

MASSACHUSETTS MUTUAL VARIABLE ANNUITY SEPARATE ACCOUNT 1

FORM 485BPOS

(Post-Effective Amendment (investment company, rule 485(b)))

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UNITED STATES
SECURITIES AND EXCHANGE COMMISSION
Washington, D.C. 20549

FORM N-4

REGISTRATION STATEMENT UNDER THE SECURITIES ACT OF 1933

Pre-Effective Amendment No.
 Post-Effective Amendment No. 40

and/or

REGISTRATION STATEMENT UNDER THE INVESTMENT COMPANY ACT OF 1940

Amendment No. 46
(Check appropriate box or boxes.)

Massachusetts Mutual Variable Annuity Separate Account 1

(Exact Name of Registrant)

Massachusetts Mutual Life Insurance Company
(Name of Depositor)

1295 State Street, Springfield, Massachusetts 01111-0001
(Address of Depositor's Principal Executive Offices)

(413) 788-8411
(Depositor's Telephone Number, including Area Code)

John E. Deitelbaum
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Massachusetts Mutual Life Insurance Company
1295 State Street
Springfield, Massachusetts 01111-0001
(Name and Address of Agent for Service)

Approximate Date of Proposed Public Offering: **Continuous**

It is proposed that this filing will become effective (check appropriate box)

immediately upon filing pursuant to paragraph (b) of Rule 485
 on April 29, 2024 pursuant to paragraph (b) of Rule 485
 60 days after filing pursuant to paragraph (a)(1) of Rule 485
 on _____ pursuant to paragraph (a)(1) of Rule 485

If appropriate, check the following box:

This post-effective amendment designates a new effective date for a previously filed post-effective amendment.

Title of Securities Being Registered: **Units of Interest in Flex Extra, an Individual or Group Deferred Variable Annuity Contract.**

Flex Extra Variable Annuity

Issued by Massachusetts Mutual Life Insurance Company

Massachusetts Mutual Variable Annuity Separate Account

1

(For Qualified Arrangements)

Massachusetts Mutual Variable Annuity Separate Account

2

(For Non-Qualified Arrangements)

This prospectus describes the Flex Extra individual variable annuity contract (Contract) offered by Massachusetts Mutual Life Insurance Company ("MassMutual®," "Company," "we," "us"). We no longer sell the Contract. However, we continue to administer existing Contracts. The Contract provides for accumulation of Contract Value and Annuity Payments on a fixed and/or variable basis.

You, the Contract Owner, have a number of investment choices in the Contract. These investment choices include a fixed interest account option called the Guaranteed Principal Account (GPA) and one or more variable investment divisions (Divisions) of our separate accounts, Massachusetts Mutual Variable Annuity Separate Account 1 and Massachusetts Mutual Variable Annuity Separate Account 2 (Separate Account). Each Division, in turn, invests in one of the investment entities (Funds). For more information about the investment entities, see "Appendix A – Funds Available Under the Contract." You bear the entire investment risk for all amounts you allocate to a Division.

The Contract:

- is not a bank or credit union deposit or obligation.
- is not FDIC or NCUA insured.
- is not insured by any federal government agency.
- is not guaranteed by any bank or credit union.
- may go down in value.
- provides guarantees that are subject to our financial strength and claims-paying ability.

IF YOU ARE A NEW INVESTOR IN THE CONTRACT, YOU MAY CANCEL YOUR CONTRACT
WITHIN 10 DAYS OF RECEIVING IT WITHOUT PAYING FEES OR PENALTIES.

In some states this cancellation period may be longer. Upon cancellation, you will receive either a full refund of the amount you paid with your application or your total Contract Value. You should review the prospectus, or consult with your investment professional, for additional information about the specific cancellation terms that apply.

Additional information about certain investment products, including variable annuities, has been prepared by the Securities and Exchange Commission staff and is available at www.investor.gov.

The Securities and Exchange Commission has not approved or disapproved these securities or passed upon the adequacy of this prospectus. Any representation to the contrary is a criminal offense.

This prospectus is not an offer to sell the Contract in any jurisdiction where it is illegal to offer the Contract nor is it an offer to sell the Contract to anyone to whom it is illegal to offer the Contract.

Please read this prospectus before investing. You should keep it for future reference. It contains important information about the Flex Extra Variable Annuity.

