)	0.1	(0.7)
Data adjustments / article 12 transfers	1.3	0.6	(0.6)
Additional deferred year of COLA	1.0	(0.5)	(0.5)
Miscellaneous experience	(0.5)	(0.5)	(0.6)
Surplus/(Unfunded Liability) After Experience Gains/(Losses) at End of Year	**$ (54.0)**	**$ (95.8)**	**$ (68.1)**
Change due to change in economic assumptions	$ (13.7)	$ (10.3)	$ (44.0)
Change due to change in asset valuation method	(44.4)	0.0	0.0
Surplus/(Unfunded Liability) at End of Year	**$ (112.1)**	**$ (106.1)**	**$ (112.1)**

Discussion of Changes in Assumptions

The Committee performed interim actuarial valuations during the three-year period at January 1, 2015 and January 1, 2016. The reconciliation of the going concern financial position for the period since January 1, 2014 shows the impact of the change in assumptions in 2014, 2015 and 2016. The numbers are presented in this manner for consistency with valuation reports that were prepared for Plan management purposes which were not filed with the Financial Services Commission of Ontario (FSCO) or Canada Revenue Agency (CRA).

The following economic and demographic assumptions were updated in the interim valuation reports.

Assumption	January 1, 2014	January 1, 2015	January 1, 2016	January 1, 2017
Inflation	2.25%	2.00%	2.00%	2.00%
Discount Rate	6.00%	5.75%	5.70%	5.50%
Increase in YMPE	3.00%	2.75%	2.75%	2.75%
Increase in ITA maximum pension	3.00%	2.75%	2.75%	2.75%
Increase in Pensionable Earnings	5.00% for one year; 4.25% thereafter	4.00%	4.00%	4.00%

The updates to the economic assumptions made at January 1, 2015 increased the accrued liability at January 1, 2015 by $13.7 million and the total normal cost by $1.3 million. The update to the economic assumptions at January 1, 2016 further increased the accrued liability by $10.3 million and the total normal cost by $0.7 million. The update to the discount rate at January 1, 2017 increased the accrued liability by $44.0 million and the total normal cost by $2.8 million at January 1, 2017.

Asset Valuation Method

In 2014, the Real Return Bonds were sold. The resulting gain of $44.4 million is being held as a funding reserve until such time as the proceeds from the sale are fully deployed into the investment strategy.

Going Concern Valuation Sensitivity Results

In accordance with the CIA Standards of Practice specific to pension plans, the table below presents the sensitivity of the going concern liabilities and the total normal cost of using a discount rate 1% lower and 1% higher than that used for the going concern valuation.

			Effect	
January 1, 2017			**$**	**%**
Going concern liabilities	$	1,585,567,596		
Going concern liabilities (discount rate – 1%)	$	1,840,831,233	$ 255,263,637	16.1%
Going concern liabilities (discount rate + 1%)	$	1,382,183,859	$ (203,383,737)	(12.8%)
Total normal cost	$	67,244,568		
Total normal cost (discount rate – 1%)	$	84,312,507	$ 17,067,939	25.4%
Total normal cost (discount rate + 1%)	$	54,460,830	$ (12,783,738)	(19.0%)

Section 3: Solvency Valuation Results

Solvency Financial Position of the Plan

The solvency valuation is a financial assessment of the Plan that is required by the *Act* and is performed in accordance with requirements prescribed by that legislation. It is intended to provide an assessment of the Plan's financial position at the valuation date on the premise that certain obligations as prescribed by the *Act* are settled on the valuation date for all members. The liabilities must be calculated based on a postulated scenario that maximizes liabilities on wind up of the Plan. Contingent benefits are included in the liabilities that would be payable under the postulated scenario, unless permitted to be omitted under the definition of solvency liabilities under the Regulations to the *Act.* All assumptions for the solvency valuation are listed in Appendix D.

On the basis of the Plan provisions, membership data, solvency assumptions and methods and asset information described in the Appendices, as well as the requirements of the *Act*, the solvency financial position of the Plan as at January 1, 2017 is shown in the following table. The solvency financial position of the Plan as at January 1, 2014 is shown for comparison purposes.

Solvency Financial Position

	January 1, 2017	January 1, 2014
Assets		
Solvency assets	$ 1,517,879,933	$ 1,194,775,607
Estimated wind up expenses	(500,000)	(500,000)
Total Assets	**$ 1,517,379,933**	**$ 1,194,275,607**
Solvency Liabilities		
Active members	$ 981,453,639	$ 698,081,399
Disabled and suspended members	16,095,461	18,314,293
Deferred vested members	39,764,670	29,470,839
Retired members and beneficiaries	704,990,152	522,573,316
Additional voluntary contribution balances	1,164,723	1,251,748
Member flex contributions	744,583	959,189
Total Liabilities	**$ 1,744,213,228**	**$ 1,270,650,784**
Solvency Position	**$ (226,833,295)**	**$ (76,375,177)**
Prior year credit balance	0	0
Present value of special payments	69,855,540	69,509,814
Solvency Surplus/(Deficiency)	**$ (156,977,755)**	**$ (6,865,363)**
Solvency ratio	0.87	0.94

Solvency Concerns

A report indicates solvency concerns under the *Act* if the ratio of the solvency assets to solvency liabilities is less than 0.85.

Where a report indicates solvency concerns, the effective date of the next valuation that needs to be filed under the *Act* is one year from the valuation date of the valuation that gave rise to the solvency concerns.

Since the ratio of solvency assets to solvency liabilities ($1,517,879,933 / $1,744,213,228) is equal to 0.87, this report does not indicate solvency concerns.

Furthermore, in accordance with Section 9(5) of the Ontario Regulation 178/11, the next required valuation is as at January 1, 2020.

Solvency Asset Adjustment

The present value of scheduled special payments for solvency valuation purposes has been calculated by discounting the annual special payments to be remitted up to the end of their amortization period (to a maximum of six years), at the weighted solvency discount rate of 2.90% per year compounded monthly in arrears determined proportionately by the solvency discount rates used to determine the solvency liabilities.

Nature of Deficiency	Effective Date	End Date	Months Included	Annual Special Payment	Present Value as of January 1, 2017
Going concern	January 1, 2014	December 31, 2028	72	$ 12,684,720	$ 69,855,540

Solvency Valuation Sensitivity Results

In accordance with the CIA Standards of Practice specific to pension plans, the table below presents the sensitivity of the solvency liabilities to using a discount rate of 1% lower and 1% higher than that used for the solvency valuation.

		Effect	
January 1, 2017		**$**	**%**
Solvency liabilities	$ 1,744,213,228		
Solvency liabilities (discount rate – 1%)	$ 2,014,848,203	$ 270,634,975	15.5%
Solvency liabilities (discount rate + 1%)	$ 1,534,607,783	$ (209,605,445)	(12.0%)

Incremental Cost on a Solvency Basis

The incremental cost on a solvency basis represents the present value at January 1, 2017 of the expected aggregate change in the solvency liabilities between January 1, 2017 and the next calculation date, that is, January 1, 2020. Appendix D gives more details on the calculation methodology and on assumptions.

Based on this methodology and on these assumptions, the incremental cost on a solvency basis can be found in the following table.

	2017	**2018**	**2019**
Incremental cost on a solvency basis	$ 98,107,502	$ 110,639,555	$ 112,054,973

Pension Benefits Guarantee Fund (“PBGF”)

The development of the PBGF Assessment Base is as follows:

PBGF Assessment Base	**January 1, 2017**
(1) Solvency assets	$ 1,517,879,933
(2) PBGF liabilities	$ 1,744,213,228
(3) Solvency liabilities	$ 1,744,213,228
(4) Ontario asset ratio: [(2) divided by (3)]	1.0000
(5) Ontario portion of fund: [(1) multiplied by the ratio in (4)]	$ 1,517,879,933
PBGF assessment base: [(2) subtract (5); if negative, enter zero]	$ 226,333,295

Section 4: Hypothetical Wind Up Valuation Results

Hypothetical Wind Up Financial Position of the Plan

A hypothetical wind up valuation is performed to determine the financial position of the Plan as at the valuation date on a wind up basis, reflecting market settlement rates as of the valuation date. Unlike the solvency valuation, all benefits are included that would be payable under the postulated scenario that would maximize benefits. The hypothetical wind up valuation is determined using benefit entitlements on the assumption that the Plan has neither a surplus nor a deficit. Contingent benefits are included in the liabilities that would be payable under the postulated scenario. Assets are set equal to market value net of estimated wind up expenses. All assumptions for the hypothetical wind up valuation are listed in Appendix D.

On the basis of Plan provisions, membership data, hypothetical wind up assumptions and methods, and asset information described in the Appendices, as well as the requirements of the *Act*, the hypothetical wind up financial position of the Plan as at January 1, 2017 is shown in the following table. The hypothetical wind up financial position of the Plan as at January 1, 2014 is shown for comparison purposes.

Hypothetical Wind Up Financial Position

	January 1, 2017	January 1, 2014
Assets		
Hypothetical wind up assets	$ 1,517,879,933	$ 1,194,775,607
Estimated wind up expenses	(500,000)	(500,000)
Total Assets	**$ 1,517,379,933**	**$ 1,194,275,607**
Hypothetical Wind Up Liabilities		
Active members	$ 1,486,593,840	$ 1,208,126,587
Disabled and suspended members	24,973,468	30,399,783
Deferred vested members	80,833,562	63,374,932
Retired members and beneficiaries	957,688,555	737,677,521
Additional voluntary contribution balances	744,583	959,189
Member flex contributions	1,164,723	1,251,748
Total Liabilities	**$ 2,551,998,731**	**$ 2,041,789,760**
Hypothetical Wind Up Surplus/(Deficiency)	**$ (1,034,618,798)**	**$ (847,514,153)**

Transfer Ratio

The transfer ratio is determined as follows:

		January 1, 2017	January 1, 2014
(1) Hypothetical wind up assets		$ 1,517,879,933	$ 1,194,775,607
Prior year credit balance	(A)	$ 0	$ 0
Total University normal cost and required special payments until next mandated valuation	(B)	$ 150,462,315	$ 130,540,169
(2) Asset adjustment: Lesser of (A) and (B)		$ 0	$ 0
(3) Hypothetical wind up liabilities		$ 2,551,998,731	$ 2,041,789,760
Transfer Ratio [(1)-(2)] / (3)		**0.59**	**0.59**

Section 5: Contribution Requirements

Contribution Requirements in Respect of the Normal Cost

The annual going concern cost of benefits in respect of service accruing after the valuation date is known as the normal cost. The following table sets out:

- The development of the rule to determine the normal cost;
- An estimate of the normal cost for the three years following the valuation date; and
- The portion of the going concern normal cost that is to be paid by the members.

	2017	2018	2019
Normal Cost			
Total normal cost	$ 67,244,568	$ 69,934,351	$ 72,731,725
Required member contributions	(31,234,780)	(32,484,171)	(33,783,538)
University Normal Cost	**$ 36,009,788**	**$ 37,450,180**	**$ 38,948,187**
Total pensionable earnings	$ 423,325,493	$ 440,258,513	$ 457,868,853
University Normal Cost			
As a % of pensionable earnings	8.51%	8.51%	8.51%
As a % of member contributions	115.3%	115.3%	115.3%

In the event an updated funding range in accordance with legislative requirements is not certified before January 1, 2020, the rule for determining the University normal cost contributions outlined in the above table will continue to be appropriate for the plan year commencing on the next valuation date of January 1, 2020. Adjustment to the University contributions may be required once the next actuarial funding range in accordance with legislative requirements is certified.

Minimum Special Payments Under Solvency Relief Measures Applicable to Broader Public Sector Pension Plans

Stage One of Solvency Funding Relief Measures as at January 1, 2014

Pursuant to Ontario Regulation 178/11 made under the Pension Benefits Act, the Plan was approved to participate in the first stage of the solvency funding relief measures applicable to broader public sector pension plans.

Under the solvency funding relief measures, the minimum special payment each year during the Stage One period was determined as the greater of the two tests below:

Test No. 1
Interest on Solvency Deficit
\$76,375,177 x 3.70%[1] = \$2,825,882

Test No. 2
Solvency Assets - 80% of Solvency Liabilities
\$1,194,775,607 - 0.8 x \$1,270,650,784 > \$0
Amortization of 50% of above result (if less than \$0) over 4 years at 3.70% = Nil

The University began going concern special payments immediately effective January 1, 2014. The annual going concern special payments of \$14,985,678 exceeded the minimum solvency special payments required under Stage 1 solvency funding relief measures.

[1] Liability-weighted average of interest rates used for solvency valuation

Stage Two of Solvency Funding Relief Measures as at January 1, 2017

Amended Ontario Regulation 178/11 under the Pension Benefits Act (i.e., Regulation 307/13) requires the University to make special payments to the Plan to liquidate any solvency deficiency determined in the Stage Two Valuation Report (i.e., January 1, 2017 actuarial valuation report) according to the following rules:

Rule 1 – Amortize the solvency deficiency identified in the Stage Two Valuation Report over a period of 10 years, and make such monthly special payments for three years starting no later than 12 months after the Stage Two Valuation Date.

Rule 2 – The minimum monthly special payments during that three-year period is the greater of zero and (i) minus (ii) where (i) and (ii) are defined as follows:

- (i) Interest on solvency deficiency (without regards to estimated wind-up expenses), payable on a monthly basis,
- (ii) The monthly special payments to liquidate the going concern unfunded liability.

Rule 3 – During the remaining seven-year period, special payments must be made to liquidate the solvency deficiency as at January 1, 2017.

Rule 1 will result in a solvency deficiency payment of $12,704,025 starting January 1, 2018.

Rule 2 will result in $0 determined as follows:

- (i) Interest on the solvency deficiency (without regards to estimated wind-up expenses) of $6,563,666 ($226,333,295 x 2.9%[1]) minus
- (ii) The special payments of $12,684,720 to liquidate the Unfunded Accrued Liability

but not less than zero.

Rule 3 will result in a solvency deficiency payment of $18,976,662 starting January 1, 2021.

Therefore, special payments of $12,684,720 to fund the Unfunded Accrued Liability of $112,052,708 as at January 1, 2017 will be contributed from January 1, 2017 to January 1, 2021 (three years after the one year deferral period from the effective date of the Stage 2 Valuation Report as at January 1, 2017). Starting January 1, 2021, the special payments will increase to $31,661,382 ($12,684,720 plus $18,976,662).

[1] Liability-weighted average of interest rates used for solvency valuation

Development of Special Payments

The following table summarizes the amortization schedules of special payments prior to the application of the Stage Two solvency relief funding measures.

Nature of Deficiency	Effective Date	End Date	Annual Special Payment	Present Value as of January 1, 2017: For Going Concern Valuation[1]	Present Value as of January 1, 2017: For Solvency Valuation[2]
Going concern	January 1, 2014	December 31, 2028	$ 12,684,720	$ 112,052,708	$ 69,855,540
Solvency	January 1, 2018[3]	December 31, 2022	34,711,200	n/a	156,977,755
			$ 47,395,920	$ 112,052,708	$ 226,833,295

The following table summarizes the amortization schedules of special payments after application of the Stage Two solvency relief funding measures under the 10-year amortization period. In accordance with Regulation, the University will defer all new going concern and solvency special payments established as at January 1, 2017 by 12 months. The University has the option to amortize the solvency deficit over 10 years or to defer funding for three years and amortize the remaining solvency deficiency over seven years. This schedule is for the benefit of the report only. The University has not elected this option.

Nature of Deficiency	Effective Date	Revised End Date	Revised Annual Special Payment	Present Value as of January 1, 2017: For Going Concern Valuation[1]	Present Value as of January 1, 2017: For Solvency Valuation[2]
Going concern	January 1, 2014	December 31, 2028	$ 12,684,720	$ 112,052,708	$ 119,580,272
Solvency	January 1, 2018[3]	December 31, 2027	12,704,025	n/a	107,253,023
			$ 25,388,745	$ 112,052,708	$ 226,833,295

The following table summarizes the amortization schedules of special payments after application of the Stage Two solvency relief funding measures under the three-year deferral/seven-year amortization option, which the University has elected.

Nature of Deficiency	Effective Date	Revised End Date	Revised Annual Special Payment	Present Value as of January 1, 2017: For Going Concern Valuation[1]	Present Value as of January 1, 2017: For Solvency Valuation[2]
Going concern	January 1, 2014	December 31, 2028	$ 12,684,720	$ 112,052,708	$ 119,580,272
Solvency	January 1, 2021	December 31, 2027	18,976,662	n/a	107,253,023
			$ 31,661,382	$ 112,052,708	$ 226,833,295

1 The values in the table were developed using the going concern interest rate of 5.50% per year compounded monthly in arrears.

2 The values in the table were developed using the weighted average solvency interest rate of 2.90% per year compounded monthly in arrears. For the present value of the going concern special payments, a maximum of six years of such payments were considered in the calculation except for streams established under Stage Two solvency relief measures, in which case, a maximum of 11 years of such payments were considered.

3 In accordance with Regulation, the University would elect to defer new going concern and solvency payments established at January 1, 2017 by 12 months

Prior Year Credit Balance ("PYCB")

The Plan has no PYCB as of January 1, 2017.

Excess Surplus

The *Income Tax Act* requires that any excess surplus first be applied to reduce or eliminate the University contribution requirements. Excess surplus is defined in Section 147.2(2)(d) of the *Income Tax Act*, as the portion of surplus (if any) that exceeds 25% of the going concern liabilities.

Since the Plan has an unfunded liability, there is no excess surplus and therefore it does not impact the development of the University contribution requirements.

Development of Minimum Required University Contribution

The table below presents the development of the minimum required University contribution for each of the plan years covered by this report under legislation including temporary solvency funding relief, taking into consideration the University funding commitment.

The University has committed to contribute a minimum of 163% of required member contributions during the period covered by this valuation report.

While we have shown a fixed University normal cost in the table below, the University may actually fund the normal cost as a percentage of member contributions.

	2017	2018	2019
University normal cost	$ 36,009,788	$ 37,450,180	$ 38,948,187
Special payments toward amortizing unfunded liability	12,684,720	12,684,720	12,684,720
Special payments toward amortizing solvency deficiency	0	0	0
Required application of excess surplus	0	0	0
Permitted application of surplus	0	0	0
Minimum Required University Contribution Under Legislation	**$ 48,694,508**	**$ 50,134,900**	**$ 51,632,907**
Additional contribution to bring University contribution to 163% of member contributions	2,218,183	2,814,299	3,434,260
Minimum Required University Contribution Under Funding Commitment	**$ 50,912,691**	**$ 52,949,199**	**$ 55,067,167**
As a % of required member contributions	163%	163%	163%

Development of Maximum Deductible University Contribution

The table below presents the development of the maximum deductible University contribution for each of the plan years covered by this report.