Effective April 29, 2024

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Glossary

Accumulation Phase. The period prior to the commencement of Annuity Payments during which Purchase Payments may be made.

Accumulation Unit. A unit of measure used to determine your value in a Division during the Accumulation Phase.

Annuitant. The person(s) on whose life Annuity Payments are based, with the exception of the non-lifetime contingent option. See "The Income Phase – Period Certain Annuity Option." The term Annuitant also includes the joint Annuitant, if any. The Annuitant has no rights to the Contract.

Annuity Options. Options available for Annuity Payments.

Annuity Payments. Series of payments made pursuant to the Annuity Option(s) elected.

Beneficiary. The person(s) or entity(ies) that the Contract Owner designates to receive the death benefit provided by the Contract.

Business Day. Every day the New York Stock Exchange (NYSE), or its successor, is open for trading. Our Business Day ends at the Close of Business.

Close of Business. The time on a Business Day when the NYSE ends regular trading, usually at 4:00 p.m. Eastern Time. However, when the NYSE closes early or closes due to any emergency or SEC order, the Close of Business will occur at the same time.

Contingent Deferred Sales Charge (CDSC). A charge that may be assessed against each withdrawal that exceeds the free withdrawal amount and amounts applied to a Fixed Time Payment Option with a payment period of less than ten years.

Contract. The Flex Extra Variable Annuity; an individual variable annuity contract.

Contract Anniversary. An anniversary of the Issue Date of the Contract.

Contract Owner. The person(s) or entity entitled to ownership rights under the Contract.

Contract Value. The sum of your values in the Divisions and the Guaranteed Principal Account (GPA) during the Accumulation Phase.

Contract Year. The first Contract Year is the annual period which begins on the Issue Date and ends on the last calendar day before the first Contract Anniversary. Subsequent Contract Years begin on subsequent Contract Anniversaries.

Division. The Separate Account assets are divided into Divisions. The assets of each Division will be invested in the shares of a single Fund.

Fund(s). The investment entities into which the assets of the Separate Account will be invested.

General Account. The Company's General Investment Account, which supports the Company's annuity and insurance obligations. The General Account's assets include all the assets of the Company with the exception of the Separate Account and the Company's other segregated asset accounts.

Good Order. Any application, Purchase Payments, withdrawal requests, or forms required by the Company which are satisfactory to the Company.

Income Phase. The period that begins on the Maturity Date and ends with the last Annuity Payment. The Income Phase is also referred to as the Annuity Phase.

Issue Date. The date on which the Contract becomes effective. The Issue Date is included in the Contract.

Maturity Date. The date Annuity Payments begin. Also known as the annuity starting date.

Non-Business Day. Any day when the NYSE is not open for trading. Unless specified otherwise, if the due date for any activity required by the Contract falls on any day that is not a Business Day, performance of such activity will be rendered on the first Business Day following such due date.

Non-Qualified Contract. Your Contract is referred to as a Non-Qualified Contract if you purchase the Contract as an individual and not under a qualified plan such as an Individual Retirement Annuity (IRA), Roth IRA, or a corporate pension and profit-sharing plan.

Premium Tax. A tax imposed by certain states and other jurisdictions when a Purchase Payment is made, when Annuity Payments begin, or when Contract Value is withdrawn.

Purchase Payment(s). Any amount paid to us by you or on your behalf with respect to the Contract during the Accumulation Phase.

Qualified Contract. Your Contract is referred to as a Qualified Contract if it is purchased under a qualified retirement plan (qualified plan) such as an Individual Retirement Annuity (IRA), Roth IRA, tax-sheltered annuity plan (TSA or TSA plan), corporate pension and profit-sharing plan (including 401(k) plans and H.R. 10 plans), or a governmental 457(b) deferred compensation plan. For information on the types of qualified plans for which the Contract is available, see "Taxes – Qualified Contracts."

Required Minimum Distribution (RMD). A minimum amount the federal tax law requires to be withdrawn from certain Qualified Contracts each year. RMDs are generally required to begin by the required beginning date specified in IRC Section 401(a)(9).

Separate Account. The account that holds the assets underlying the Contracts that are not allocated to our General Account. The assets of the Separate Account are kept separate from the assets of the General Account and the Company's other separate accounts.