The maximum deductible University contribution presented in the table below for a given plan year is calculated assuming that the University makes the maximum deductible University contribution in the first plan year covered by this report.

While we have shown a fixed University normal cost in the table below, the University may actually fund the normal cost as a percentage of required member contributions.

	2017	**2018**	**2019**
University normal cost	$ 36,009,788	$ 37,450,180	$ 38,948,187
Hypothetical wind up deficiency	1,034,618,798	0	0
Required application of excess surplus	0	0	0
Maximum Deductible University Contribution	**$ 1,070,628,586**	**$ 37,450,180**	**$ 38,948,187**

If the University wishes to make the maximum deductible University contribution, it is advisable to contact the Plan’s actuary before making such contribution to ensure that the contribution will be permissible and deductible and that any regulatory requirements are considered.

Section 6: Actuarial Certificate

Actuarial Opinion, Advice and Certification for the University of Waterloo Pension Plan

Canada Revenue Agency Registration Number: 0310565
Provincial Registration Number: 0310565

Opinion

This actuarial certification forms an integral part of the actuarial valuation report for the Plan as at January 1, 2017. We confirm that I have prepared an actuarial valuation of the Plan as at January 1, 2017 for the purposes outlined in the Introduction section to this report and consequently:

Our advice on funding is the following:

- The University should contribute the amounts within the range of minimum and maximum contribution amounts as outlined in Section 5 of this report, in accordance with legislative requirements.
- The next actuarial valuation for the purpose of developing funding requirements should be performed no later than as at January 1, 2020.

We hereby certify that, in our opinion:

- The contribution range as outlined in this report is expected to be sufficient to satisfy the Plan's funding requirements.
- The contribution range outlined in this report qualifies as eligible contributions under Section 147.2(2) of the *Income Tax Act.*
- The pre-1990 maximum pension restrictions in Subsection 8504(6) of the Regulations to the *Income Tax Act* do not apply to any members of the Plan
- For the purposes of the valuation:
  - The data on which this valuation is based are sufficient and reliable;
  - The assumptions used are appropriate; and
  - The actuarial cost methods and the asset valuation methods used are appropriate.
- This report and its associated work have been prepared, and our opinion given, in accordance with accepted actuarial practice in Canada and in compliance with the requirements outlined in subparagraphs 147.2(2)(a)(iii) and (iv) of the *Income Tax Act*.

- Notwithstanding the above certifications, emerging experience differing from the assumptions will result in gains or losses that will be revealed in subsequent valuations.

Linda Byron, FCIA, FSA
Senior Partner

Allan H. Shapira, FCIA, FSA
Managing Partner

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225 King Street West, Suite 1600
Toronto, Ontario M5V 3M2

December 2017

Appendix A: Assets

Asset Data

The Plan's assets are held by CIBC Mellon. The asset information presented in this report is based on the financial statements of the pension fund prepared by CIBC Mellon and statements audited by Ernst & Young.

Tests of the sufficiency and reliability of the asset data were performed and the results were satisfactory. The tests included:

- A reconciliation of actual cash flow with expected cash flow from the previous actuarial report; and
- A reconciliation of any anticipated benefit payments (for retirees, terminated or deceased employees) against the financial statements of the pension fund for confirmation of payments.

Market Value of Assets

The following is a summary of the composition of the Plan's assets by asset type as reported by CIBC Mellon as at January 1, 2017. For comparison purposes, the composition at the previous valuation date of January 1, 2014 is also shown.

	January 1, 2017	**January 1, 2014**
Canadian equities	4%	12%
Foreign equities	35%	29%
Fixed income/cash	51%	34%
Real return bonds	0%	17%
Real estate	3%	3%
Infrastructure	7%	5%
Total	**100%**	**100%**

Target Asset Mix

The following chart shows the long-term target asset mix under the Statement of Investment Policies and Procedures.

	Target Asset Mix
Canadian equities	15%
Global equities	40%
Fixed income/cash	35%
Real estate	5%
Infrastructure	5%
	100%

Reconciliation of Changes in Market Value of Assets

The table below reconciles changes in the market value of assets between January 1, 2014 and January 1, 2017.

	2014	2015	2016
Market Value of Assets, Beginning of Plan Year	**$1,194,775,607**	**$1,316,509,737**	**$1,402,751,131**
Contributions During Plan Year			
Required member contributions	$ 26,037,174	$ 27,586,988	$ 29,217,369
University contributions	42,373,222	45,002,974	47,679,126
Total	**$ 68,410,396**	**$ 72,589,962**	**$ 76,896,495**
Benefit Payments During Plan Year			
Non-retired members[1]	$ 14,448,430	$ 7,026,171	$ 7,185,587
Retired members	47,012,723	50,256,977	53,808,001
Total	**$ 61,461,153**	**$ 57,283,148**	**$ 60,993,588**
Transfers During Plan Year			
Into plan	$ 1,552,320	$ 1,655,420	$ 2,219,963
Out of plan	0	0	0
Total	**$ 1,552,320**	**$ 1,655,420**	**$ 2,219,963**
Fees/Expenses			
Investment fees/expenses	$ 2,138,520	$ 2,768,574	$ 2,850,683
Non-investment fees/expenses	1,409,332	1,349,912	1,795,451
Total	**$ 3,626,142**	**$ 4,118,486**	**$ 4,646,134**
Investment Income	**$ 116,780,419**	**$ 73,397,646**	**$ 102,784,971**
Market Value of Assets, End of Plan Year (unaudited)	**$1,316,509,737**	**$1,402,751,131**	**$ 1,519,012,838**
Adjustment to bring unaudited value equal to audited value[2]			(1,078,889)
Market Value of Assets, December 31, 2016 (audited)			**$ 1,517,933,949**
Rate of return, net of fees/expenses	9.4%	5.2%	7.0%

[1] Includes members who have terminated employment or died

[2] Calculated as $1,517,496,077 as per audited statements, plus $437,872 of in-transit benefit payments that for valuation purposes are included in the liabilities

Development of Adjusted Market Value of Assets

The adjusted market value of assets is equal to the market value of assets adjusted to reflect any contributions, benefit payments, transfers and fees/expenses in-transit as of the valuation date. The development of the adjusted market value of assets is shown below.

	January 1, 2017	January 1, 2014
Market value of assets	$ 1,517,933,949	$ 1,194,775,607
Contributions receivable	0	0
Benefits payable	(54,016)	0
Transfers (payable)/receivable	0	0
Fees/expenses payable	0	0
Adjusted Market Value of Assets	**$ 1,517,879,933**	**$ 1,194,775,607**

Development of Actuarial Value of Assets

Effective at the previous valuation, the actuarial value of assets other than real return bonds, was set equal to the adjusted market value of assets. The actuarial value of the real return bonds was determined by discounting their projected cash flow using a discount rate of 3.75%, equal to the real rate of return assumption incorporated in the going concern actuarial assumptions at January 1, 2014, the previous valuation.

The real return bonds were sold in October 2014 at a market value of $216,935,034 compared to an actuarial value of $172,569,989, a gain of $44,365,045.

Effective this valuation, the actuarial value of assets is set equal to the adjusted market value of assets less a reserve equal to the gain on the sale of the real return bonds.

	January 1, 2017	January 1, 2014
Adjusted market value of assets	$ 1,517,879,933	$ 1,194,775,607
Market value of real return bonds	0	(205,830,390)
Actuarial value of real return bonds	0	167,120,211
Reserve on sale of real return bonds	(44,365,045)	0
Actuarial Value of Assets	**$ 1,473,514,888**	**$ 1,156,065,428**

Appendix B: Membership Data

Source of Data

This valuation was based on member data provided by the University as of January 1, 2017. Tests of the sufficiency and reliability of the member data were performed and the results were satisfactory. The tests included:

- A reconciliation of membership status against the membership status at the last valuation. This test was performed to ensure that all members were accounted for. A summary of this reconciliation follows on the next page;
- A reconciliation of birth, hire, and participation dates against the corresponding dates provided for the last valuation to ensure consistency of data;
- A reconciliation of credited service against the corresponding amount provided for the last valuation to ensure that no member accrued more than three years of credited service from January 1, 2014. This test also revealed any members who accrued less than three years of credited service;
- A reconciliation of pensionable earnings against the corresponding amounts provided for the last valuation to identify any unusual increases or decreases;
- A reconciliation of accrued benefits against the corresponding amounts provided for the last valuation to identify any unusual benefit accruals;
- A reconciliation of any stated benefit payments (for retired, terminated or deceased employees) against the financial statements of the pension fund for confirmation of the payments; and
- A reconciliation of inactive member benefit amounts against the corresponding amounts provided for the last valuation to ensure consistency of data.

There was no information missing from the data, so no assumptions were required with respect to such data.

A copy of the administrator certification certifying the accuracy and completeness of the member data (and the Plan provisions summarized in this report) is included in Appendix G of this report.

Membership Summary

The table below reconciles the number of members as of January 1, 2017 with the number of members as of January 1, 2014 and the changes due to experience in the period.

	Active	Disabled	Suspended	Retired and Beneficiaries	Deferred Vested	MMO Deferred	Total
Members, January 1, 2014	**3,891**	**97**	**11**	**1,603**	**484**	**9**	**6,095**
Changes due to:							
New entrants	1,127	-	-	-	-	-	1,127
Termination							
Non-vested	-	-	-	-	-	-	-
Deferred vested	(148)	(2)	-	-	150	-	-
Lump sum	(253)	(3)	(3)	-	(104)	(1)	(364)
Death							
No further benefits	(4)	(8)	-	(106)	-	-	(118)
Remaining guarantee	-	-	-	(1)	-	-	(1)
Surviving beneficiary	-	(1)	-	(38)	(1)	-	(40)
New beneficiary	-	-	-	40	-	-	40
Retirement	(272)	(32)	-	346	(38)	(4)	-
Disability	(44)	44	-	-	-	-	-
Return from Disability	21	(21)	-	-	-	-	-
Transfer to Suspended	(4)	-	4	-	-	-	-
Re-Entry Into Plan	2	-	(2)	-	-	-	-
New Certain Only Beneficiary	-	-	-	1	-	-	1
Certain Only Payments Ceased	-	-	-	(6)	-	-	(6)
Data correction	10	-	-	(2)	(6)	-	2
Net change	435	(23)	(1)	234	1	(5)	641
Members, January 1, 2017	**4,326**	**74**	**10**	**1,837**	**485**	**4**	**6,736**

Active Members (Including Leaves)

	January 1, 2017	January 1, 2014
Number	4,326	3,891
Average age	47.4	47.6
Average credited service	10.4	10.6
Average Pensionable Earnings	$ 96,884	$ 89,973
Proportion female	48.3%	51.6%

Disabled Members

	January 1, 2017	January 1, 2014
Number	74	97
Average age	55.9	56.4
Average credited service	17.6	18.1
Average Pensionable Earnings	$ 56,818	$ 55,769
Proportion female	75.7%	73.2%

Suspended Members

	January 1, 2017	January 1, 2014
Number	10	11
Average age	33.6	32.6
Average credited service	2.3	2.7

Retired Members and Beneficiaries

	January 1, 2017	January 1, 2014
Number	1,837	1,603
Average age	74.4	74.2
Average Annual Pension	$ 30,029	$ 28,577
Total Annual Pension	$ 55,162,643	$ 45,809,128

Deferred Vested Members—Subject to COLA

	January 1, 2017	January 1, 2014
Number	477	475
Average age	50.6	48.9
Average Annual Pension	$ 6,701	$ 5,964
Total Annual Pension	$ 3,196,322	$ 2,832,823

Deferred Vested Members—Others

	January 1, 2017	January 1, 2014
Number	8	9
Average age	67.6	64.5
Average Annual Pension	$ 980	$ 872
Total Annual Pension	$ 7,838	$ 7,850

Active/Disabled/Suspended Membership Distribution

The following table provides a detailed summary of the active, disabled and suspended membership at the valuation date by years of credited service and by age group. For privacy reasons, average pensionable earnings are not shown for groups with two or less members.

Age	< 5	5–10	10–15	15–20	20–25	25–30	>=30	Total
< 30	203	11						214
	$56,524	$67,626						$57,031
30–35	309	115	6					430
	$71,113	$71,234	$64,958					$71,250
35–40	369	137	58	8				572
	$79,607	$91,922	$88,721	$87,505				$83,676
40–45	219	185	140	49	2			595
	$83,696	$106,594	$111,378	$85,943	*			*
45–50	180	152	166	105	21	4		628
	$75,637	$91,699	$108,160	$107,686	$99,185	$72,970		$94,251
50–55	126	121	142	222	62	16	1	690
	$84,059	$95,211	$97,077	$100,103	$115,102	$82,728	*	*
55–60	106	102	102	110	196	68	9	693
	$80,785	$98,678	$105,268	$107,848	$102,173	$116,238	$106,184	$101,176
60–65	38	64	62	75	40	146	37	462
	$103,003	$94,953	$86,766	$86,959	$84,889	$109,745	$131,038	$99,912
>=65	19	15	14	14	8	17	39	126
	$115,111	$100,079	$114,268	$114,507	$144,993	$143,110	$168,357	$135,317
Total								
Count	1,569	902	690	583	329	251	86	4,410
Average pensionable earnings	$76,496	$93,516	$102,297	$100,222	*	$111,456	*	$92,458

Deferred Vested and Retired Membership Distribution

The following table provides a detailed summary of the deferred vested and retired membership at the valuation date by age group.

Age	Deferred Pensions	Retired Members and Beneficiaries
< 50	225 $ 4,785	
50–55	81 $ 7,233	
55–60	79 $ 10,307	25 $ 15,543
60–65	77 $ 8,651	151 $ 23,458
65–70	14 $ 3,764	456 $ 28,976
70–75	5 $ 976	432 $ 34,542
75–80	1 $ 85	341 $ 35,167
>=80	3 $ 1,230	432 $ 25,706
Total		
Count	485	1,837
Average annual pension	$ 6,607	$ 30,029

Appendix C: Going Concern Assumptions and Methods

Assumptions and Methods

A member's entitlements under a pension plan are generally funded during the period over which service is accrued by the member. The cost of each member's benefits is allocated in some fashion over the member's service. An actuarial valuation provides an assessment of the extent to which allocations relating to periods prior to a valuation date (often referred to as the actuarial liabilities) are covered by the plan's assets.

The going concern valuation provides an assessment of a pension plan on the premise that the plan continues on into the future indefinitely based on assumptions in respect of future events upon which a plan's benefits are contingent and methods that effectively determine the way in which a plan's costs will be allocated over the members' service. The true cost of a plan, however, will emerge only as experience develops, investment earnings are received, and benefit payments are made.

This appendix summarizes the going concern assumptions and methods that have been used for the going concern valuation of the Plan at the valuation date. The going concern assumptions and methods have been chosen to reflect our understanding of the Plan's funding objectives with due respect to accepted actuarial practice and regulatory constraints. For purposes of this valuation, the going concern methods and assumptions were reviewed and changes as indicated were made.

The actuarial assumptions and methods used in the current and previous valuations are summarized below and described on the following pages.

	January 1, 2017	January 1, 2014
Economic Assumptions		
Discount rate	5.50% per year	6.00% per year
Inflation rate	2.00% per year	2.25% per year
Post-retirement indexation		
Pre-2014 pensions	2.00% per year	2.25% per year
Post-2013 pensions	1.50% per year	1.69% per year
Increases in pensionable earnings		
Active members	4.00% per year	5.00% per year for 1 year; 4.25% per year thereafter
Disabled members	2.00% per year	2.25% per year
Increases in year's maximum pensionable earnings	2.75% per year	3.00% per year
Increases in maximum pension limit	$2,914.44 in 2017; then 2.75% per year up to $3,200	$2,770.00 in 2014; then 3.00% per year up to $3,200
Interest on member contributions	3.00% per year	Same
Interest rate used to calculate 50% rule	1.30% per year for 10 years; 1.60% per year thereafter[1]	1.70% per year for 10 years; 2.30% per year thereafter
Expenses	Discount rate is net of all expenses	Same
Demographic Assumptions		
Mortality rates	CPM2014 combined with mortality improvement Scale CPM-B	Same
Retirement age	Age 64, but no earlier than one year after the valuation date	Same
Termination rates	Table A following	Same
Disability rates	None	Same

[1] 1.50% per year for 10 years; 2.10% per year thereafter for 75% of CPI indexed benefits

	January 1, 2017	January 1, 2014
Methods		
Actuarial cost method	Projected unit credit (prorated on benefit)	Same
Asset valuation method	Market value of assets adjusted to reflect contributions and benefit payments in-transit as of the valuation date less reserve for gain on sale of real return bonds	Non-RRB: Market value of assets adjusted to reflect contributions and benefit payments in-transit as of the valuation date. RRB: Projected cash flows discounted to valuation date at 3.75% real rate of return.

Table A—Termination Rates

Sample terminations per 1,000 are shown in the following table:

Age	Male and Female
20	100
25	100
30	56
35	32
40	22
45	17
50	12
55	7
60	2
65	0

Justification of Actuarial Assumptions and Methods

Margins for Adverse Deviations

Margins for conservatism or provisions for adverse deviation have been built into the going concern valuation where appropriate.

The margins have been chosen so as to balance the need for financial security for existing plan members against overly conservative contribution requirements that potentially result in intergenerational inequity among members and unnecessary financial strain on the plan sponsor.

Margins are addressed through the asset reserve being held and the University funding policy under which the University is contributing at a higher rate than the statutorily required minimum.

The going concern assumptions do not include margins for adverse deviations, except as noted above.

Economic Assumptions

Discount Rate

The overall expected return ("best-estimate") of 5.60% was developed based on an inflation rate of 2.00% per year, using best-estimate returns for each major asset class in which the pension fund is invested, using the target asset mix. A Monte Carlo simulation is performed over 30 years, where the portfolio returns are projected assuming annual rebalancing. The average 30-year geometric return is used to develop an overall best-estimate rate for the entire pension fund. Gains from rebalancing and diversification are implicit to this return. Investment expenses are based on passive management expenses. There are no additional returns assumed to be derived from active management, net of investment fees for active management.

The following table lays out the adjustments that have been made to the overall expected rate of return in order to arrive at our going concern discount rate assumption:

Development of Discount Rate	
Overall expected return	5.60%
Non-investment expenses	(0.10)%
Margin for adverse deviations	(0.00)%
Unrounded Discount Rate	**5.50%**
Rounded Discount Rate	**5.50%**

Inflation Rate

The inflation rate assumption reflects our best estimate of future inflation considering current economic and financial market conditions and reflects the midpoint of Bank of Canada target inflation.