Service Center. MassMutual, Document Management Services – Annuities W360, PO Box 9067, Springfield, MA 01102-9067, (800) 272-2216, (fax) (866) 329-4272, (email) ANNfax@MassMutual.com, www.MassMutual.com. (Overnight mail address: MassMutual, Document Management Services – Annuities W360, 1295 State Street, Springfield, MA 01111-0001.)

Written Request. A written communication or instruction you send to us in Good Order. We may consent to receiving requests electronically or by telephone at our Service Center.

Important Information You Should Consider About the Contract

	FEES AND EXPENSES	LOCATION IN PROSPECTUS
Charges for Early Withdrawals	<p>If your Contract is a Flexible Purchase Payment Contract and, within nine years following your Issue Date, you withdraw money from your Contract or apply your Contract Value to a Fixed Time Payment Option with a payment period of less than ten years, you may be assessed a Contingent Deferred Sales Charge (CDSC) of up to 8% of the amount withdrawn (less a 10% free withdrawal amount) or applied to the Fixed Time Payment Annuity Option, declining to 0% after the ninth year. For example, if you withdraw \$100,000 during the first year after your Contract is issued, you could be assessed a charge of up to \$7,200 on the amount withdrawn.</p> <p>If your Contract is a Single Purchase Payment Contract and, within five years following your Issue Date, you withdraw money from your Contract or apply your Contract Value to a Fixed Time Payment Option with a payment period of less than ten years, you may be assessed a Contingent Deferred Sales Charge (CDSC) of up to 5% of the amount withdrawn (less a 10% free withdrawal amount) or applied to the Fixed Time Payment Annuity Option, declining to 0% after the fifth year. For example, if you withdraw \$100,000 during the first year after your Contract is issued, you could be assessed a charge of up to \$4,500 on the amount withdrawn.</p>	Charges and Deductions – Contingent Deferred Sales Charge (CDSC)
Transaction Charges	We do not assess a charge to transfer Contract Value among the Divisions during the Accumulation Phase.	Charges and Deductions – Transfer Fee

FEES AND EXPENSES			LOCATION IN PROSPECTUS																												
Ongoing Fees and Expenses (annual charges)	<p>The table below describes the fees and expenses that you may pay <i>each year</i>, depending on the options you choose. Please refer to your Contract specifications page(s) for information about the specific fees you will pay each year based on the options you elected.</p> <table border="1"> <thead> <tr> <th>Annual Fee</th><th>Minimum</th><th>Maximum</th></tr> </thead> <tbody> <tr> <td>Base Contract</td><td></td><td></td></tr> <tr> <td>Single Purchase Payment</td><td>1.35%⁽¹⁾</td><td>1.35%⁽¹⁾</td></tr> <tr> <td>Flexible Purchase Payment</td><td>1.45%⁽¹⁾</td><td>1.45%⁽¹⁾</td></tr> <tr> <td>Investment options (Fund fees and expenses)</td><td>0.44%⁽²⁾</td><td>0.93%⁽²⁾</td></tr> <tr> <td>Optional benefits available for an additional charge (for a single optional benefit, if elected)</td><td>0%</td><td>0%</td></tr> </tbody> </table> <p>Because your Contract is customizable, the choices you make affect how much you will pay. To help you understand the cost of owning your Contract, the following table shows the lowest and highest cost you could pay <i>each year</i>, based on current charges. This estimate assumes that you do not take withdrawals from the Contract, which could result in the assessment of CDSCs that substantially increase costs.</p> <table border="1"> <thead> <tr> <th>Lowest Annual Cost:</th><th>Highest Annual Cost:</th></tr> </thead> <tbody> <tr> <td>Single Purchase Payment: \$1,563</td><td>Single Purchase Payment: \$1,971</td></tr> <tr> <td>Flexible Purchase Payment: \$1,568</td><td>Flexible Purchase Payment: \$1,971</td></tr> <tr> <td>Assumes:</td><td>Assumes:</td></tr> <tr> <td> <ul style="list-style-type: none"> Investment of \$100,000 5% annual appreciation Least expensive Fund fees and expenses No optional benefits No CDSC No additional Purchase Payments, transfers, or withdrawals </td><td> <ul style="list-style-type: none"> Investment of \$100,000 5% annual appreciation Most expensive combination of optional benefits and Fund fees and expenses No CDSC No additional Purchase Payments, transfers, or withdrawals </td></tr> </tbody> </table>			Annual Fee	Minimum	Maximum	Base Contract			Single Purchase Payment	1.35% ⁽¹⁾	1.35% ⁽¹⁾	Flexible Purchase Payment	1.45% ⁽¹⁾	1.45% ⁽¹⁾	Investment options (Fund fees and expenses)	0.44% ⁽²⁾	0.93% ⁽²⁾	Optional benefits available for an additional charge (for a single optional benefit, if elected)	0%	0%	Lowest Annual Cost:	Highest Annual Cost:	Single Purchase Payment: \$1,563	Single Purchase Payment: \$1,971	Flexible Purchase Payment: \$1,568	Flexible Purchase Payment: \$1,971	Assumes:	Assumes:	<ul style="list-style-type: none"> Investment of \$100,000 5% annual appreciation Least expensive Fund fees and expenses No optional benefits No CDSC No additional Purchase Payments, transfers, or withdrawals 	<ul style="list-style-type: none"> Investment of \$100,000 5% annual appreciation Most expensive combination of optional benefits and Fund fees and expenses No CDSC No additional Purchase Payments, transfers, or withdrawals
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(1) Represents the mortality and expense risk charge and administrative expense charge (charged as a percentage of average account value in the Separate Account on an annualized basis) and the annual administrative charge (a fixed dollar amount that may be waived for certain Contract Value amounts) collected during the Contract Year that are attributable to the Contract divided by the total average net assets that are attributable to the Contract.

(2) As a percentage of the daily value of the Contract Value allocated to the Funds on an annualized basis.

RISKS		LOCATION IN PROSPECTUS
Risk of Loss	<ul style="list-style-type: none">• You can lose money by investing in this Contract, including loss of principal.	Principal Risks of Investing in the Contract
Not a Short-Term Investment	<ul style="list-style-type: none">• This Contract is not designed for short-term investing and is not appropriate for an investor who needs ready access to cash.• If your Contract is a Flexible Purchase Payment Contract, CDSCs may apply if you withdraw money from your Contract or apply your Contract Value to certain Annuity Options in the first nine Contract Years. If your Contract is a Single Purchase Payment Contract, CDSCs may apply if you withdraw money from your Contract or apply your Contract Value to certain Annuity Options in the first five Contract Years.• If CDSCs apply, they will reduce the value of your Contract if you withdraw money during that time. The benefits of tax deferral also mean the Contract is more beneficial to investors with a long time horizon.	Principal Risks of Investing in the Contract
Risks Associated with Investment Options	<ul style="list-style-type: none">• An investment in this Contract is subject to the risk of poor investment performance of the Funds you choose and can vary depending upon the performance of the Funds available under the Contract.• Each Fund has its own unique risks.• You should review the prospectuses for the available Funds before making an investment decision.	Principal Risks of Investing in the Contract
Insurance Company Risks	<ul style="list-style-type: none">• An investment in the Contract is subject to the risks related to the Depositor (MassMutual). Any obligations (including under any fixed account investment option), guarantees, and benefits of the Contract are subject to the Claims-Paying Ability of MassMutual. If MassMutual experiences financial distress, it may not be able to meet its obligations to you. More information about MassMutual, including its financial strength ratings, is available by request by calling (800) 272-2216 or by visiting www.MassMutual.com/ratings.	Principal Risks of Investing in the Contract

	RESTRICTIONS	LOCATION IN PROSPECTUS
Investments	<ul style="list-style-type: none">• MassMutual reserves the right to remove or substitute Funds as investment options that are available under the Contract.• We reserve the right to limit transfers if frequent or large transfers occur.	General Information about Massachusetts Mutual Life Insurance Company, the Separate Account and the Investment Choices – The Funds
Optional Benefits	<ul style="list-style-type: none">• If your Contract is a non-ERISA and non-Texas Optional Retirement Program tax-sheltered annuity, you may be able to take a loan under your Contract.• We charge interest on loans.• If the loan is in default, the outstanding debt will be considered a taxable distribution.• Loans may negatively affect the death benefit and Contract Value.	Additional Benefits – Right to Take Loans