Productivity Increases

The productivity increase assumption of 0.75% reflects our best estimate of future increases considering current economic and financial market conditions, and is consistent with historical real economic growth.

Increases in Pensionable Earnings

The assumption for increases in pensionable earnings reflects the assumed rate of inflation, plus allowances for the effect of productivity growth, individual employee merit and promotion.

Increases in YMPE

As the benefits paid to a member from the Plan are dependent on the future YMPE, it is necessary to make an assumption regarding the future increases in the YMPE.

The assumed increase in the YMPE reflects the assumed rate of inflation plus the productivity increase assumption.

Increases in the Maximum Pension Limit

Pensions are limited to the maximum limits under the *Income Tax Act*. The *Income Tax Act* specifies both a dollar limit, and in addition pensions cannot exceed 2% of indexed highest average compensation per year of credited service. The assumed increase in the dollar limit reflects the assumed rate of inflation plus the productivity increase assumption.

Interest on Member Contributions

Interest is credited on member contributions with the rate credited by chartered banks on five-year personal fixed term deposits. The assumption for interest on member contributions reflects our expected increase in these rates.

Expenses

Since the discount rate has been established net of all expenses, no explicit assumption is required for expenses.

Demographic Assumptions

Mortality

During 2014, the CIA completed a study of Canadian pensioner mortality levels and trends. The 2014 study published mortality rates split by sector and included Public, Private and Combined tables, as well as possible pension size adjustment factors. A generational projection scale, CPM-B, was also developed to allow for improvements in mortality after 2014. The continued use of this mortality table and projection scale are considered reasonable.

Retirement

A single-point retirement age of 64 has been used for all members. Pension benefits are payable on an unreduced basis at age 62. However, the nature of the workforce is such that we do not expect a significant proportion of members to commence pension payments prior to age 65. We monitor actual experience against this assumption at each valuation and consider this retirement age appropriate.

Termination of Employment

The rates of termination of employment before retirement represent a best estimate of termination rates for a plan of this size and workforce characteristics of the Plan. Table A was developed by a previous actuary for the Plan. We have been using this table as our assumption since our first valuation in 2005. The resulting gains and losses have been relatively small. Therefore, we continue to find this table appropriate.

Option Elections on Termination

We have assumed all members will elect a deferred annuity on termination.

Disability

If an active Plan member becomes disabled, credited service continues to accrue until normal retirement date, but employee contributions are waived. Since this benefit is substantially the same as the benefit that accrues to an active member, no disability assumption has been used. Use of an actual disability assumption in this case would reduce liabilities slightly, so a nil disability incidence assumption represents a small element of conservatism. The disability assumption has very little impact on the valuation results.

Proportion of Members with Spouses and Spousal Age Differential

There is no percent married assumption or age difference assumption required since the Plan does not offer a subsidized joint and survivor pension at retirement, nor any specific preretirement death benefit for a spouse that is not offered to any other beneficiary.

Other

Actuarial Cost Method

An actuarial cost method is a technique used to allocate in a systematic and consistent manner the expected cost of a pension plan over the years of service during which Plan members earn benefits under the Plan. By funding the cost of a pension plan in an orderly and rational manner, the security of benefits provided under the terms of the Plan in respect of service that has already been rendered is significantly enhanced.

The projected unit credit prorated on benefit actuarial cost method has been used for this valuation. Under this method, the actuarial present value of benefits in respect of service prior to the valuation date, but based on pensionable earnings projected to retirement, is compared with the actuarial asset value, revealing either a surplus or an unfunded actuarial liability.

With respect to service after the valuation date, the expected value of benefits for service in the year following the valuation date (i.e., the normal cost) net of any required employee contributions is expressed as a percentage of the expected value of participating payroll for that year. The employer normal cost contributions are determined each year by applying this percentage to the actual participating payroll for the year.

When calculating the actuarial present value of benefits at the valuation date, the present value of all retirement, withdrawal and preretirement death benefits are included. For each member, the retirement, withdrawal and preretirement death benefits for a particular period of service are first projected each year into the future taking into account future vesting, early retirement entitlements and minimum pension/value entitlements. These projected benefits for each future year are then capitalized, multiplied by the probability of the member leaving the Plan in that year and discounted with interest and survivorship to the valuation date. The actuarial present value of benefits for the particular period of service is then determined by summing the present values of these projected benefits.

The pattern of future contributions necessary to pre fund future benefit accruals for any one particular individual will increase gradually as a percentage of their pensionable earnings as the individual approaches retirement. For a stable population (i.e., one where the demographics of the group remain constant from year to year), the normal cost will remain relatively level as a percentage of payroll. The projected unit credit prorated on benefit actuarial cost method therefore allocates contributions among different periods in an orderly and rational manner for a stable population group.

In the event of future adverse experience, contributions in addition to the normal cost calculated under the projected unit credit actuarial cost method may be required to ensure that the Plan's assets are adequate to provide the benefits. Conversely, favourable experience may generate surplus which may serve to reduce future contribution requirements.

Asset Valuation Method

The asset valuation method for this valuation is market value of assets less the gain from the sale of real return bonds. All other gains and losses have been fully recognized.

The deferral of the gain from the sale of real return bonds recognizes these assets have not yet been fully deployed into other asset classes. Once these assets are fully deployed and the actual asset mix is closer to target this deferred gain will be recognized.

Appendix D: Solvency and Hypothetical Wind Up Assumptions and Methods

Valuation Assumptions

	January 1, 2017	January 1, 2014
Economic Assumptions		
Discount Rates—Solvency		
Transfer value basis	2.30% per year for 10 years; 3.70% per year thereafter	3.10% per year for 10 years; 4.60% per year thereafter
Annuity purchase basis	3.12% per year	3.83% per year
Duration used to determine annuity purchase basis	11.24	10.00
Blended rate used to determine solvency special payments	2.90% per year	3.70% per year
Discount Rates—Hypothetical Wind-Up		
Transfer value basis		
100% CPI Indexed	1.30%per year for 10 years; 1.60% per year thereafter	1.70% per year for 10 years; 2.30% per year thereafter
75% CPI Indexed	1.50% per year for 10 years; 2.10% per year thereafter	N/A
Annuity purchase basis		
100% CPI Indexed	-0.09% per year	0.15% per year
75% CPI Indexed	0.71% per year	N/A
Demographic Assumptions		
Mortality table	CPM2014 combined with mortality improvement Scale CPM-B	1994 Uninsured Pensioner Mortality Table With generational mortality improvements using Scale AA
Retirement age	Age between 55 and 65 that produces highest value	Same
Termination	Immediate	Same

	January 1, 2017	January 1, 2014
Other		
Wind up expenses	$500,000	Same
Actuarial cost method	Unit credit	Same
Asset valuation method	Market value of assets adjusted to reflect contributions and benefit payments in-transit as of the valuation date	Same
Incremental Cost		
The assumptions for the expected benefit payments and decrement probabilities, service accruals, and projected changes in benefits and/or pensionable earnings	Same as going concern	Same

Based on the CIA's Guidance and information such as pension legislation, Plan provisions and Plan experience, we have made the following assumptions regarding how the Plan's benefits would be settled on Plan wind up:

	Percent of Liability Assumed to be Settled By Purchase of Annuities	Percent of Liability Assumed to be Settled By Lump-Sum Transfer
Active Members		
Not retirement eligible	0%	100%
Retirement eligible	100%	0%
Deferred Vested Members		
Not retirement eligible	100%	0%
Retirement eligible	100%	0%
Retired Members and Beneficiaries	**100%**	**0%**

Postulated Scenario

The postulated scenario is the assumption of immediate termination of employment for the active group at the valuation date. Therefore, no allowance for future salary increases or demographic experience are reflected.

Benefits Valued

	Solvency Valuation	Hypothetical Wind Up Valuation
Vesting	We have treated all accrued benefits as vested on Plan wind up.	We have treated all accrued benefits as vested on Plan wind up.
Consent Benefits	None.	None.
Grow-in Benefits	Active members with 55 age-plus-continuous service points as of the valuation date are assumed to grow into the enhanced early retirement reductions of the Plan.	Active members with 55 age-plus-continuous service points as of the valuation date are assumed to grow into the enhanced early retirement reductions of the Plan.
Exclusions	In accordance with the Pension Benefits Act (Ontario), the solvency liability excludes the value of future escalated adjustments (future indexation) for both the preretirement and postretirement period.	The hypothetical wind up liability includes the value of future escalated adjustments (future indexation) for both the preretirement and postretirement period as provided for in the Plan.
Post-valuation Date Benefit Increases	Not applicable	Not applicable
Indexing	Excluded	Included

Justification for Valuation Assumptions

Non-indexed rates

Lump-sum discount rate for 10 years	= V122542[1] + 90 bps = 1.44% + 0.90% **= 2.34% (rounded to 2.30%) per year**
Lump-sum discount rate thereafter	= V122544[1] + 0.5 x (V122544[1] – V122542[1]) + 90 bps = 2.35% + 0.5 x (2.35% – 1.44%) + 0.90% **= 3.71% (rounded to 3.70%) per year**
Annuity purchase discount rate	= V39062 + Duration Adjustment[2] = 2.21% + 0.91% **= 3.12% per year**

Indexed rates

Theoretical Yield on 7-year RRGCB (r7)	= V122553[1] x (V122542[1] / V122544[1]) = 0.58% + (1.44% / 2.35%) **= 0.36% per year**
Lump-sum discount rate for 10 years	= r7 + 90 bps = 0.36% + 0.90% **= 1.26% (rounded to 1.30%) per year**
Lump-sum discount rate thereafter	= V122553[1] + 0.5 x (V122553[1] – r7) + 90 bps = 0.58% + 0.5 x (0.58% – 0.36%) + 0.90% **= 1.59% (rounded to 1.60%) per year**
Annuity purchase discount rate	= V39057 – 60 bps = 0.51% – 0.60% **= -0.09% per year**

We have set the aforementioned assumptions based on guidance prepared by the CIA Committee on Pension Plan Financial Reporting (“PPFRC”) in the Educational Note Assumptions for Hypothetical Wind Up and Solvency Valuations with Effective Dates Between December 31, 2016 and December 30, 2017 (“CIA Guidance”) released on March 1, 2017

For benefit entitlements that are expected to be settled by lump-sum transfer, we based the assumptions on Section 3500 (Pension Commuted Values) of the CIA Standards of Practice, using rates corresponding to a valuation date of January 1, 2017.

For benefit entitlements that are expected to be settled by purchase of annuities, we based the assumptions on information compiled by the PPFRC from insurance companies active in the group annuity market as described in the educational note.

1 CANSIM Series (annualized)
2 The duration of the annuity purchase portion of the liabilities is estimated to be 11.24

Mortality Table

The derivation of the discount rate above is in conjunction with CPM2014 Combined Table with mortality improvement Scale CPM-B in accordance with the CIA Guidance.

Preretirement Mortality

We have made no allowance for preretirement mortality. The impact of including such an assumption would not have a material impact on the valuation, since the value of the death benefit is approximately equal to the value of the accrued pension.

Assumptions Not Needed

The following are not relevant to the solvency or hypothetical wind up valuation:

- Increases in pensionable earnings;
- Termination of employment rates;
- Increases in the YMPE; and
- Increases in *Income Tax Act* maximum pension limit

Estimated Wind Up Expenses

Plan wind up expenses would normally include such items as fees related to preparation of the actuarial wind up report, fees imposed by a pension supervisory authority, legal fees, administration, custodial and investment management expenses. We have assumed these fees would be $500,000. We have not made an allowance for expenses related to surplus or deficit resolution. We have assumed that the University will still be solvent on the wind up of the Plan.

Calculation of Special Solvency Payments

We used a discount rate of 2.90% per year to calculate the special payments necessary to liquidate the solvency deficiency. This rate is a weighted average of the solvency discount rates based on the relative proportions of benefit entitlements that are expected to be settled by purchase of annuities and lump-sum transfer.

Unisex Assumption

The liabilities are valued on a sex-distinct basis. The determination of the unisex percentage used in the payment of commuted values to members eligible for portability is based on the proportion of active and deferred vested liabilities for males and females. As such, the determination of commuted value liabilities on a sex-distinct basis in the solvency/hypothetical wind-up valuation is appropriate.

Actuarial Cost Methods

Unit credit (accrued benefit) cost method as prescribed.

Asset Valuation Method Considerations

Assets for solvency purposes have been determined using market value.

Incremental Cost

The incremental cost represents the present value, at the calculation date (time 0), of the expected aggregate change in the liabilities between time 0 and the next calculation date (time t), adjusted upwards for expected benefit payments between time 0 and time t.

An educational note was published in December 2010 by the CIA Committee on PPFRC to provide guidance for actuaries on the calculation of this new information.

The calculation methodology can be summarized as follows:

- The present value at time 0 of expected benefit payments between time 0 and time t, discounted to time 0,

  plus

- Projected liabilities at time t, discounted to time 0, allowing for, if applicable to the pension plan being valued:
  - expected decrements and related changes in membership status between time 0 and time t,
  - accrual of service to time t,
  - expected changes in benefits to time t,
  - a projection of pensionable earnings to time t,

  minus

- The liabilities at time 0.

The projection calculations take into account the following assumptions and additional considerations:

- The assumptions for the expected benefit payments and decrement probabilities, service accruals, and projected changes in benefits and/or pensionable earnings would be consistent with the assumptions used in the pension plan's going concern valuation.
- The assumptions used to calculate the projected liability at time t are consistent with the assumptions for the liabilities at time 0, assuming that interest rates remain at the levels applicable at time 0, that the select period is reset at time t for interest rate assumptions that are select and ultimate and that the Standards of Practice for the calculation of commuted values and the guidance for estimated annuity purchase costs in effect at time 0 remain in effect at time t.
  - Active and inactive Plan members as of time 0 are considered in calculating the incremental cost.

Appendix E: Summary of Plan Provisions

This funding valuation was based on Plan design information provided by the University as of January 1, 2017. The following is a summary of the main provisions of the Plan.

Plan Provisions

Effective Date	January 1, 2011 (last restatement of the Plan document).
Jurisdiction of Registration	Ontario
Eligibility for Membership	Faculty and Staff Employees are eligible to join the Plan on the first day of any month coincident with or next following the date of employment with the University. An eligible Employee must join the Plan no later than the first day of the calendar year coincident with or next following attainment of age 35, or their appointment (if already age 35). Faculty Employees employed as lecturers may elect not to join the Plan. However, a lecturer who has attained age 35 must join the Plan on the first day of the month coincident with or next following the earlier of promotion to a higher rank or completion of five years of service with the University. Any Employee who has either earned at least 35% of the Year's Maximum Pensionable Earnings (YMPE) under the Canada Pension Plan or worked at least 700 hours in each of the two immediately preceding calendar years, shall be eligible to join the Plan on the first day of any month coincident with or next following the date on which such conditions are satisfied.
Normal Retirement	
Eligibility	First day of the month coincident with or next following attainment of age 65.
Benefit	Effective May 1, 1998 on retirement, a member receives an annual pension equal to the sum of the following: 1.4% of Final Average Earnings up to the Average Year's Maximum Pensionable Earnings, plus, 2.0% of Final Average Earnings in excess of the Average Year's Maximum Pensionable Earnings for each year and completed month of Credited Service under the Plan.

The Final Average Earnings is determined based on 36 consecutive months of earnings for retirements on or before January 1, 2014. The averaging period is increased by one month for each month in 2014 and 2015 so that the averaging period is 60 consecutive months for all retirements after December 31, 2015. The Average Year's Maximum Pensionable Earnings is determined over a five-year period.

On retirement prior to May 1, 1998, a member received an annual pension equal to the sum of the following:

1.3% of Final Three-Year Average Earnings up to the Average Year's Maximum Pensionable Earnings, plus,

2.0% of Final Three-Year Average Earnings in excess of the Average Year's Maximum Pensionable Earnings.

for each year and completed month of Credited Service under the Plan.

The Average Year's Maximum Pensionable Earnings was determined over a three-year period.

Maximum Pension

The annual benefit payable in the Normal Form under the Plan for a member determined at the time of pension commencement cannot exceed the lesser of:

- the lesser of (a) and (b):

(a) the defined benefit limit for the year as defined in the Income Tax Act; and

(b) $3,200.00

times the Member's Credited Service; and

- 2.0% of the Member's highest indexed compensation times Credited Service.

For service prior to January 1, 1992, a member's Credited Service shall not exceed 35 years.

Regulation 8504(6) imposes a lower maximum benefit limit in respect of any pre-1990 service that is granted after June 8, 1990 (e.g., buy-back or granting of years of pre-1990 service that was not previously counted as Credited Service).

Early Retirement

Eligibility	Within ten years of normal retirement date and retire from active service.
Benefit	For Members who retired on an early retirement date prior to May 1, 2000, the pension payable on early retirement is reduced by ⅓ of 1% for each of the first 60 complete months by which early retirement precedes the normal retirement date plus ½ of 1% for each additional complete month. For Members who retire on an early retirement date on or after May 1, 2000, the pension payable on early retirement is reduced by 1/2 of 1% for each complete month by which early retirement date precedes the first day of the month coincident with or next following age 62. In any event, the reduced pension cannot be less than the actuarial equivalent of the Member's accrued pension.

Postponed Retirement

Eligibility	Any age after normal retirement date; pension commencement under the Plan may not be postponed beyond the end of the calendar year in which the Member attains age 71.
Benefit	The Member continues to make required contributions, his or her service continues to accrue and the Member will receive a pension on his or her postponed retirement date based on Credited Service, Final Average Earnings and Average Year's Maximum Pensionable Earnings at that date, subject to the paragraphs below. A Member who is a Faculty Employee employed by the University since prior to January 1, 1969 is permitted, if he or she elects on or before normal retirement date to postpone retirement by no more than three years following the first of the month coincident with or next following the end of the contract year during which he or she attains age 65, to elect on or before normal retirement date to cease making any further contributions to the Plan. Such Member shall receive a pension equal to the actuarial equivalent of the pension they would have received at normal retirement date. A Member who is a non-union Staff Employee employed by the University since prior to January 1, 1969 is permitted, if he or she elects on or before normal retirement date to postpone retirement by no more than three years following the first of the month coincident with or next following the normal retirement date, to elect on or before normal retirement date to cease

making any further contributions to the Plan. Such Member shall receive a pension equal to the actuarial equivalent of the pension they would have received at normal retirement date.

Termination Benefits

Eligibility — Immediate (prior to early retirement date)

Benefit — A Member whose service terminates is entitled to a locked-in fully vested deferred pension commencing at his normal retirement date.