	TAXES	LOCATION IN PROSPECTUS
Tax Implications	<ul style="list-style-type: none">• You should consult with a tax professional to determine the tax implications of an investment in and payments received under the Contract.• If you purchase the Contract through a qualified retirement plan or individual retirement annuity (IRA), you do not receive any additional tax deferral.• Earnings on your Contract are taxed at ordinary income tax rates when you withdraw them, and you may have to pay an additional income tax if you take a withdrawal before age 59½. Earnings for this purpose consist of Contract Value in excess of your after-tax investment in the Contract.	Taxes

CONFLICTS OF INTEREST		LOCATION IN PROSPECTUS
Investment Professional Compensation	<ul style="list-style-type: none">• Your registered representative may have received compensation, in the form of commissions, for selling this Contract to you. If your registered representative is also a MassMutual insurance agent, they are also eligible for certain cash and non-cash benefits from MassMutual. Cash compensation includes bonuses and allowances based on factors such as sales, productivity and persistency (contract retention). Non-cash compensation includes various recognition items such as prizes and awards as well as attendance at, and payment of the costs associated with attendance at, conferences, seminars and recognition trips, and also includes contributions to certain individual plans such as pension and medical plans. Sales of the Contract may have helped these registered representatives and their supervisors qualify for such benefits.• This conflict of interest may have influenced your registered representative to offer or recommend this Contract over another investment.	Distribution
Exchanges	<ul style="list-style-type: none">• Because the Contract is no longer sold, you would not be affected by a scenario in which you are asked to replace an existing annuity contract you own with a new purchase of this Contract. However, in general you should be aware that some investment professionals may have a financial incentive to offer you a new contract in place of the one you already own. Thus, in general, you should only exchange your annuity contract if you determine, after comparing the features, fees, and risks of both contracts, that it is preferable for you to purchase the new annuity rather than continue to own the existing annuity.	N/A

Overview of the Contract

What is this Contract, and what is it designed to do? The Flex Extra Variable Annuity Contract is designed to enable you to accumulate assets through investments in one or more of the variable investment divisions (Divisions) of the Massachusetts Mutual Variable Annuity Separate Account 1 and Massachusetts Mutual Variable Annuity Separate Account 2 (Separate Account) and one fixed interest account called the Guaranteed Principal Account (GPA). The Contract can supplement your retirement income by providing a stream of income during the Income Phase. Before you begin receiving Annuity Payments, the Contract also provides a death benefit for your designated Beneficiaries. The Contract may be appropriate if you have a long term investment horizon. It is not intended for people who need to take early or frequent withdrawals or who intend to engage in frequent trading among the Separate Account Divisions.

We no longer sell Flex Extra. However, we continue to administer existing Contracts, and you may continue making additional Purchase Payments to your Contract, subject to certain restrictions.

This prospectus describes two Contracts: a Single Purchase Payment Contract and a Flexible Purchase Payment Contract. Both are individual variable annuity contracts. They both provide for accumulation of Contract Value and Annuity Payments on a fixed and/or variable basis.

The two Contract types are the same, except that there are:

- different sales and administrative charges;
- different minimum Purchase Payment amounts; and
- certain differences associated with tax-qualified plans.

A Contract issued by Massachusetts Mutual Variable Annuity Separate Account 1 is designed for use in retirement plans which qualify for special federal tax treatment under the Internal Revenue Code (IRC). See "Taxes."

A Contract issued by Massachusetts Mutual Variable Annuity Separate Account 2 is designed for use outside of the qualified retirement plans offered through Massachusetts Mutual Variable Annuity Separate Account 1 and was available for purchase by a Charitable Remainder Trust. This Contract is referred to as non-qualified. See "Taxes."

How do I accumulate assets in the Contract and receive income from the Contract? The Contract has two phases: 1) the Accumulation Phase and 2) the Income Phase. Your Contract is in the Accumulation Phase until you decide to begin receiving Annuity Payments. During the Accumulation Phase we provide a death benefit. Once you begin receiving Annuity Payments, your Contract enters the Income Phase.

A list of the Funds in which you may invest is provided at the back of this Prospectus. See "Appendix A – Funds Available Under the Contract."

Accumulation Phase

During the Accumulation Phase, subject to certain restrictions, you may apply Purchase Payments to the Contract and allocate the Purchase Payments among:

- the Separate Account Divisions, each of which invests in a mutual fund (Fund), with each Fund having its own investment strategy, investment adviser, expense ratio and returns, and
- the GPA. Assets allocated to the GPA are credited with a specified rate that we declare in advance.