The early retirement reduction applicable if the former Member commences receipt of the pension prior to normal retirement date, on or after early retirement date, is equal to 1/3 of 1% for each of the first 60 complete months by which early retirement precedes the normal retirement date plus ½ of 1% for each additional complete month.

A Member who terminates employment and is entitled to a locked-in vested deferred pension may request that an amount equal to the commuted value of the deferred pension entitlement be transferred to another registered pension plan, to a prescribed locked-in retirement savings arrangement or to an insurance company for the purchase of a life annuity that will not commence benefit payments prior to the Member's early retirement date. Different provisions applied for those members who terminated employment prior to July 1, 2012

Death Benefits

Eligibility — Immediate

Benefit — On the death of a Member while in the service of the University, a refund of the commuted value of the accrued pension, subject to the 50% minimum employer cost rule plus any additional voluntary contributions, are paid to the Member's spouse, or if no spouse, the Member's designated beneficiary or estate. Different pensions applied prior to July 1, 2012.

Disability

Eligibility — Immediate (prior to age 65)

Benefit — Members who are in receipt of income disability benefits under the long-term disability insurance plan of the University cease to contribute while disabled but continue to accrue Credited Service for pension purposes.

Accrued pensions for LTD Members are based on pensionable earnings, to date of disability, increased each year by a percentage which is determined annually by the Committee.

Normal Form of Payment

The normal form of pension payable to a Member is a life annuity with a ten-year guarantee period.

For Members who terminated prior to May 1, 1998 and are entitled to a deferred pension under the Plan, the normal form is a life annuity with a five-year guarantee period.

Cost-of-Living Adjustments

The pension of each Member receiving pension payments on May 1 of any year shall be adjusted by the Postretirement Cost-of-Living Factor for each year, provided that the Member has received at least one regular pension payment prior to May 1.

For any pension benefits accrued prior to January 1, 2014, this factor is obtained by dividing the average Consumer Price Index for the preceding calendar year by the average index for the next preceding calendar year. In the first year of retirement, the increase will be provided on a pro rata basis subject to the Income Tax Act rules. However, if this factor exceeds 105% and if the financial position of the Plan is not sufficient to provide for this increase, the factor may be reduced, within certain limits, to maintain the solvency of the Plan.

For any pension benefits accrued on and after January 1, 2014 this factor is obtained by dividing the average Consumer Price Index from the preceding calendar year by the average index for next preceding calendar year, and then multiplying the result by 0.75. However, if this factor exceeds 103.75% and if the financial position of the plan is not sufficient to period for this increase, the factor may be reduced, within certain limits, to maintain the solvency of the Plan.

In 2009, the date of the annual adjustment changed from July 1 to May 1, with the first such adjustment as of May 1, 2009 prorated to reflect the ten-month period since the prior adjustment.

All terminated Members who are entitled to a terminated vested pension except for those who terminated between July 1, 1977 and December 31, 1986 shall have their terminated vested pensions adjusted on May 1 (July 1 prior to 2009) of each year by a cost-of-living factor to be determined annually by the Committee, subject to the Income Tax Act Rules. Notwithstanding the foregoing, if a Member terminates employment on or after January 1, 2008 and is not within ten years of his or her Normal Retirement Date, or has not completed 20 years or more of continuous employment, the Cost of Living Factor shall only apply to the terminated vested member's pension earned in respect of Credited Service prior to January 1, 2008.

Increases in the Consumer Price Index and the corresponding postretirement cost-of-living factors for 2017 and the previous years are shown below[1]:

Year	Increase in Prior Year Consumer Price Index (%)	Postretirement Cost-of-Living Factor (%)
1968	-	2.50
1969	-	3.00
1970	4.50	4.50
1971	3.30	2.00
1972	2.90	2.30
1973	4.80	4.80
1974	7.70	6.40
1975	10.90	10.90
1976	10.80	10.80
1977	7.50	7.50
1978	7.99	5.00
1979	8.91	8.91
1980	9.15	9.15
1981	10.16	10.16
1982	12.49	10.00
1983	10.76	10.76
1984	5.83	5.83
1985	4.35	4.35
1986	3.96	3.96
1987	4.17	4.17
1988	4.37	4.37
1989	4.04	4.04
1990	4.97	4.97
1991	4.76	4.76
1992	5.64	5.64
1993	1.49	1.49
1994	1.84	1.84
1995	0.19	0.19
1996	2.17	2.17
1997	1.56	1.56
1998	1.63	1.63
1999	0.97	0.97
2000	1.74	1.74
2001	2.68	2.68
2002	2.56	2.56
2003	2.23	2.23
2004	2.77	2.77
2005	1.88	1.88
2006	2.17	2.17
2007	2.04	2.04
2008	2.20	2.20
2009[1]	1.94	1.94

1 Cost of living factors only shown for pre-2014 accrued benefits

2010	0.29	0.29
2011	1.78	1.78
2012	2.91	2.91
2013	1.52	1.52
2014	0.94	0.94
2015[2]	1.91	1.91
2016	1.13	1.13
2017	1.43	1.43

Member Contributions

Effective January 1, 2013, members are required to contribute 6.25% of annual earnings up to the YMPE, 8.95% of annual earnings that exceed the YMPE but are less than two times the YMPE, and 9.95% of annual earnings in excess of two times the YMPE, subject to the amount permitted under the Income Tax Act for the year.

Effective May 1, 2009, Members were required to contribute 5.80% of annual Earnings up to the YMPE, 8.30% of annual Earnings that exceed the YMPE but are less than two times the YMPE, and 9.65% of annual Earnings in excess of two times the YMPE, subject to the amount permitted under the Income Tax Act for the year.

Effective July 1, 2008, Members were required to contribute 5.05% of annual Earnings up to the YMPE, 7.85% of annual Earnings that exceed the YMPE but are less than two times the YMPE, and 9.20% of annual Earnings in excess of two times the YMPE, subject to the maximum amount permitted under the Income Tax Act for the year.

Effective July 1, 2007, Members were required to contribute 4.80% of annual Earnings up to the YMPE, 7.175% of annual Earnings that exceeds the YMPE but are less than two times the YMPE, and 7.85% of annual Earnings in excess of two times the YMPE, subject to the maximum amount permitted under the Income Tax Act for the year.

For the period January 1, 2003 to June 30, 2007, Members were required to contribute 4.55% of annual Earnings up to the YMPE and 6.50% of the excess of Earnings above the YMPE, subject to the maximum amount permitted under the Income Tax Act for the year.

Prior to May 1, 1998, Members were required to contribute 4.875% of annual Earnings up to the YMPE and 6.50% of the excess of annual Earnings above the YMPE, subject to the

[1] Effective May 1, 2009 the indexation date was changed from July 1 to May 1. Therefore, the indexation adjustment made in 2009 is prorated for ten months since the prior adjustment

[2] Pensions earned up to December 31, 2013 are indexed annually at 100% of the postretirement cost-of-living factor; pensions earned on and after January 1, 2014 are indexed at 75% of the postretirement cost-of-living factor

maximum amount permitted under the Income Tax Act for the year. Between May 1, 1998 and January 1, 2003, there were temporary reductions in these member contribution rates.

Prior to January 1, 2012, these contributions were credited with interest each year at the four-year arithmetical average rate of return on the pension fund, excluding real return bonds, calculated at December 31st of the prior year. Effective January 1, 2012, the interest credit is the CANSIM rate.

Member Flexible Pension Plan Contributions

Prior to January 1, 2014, members are permitted to make additional flexible Pension Plan contributions on December 31st of each year up to the maximum deductible contribution permitted by the Income Tax Act.

On retirement or termination of membership, a Member's flexible Pension Plan contribution balance may be used to purchase additional ancillary benefits under the Pension Plan, up to the maximum ancillary benefits permitted by the Income Tax Act.

Flexible contributions that cannot be used to purchase ancillary benefits will be forfeited by the Member.

Transfers to the Pension Fund

A new Member may transfer the value of his or her benefits earned under the registered pension plan of a previous employer into the pension fund. The terms and conditions of such transfer and the benefits that will be payable are determined in accordance with Article 12 of the Plan, as amended from time to time.

Definitions

Pensionable earnings

Staff Employees
Base salary, excluding overtime pay, reimbursement for expenses, special payments, shift premiums, week-end provisions, special allowances and other like payments.

Faculty Employees
Base salary, excluding reimbursement for expenses, administrative stipends, faculty research fellowships, seasonal stipends, summer teaching stipends, special payments, special allowances and other like payments.

Credited service

Member's years and completed months of continuous employment with the University while a member in the Plan. For service of a member employed on a part-time basis, the period of service is multiplied by the proportion the member's reduced work load bears to a regular full-time work load.