Income Phase

During the Income Phase, you may receive fixed, variable or a combination of fixed and variable Annuity Payments under the Contract by applying your Contract Value to a payment option.

- Depending on the payment option you select, payments may continue for the life of one or two Annuitants, for a specified period between five and thirty years, or as determined in accordance with terms agreed upon in writing by you and us.

When you elect to receive Annuity Payments, your Contract Value will be converted into income payments and you may no longer be able to withdraw money at will from the Contract. At this time, the Accumulation Phase will end, and the death benefit will terminate.

If you elect to apply your Contract Value to a Fixed Time Payment Option with a payment period of less than ten years, the amount applied will be treated as a withdrawal and may be subject to a CDSC.

What are the primary features and options that the Flex Extra Variable Annuity offers?

- **Accessing your money.** During the Accumulation Phase, you may make a partial or full withdrawal of your Contract Value by submitting our partial withdrawal form or full withdrawal form in Good Order to our Service Center. You may also submit the requests by other means that we authorize, such as email, telephone or fax. Contact our Service Center for details.
- All withdrawals are subject to the limitations described in the prospectus. Withdrawal rights during the Income Phase will depend on the Annuity Option selected.
- In some states, if your Contract is a tax-sheltered annuity, you may be able to take a loan under your Contract.
- **Tax treatment.** You may transfer Contract Value among Divisions without tax implications, and earnings (if any) on your investments are generally tax-deferred. You are generally taxed only (1) when you make a partial or full withdrawal; (2) when you receive an Annuity Payment under the Contract; or (3) upon payment of the death benefit.
- **Death Benefit.** A Beneficiary may receive a benefit in the event of your death prior to the Income Phase. Once the Income Phase commences, payments upon death may be available to Beneficiaries depending on the Annuity Option elected.
- **Additional Benefits and Services.** We make certain additional services available under the Contract at no additional charge:

The Dollar Cost Averaging Program allows you to transfer a set amount from a Division to any other Division on a regular schedule.

The Asset Allocation Program automatically rebalances your Contract Value among your selected Divisions in order to restore your allocation to the original level. Contract Value allocated to the GPA cannot participate.

The Interest Sweep Option automatically transfers earnings from your Contract Value in the GPA to any one Division or combination of Divisions that you select.

The GPA Liquidation Program automatically transfers 25% of your GPA balance to one or more Funds until your GPA balance is liquidated in the fourth consecutive year.

The Systematic Withdrawal Program allows you to set up automatic periodic withdrawals from your Contract Value. We will take any withdrawal under this Program proportionally from your Contract Value in your selected investment choices.

The prospectus and Statement of Additional Information (SAI) describe all material terms and features of your Contract. Certain non-material provisions of your Certificate may be different than the general description in the prospectus and the SAI, and certain riders may not be available because of legal requirements in your state. Any such state variations will be included in your Certificate or in riders or endorsements attached to your Certificate. See your Certificate for specific variations. Also see "Appendix D – State Variations of Certain Certificate Features."

Additional Information about Fees

The following tables describe the fees and expenses you pay when buying, owning, and surrendering or making withdrawals from the Contract. Please refer to your Contract specifications page(s) for information about the specific fees you will pay each year based on the options you have elected.

The first table describes the fees and expenses that you will pay at the time that you buy the Contract, surrender, or make withdrawals from the Contract. State Premium Taxes may also be deducted.

Transaction Expenses	Maximum	Current
Contingent Deferred Sales Charge (CDSC)⁽¹⁾		
Single Purchase Payment Contract	5%	5%
Flexible Purchase Payment Contract	8%	8%

(1) The CDSC percentage charge is a percentage of the amount withdrawn or applied to certain Annuity Options. For Single Purchase Payment Contracts, the CDSC percentage decreases over time in the following manner: 5% in year 1, 4% in year 2, 3% in year 3, 2% in year 4, 1% in year 5, and 0% in year 6 or later. For Flexible Purchase Payment Contracts, the CDSC percentage decreases over time in the following manner: 8% in years 1 and 2, 7% in year 3, 6% in year 4, 5% in year 5, 4% in year 6, 3% in year 7, 2% in year 8, 1% in year 9, and 0% in year 10 or later.