Appendix F: Glossary of Terms

- The **actuarial value of assets** is the asset value used for going concern valuation purposes. Smoothing methods are sometimes used to smooth investment gains and losses over a certain period.
- The **estimated wind up expenses** is an estimate of the administrative and other expenses expected to be charged against the pension fund if the Plan were to terminate on the valuation date.
- The **going concern liabilities** are the actuarial present value of benefits earned in respect of service prior to the valuation date. The actuary may choose to omit indexing liabilities (i.e., “escalated adjustments”) from the going concern liabilities as per Section 11(1) of the *Act*. However, if escalated adjustments are omitted from the going concern liabilities, the amount of payment of an escalated adjustment that is made from the pension fund, to the extent that it has not been funded, must be included in the normal cost pursuant to Section 11(2) of the Regulation to the *Act*. The going concern liabilities are calculated using the going concern assumptions and methods summarized in Appendix C of this report.
- The **going concern position** is the difference between the actuarial value of assets and the going concern liabilities. Escalated adjustments may be omitted from the determination of the surplus/(unfunded liability) pursuant to Section 11(3) of the Regulation to the *Act*.
- The **maximum deductible company contribution** refers to an eligible contribution pursuant to Subsection 147.2(2) of the *Income Tax Act*. Under Paragraph 8502(b) of the Regulations to the *Income Tax Act*, each University contribution made after January 1, 1991 in respect of a defined benefit provision of a registered pension plan must be such eligible contribution.

  In a company’s fiscal year, the following contributions are eligible under Subsection 147.2(2) of the *Income Tax Act*.

  – The company normal cost, eligible under Subsection 147.2(2) subject to certification by the actuary and approval by the Canada Revenue Agency; plus
  – Special payments eligible under Subsection 147.2(2) up to the amount of the unfunded liability, the solvency deficiency, or the hypothetical wind up deficiency, whichever is greater, subject to certification by the actuary and approval by the Canada Revenue Agency; less
  – Required application of excess surplus.

  The company normal cost and special payments for this Plan will be deductible under Subsection 147.2(2) of the *Income Tax Act*, subject to the approval of the Canada Revenue Agency.

  Note that contributions to a plan are still permissible and deductible if there is an excess surplus, providing there is simultaneously a solvency or hypothetical wind up deficiency in the Plan or the contributions are required as minimum contributions under provincial or federal *Act* legislation, pursuant to Subsections 8516(2) and (3) of the Regulations to the *Income Tax Act*.

  One restriction under the *Income Tax Act* is that if there is an excess surplus, and a solvency or hypothetical wind up deficiency, the maximum deductible contribution is restricted to the full amount of the deficiency without allowance for interest or any other contributions such as company normal cost and/or transfer deficiency payments.

  In order to be deductible in a given fiscal year, company contributions must be made not later than 120 days after the end of the fiscal year.

- The **minimum required company contribution** for each plan year is equal to:
  - The company normal cost; plus
  - Special payments toward amortizing any unfunded liability over 15 years beginning no later than 12 months from the date on which the unfunded liability was established; plus
  - Special payments toward amortizing any solvency deficiency over five years beginning no later than 12 months from the date on which the solvency deficiency was established (this period of years may be longer if the University has participated in Stage Two solvency funding relief); less
  - Required application of excess surplus; less
  - Permitted application of surplus; less
  - Permitted application of PYCB.

  In order to satisfy the requirements of the *Act* and its Regulations, contributions to the fund must be made in accordance with the following rules:

  - Required member contributions (if any) must be remitted to the pension fund within 30 days following the month in which the contributions were received from the member or deducted from his or her remuneration.
  - University normal cost contributions must be remitted to the pension fund within 30 days after the end of the month for which the contributions are payable.
  - Special payments must be remitted to the pension fund in the month for which they are payable.
- The **prior year credit balance** is
  - The PYCB stated in the last report in respect of the Plan under the Regulation; plus
  - The total amount of contributions made to the Plan by the University after the valuation date of the last report in respect of the Plan and before the valuation date for the report being prepared; less
  - The total minimum amount of contributions required to have been made after the valuation date of the last report in respect of the Plan and before the valuation date for the report being prepared, if the contributions had been calculated without reference to any PYCB.

  The company may choose to set the PYCB between nil and the amount as calculated above, but may not recapture the amount forfeited at any time.
- **Solvency/Hypothetical wind up assets** are the market value of pension fund assets adjusted to reflect contributions, benefit payments, transfers and fees/expenses in-transit at the valuation date.
- The **solvency asset adjustment** is an adjustment that may be made to the solvency assets to reflect:
  - The impact of using an averaging method that stabilizes short-term fluctuations in the market value of the Plan’s assets calculated over a period of not more than five years; plus
  - The present value of any remaining special payments required to liquidate any unfunded liability (for service not previously recognized for benefit determination purposes) established after December 31, 1987; plus
  - The present value of any remaining special payments other than those above that are scheduled for payment within six years after the valuation date. This period of years may be longer if the University has participated in Stage Two solvency funding relief.

- The **solvency liabilities** are the actuarial present value of benefits earned in respect of service prior to the valuation date determined as if the Plan were wound up on the valuation date and taking into account Section 74 of the *Act* (i.e., grow-in). In calculating the solvency liabilities, which includes plant closure benefits or permanent layoff benefits that would be immediately payable if the Plan sponsor's business was discontinued on the valuation date, the *Act* and its Regulations permit the exclusion of the following benefits:
  - Any escalated adjustments;
  - "Excluded plant closure benefits" that the University1:elected on November 26, 1992 to exclude;
  - "Excluded permanent layoff benefits" that the University elected on November 26, 1992 to exclude; |
  - Special allowances other than those where the member has met all age and service eligibility requirements;
  - Consent benefits other than those where the member has met all eligibility requirements except the consent of the employer, or in the case of a jointly sponsored pension plan, the consent of the employer or the administrator;
  - Prospective benefit increases;
  - Potential early retirement window benefit values; and
  - Pension and ancillary benefits payable under a qualifying annuity contract.

  The solvency liabilities are determined using benefit entitlements on the assumption that the Plan has neither a surplus nor a deficit. The solvency liabilities are calculated using the solvency valuation assumptions summarized in Appendix D of this report.
- The **solvency liability adjustment** is an adjustment that may be made to the solvency liabilities to reflect the impact of using a solvency valuation discount rate for discounting the liability that is the average of market discount rates calculated over the same period of time as that used in the calculation of the solvency asset adjustment.
- The **solvency position** is the difference between the solvency assets (net of estimated wind up expenses) and the solvency liabilities.
- The **solvency ratio** compares the solvency assets to the solvency liabilities for purposes of Subsections 14(2) and (3) of the Regulations of the *Act* to determine the latest effective date of the next required valuation.
- The **solvency surplus/(deficiency)** is the solvency position, increased by the solvency asset adjustment and the solvency liability adjustment, then decreased by the PYCB.
- The **special payments** are payments required to liquidate the unfunded liability and/or solvency deficiency:
  - The going concern special payments are payments required to liquidate the unfunded liability, with interest at the going concern valuation discount rate, by equal monthly instalments over a period of 15 years beginning no later than 12 months from the valuation date of the report in which the going concern unfunded liability was determined.
  - The solvency special payments are payments required to liquidate the solvency deficiency, with interest at the solvency valuation discount rate, by equal monthly instalments over a period of five years beginning no later than 12 months from the valuation date of the report in which the solvency deficiency was determined. This period of years may be longer if the University has participated in Stage Two solvency funding relief.

- The **surplus/(unfunded liability)** is the difference between the actuarial value of assets and the sum of the going concern liabilities and the PYCB.
- The **total normal cost** is the actuarial present value of benefits expected to be earned in respect of service for each year starting on the valuation date. Required member contributions (if any) are deducted from the total normal cost to determine the company normal cost. The total normal cost is calculated using the going concern valuation assumptions and methods summarized in Appendix C of this report.
- The **transfer ratio** compares the solvency assets, minus the lesser of the PYCB and the required company contributions until the next required valuation (before application of the PYCB), to the solvency liabilities plus the liability of any excluded benefits (except for pension benefits and ancillary benefits payable under a qualifying annuity contract). If the transfer ratio is less than 1.00, lump-sum transfers from the pension fund under Section 42 of the *Act* are limited to the commuted value of the member's pension multiplied by the transfer ratio. The administrator may transfer the entire commuted value if:
  - The administrator is satisfied that an amount equal to the transfer deficiency has been remitted to the pension fund; or
  - The aggregate of transfer deficiencies for all transfers made since the last valuation date does not exceed 5% of the Plan's assets at that time.

  In accordance with Policy T800-402 as related to Subsection 19 of the Regulations of the *Act* there are additional restrictions for payment of commuted values under certain circumstances.

Appendix G: Administrator Certification

With respect to the University of Waterloo Pension Plan, forming part of the actuarial report as at January 1, 2017, I hereby certify that, to the best of my knowledge and belief:

- The asset data provided or made available to the actuary is complete and accurate;
- The membership data and subsequent query answers provided or made available to the actuary are complete and accurate for all persons who are entitled to benefits under the terms of the Plan in respect of service up to the date of the valuation;
- The Plan provisions provided or made available to the actuary are complete and accurate;
- The actuary has been notified of all relevant events subsequent to the valuation measurement date; and
- The terms of engagement contained in Section 1 of this report are accurate and reflect the plan administrator's direction.

Sue McGrath
Name (print) of Authorized Signatory

Manager, Pension Services
Title

Sue McGrath
Signature

October 20/17
Date

About Aon Hewitt

Aon Hewitt empowers organizations and individuals to secure a better future through innovative talent, retirement and health solutions. We advise, design and execute a wide range of solutions that enable clients to cultivate talent to drive organizational and personal performance and growth, navigate retirement risk while providing new levels of financial security, and redefine health solutions for greater choice, affordability and wellness. Aon Hewitt is the global leader in human resource solutions, with over 35,000 professionals in 90 countries serving more than 20,000 clients worldwide across 100+ solutions. For more information on Aon Hewitt, please visit aonhewitt.com.

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