The next table describes fees and expenses you will pay each year during the time you own the Contract, not including underlying Fund fees and expenses.

Annual Contract Expenses	Maximum	Current
Administrative Expenses⁽¹⁾		
Single Purchase Payment Contract	\$50	\$30
Flexible Purchase Payment Contract	\$50	\$35
Base Contract Expenses (as a percentage of average account value)	1.40% ⁽²⁾	1.30% ⁽²⁾

(1) This represents the administrative charge.

(2) The Base Contract Expenses represent the sum of the mortality and expense risk charge and the administrative expense charge. For both the Single Purchase Payment and Flexible Purchase Payment versions, the current mortality and expense risk charge is 1.15% annually and the current administrative expense charge is 0.15% annually. For both the Single Purchase Payment and Flexible Purchase Payment versions, the maximum mortality and expense risk charge is 1.25% annually and the maximum administrative expense charge is 0.15% annually. These charges are a percentage of average account value in the Separate Account on an annualized basis.

The next item shows the minimum and maximum operating expenses charged by the Funds that you may pay periodically during the time that you own the Contract. A complete list of Funds available under the Contract, including their annual expenses, may be found in Appendix A.

Annual Fund Operating Expenses

Charge	Minimum	Maximum
Range of annual Fund operating expenses including management fees, distribution and/or service (12b-1) fees and other expenses. ⁽¹⁾	0.44%	0.93%

(1) The Fund expenses used to prepare this item were provided to us by the Funds. We have not independently verified such information provided to us by Funds that are not affiliated with us.

The information above describes the fees and expenses you pay related to the Contract. For information on compensation we may receive from the Funds and their advisers and sub-advisers, see "General Information about Massachusetts Mutual Life Insurance Company, the Separate Account and the Investment Choices – Compensation We Receive from Funds, Advisers and Sub-Advisers." For information on compensation we pay to broker-dealers selling the Contract, see "Distribution."

Examples

These examples are intended to help you compare the cost of investing in the Contract with the cost of investing in other variable annuity contracts. These costs include Contract Owner transaction expenses, annual Contract fees, and Fund fees and expenses. The Examples assume that no loan has been taken. The examples do not reflect any Premium Taxes. However, Premium Taxes may apply.

There are two sets of Examples. The first set assumes you purchased a Single Purchase Payment Contract and the second set of Examples assumes you purchased a Flexible Purchase Payment Contract.

Examples for a Single Purchase Payment Contract

Example I assumes that you withdraw all your Contract Value at the end of each year shown.

Example II assumes you do not withdraw any Contract Value at the end of each year shown, or that you decide to begin the Income Phase at the end of each year shown and we do not deduct a Contingent Deferred Sales Charge.

Both Example I and Example II assume:

- that you invest \$100,000 in the Contract for the time periods indicated,
- that you allocate it to a Division that has a 5% gross return each year,
- that either the current or maximum fees and expenses in the "Additional Information About Fees" tables apply, and
- that you selected one of two Divisions:
 - the one that invests in the Fund with the maximum operating expenses; or
 - the one that invests in the Fund with the minimum operating expenses.

Examples Using Maximum Expenses

Based on the above assumptions, your costs would be as shown in the following tables. Your actual costs may be higher or lower.

Years	Example I				Example II			
	1	3	5	10	1	3	5	10
Division with maximum operating expenses	\$6,981	\$10,196	\$13,480	\$26,660	\$2,361	\$7,274	\$12,453	\$26,660
Division with minimum operating expenses	\$6,511	\$8,750	\$11,006	\$21,585	\$1,869	\$5,786	\$9,955	\$21,585

Examples Using Current Expenses

Based on the above assumptions, your costs would be as shown in the following tables. Your actual costs may be higher or lower.

Years	Example I				Example II			
	1	3	5	10	1	3	5	10
Division with maximum operating expenses	\$6,914	\$9,991	\$13,130	\$25,951	\$2,291	\$7,063	\$12,100	\$25,951
Division with minimum operating expenses	\$6,444	\$8,542	\$10,648	\$20,839	\$1,799	\$5,572	\$9,593	\$20,839

For the Single Purchase Payment Contract, the examples using current expenses reflect the annual administrative charge of \$30 as an annual charge of 0.03%. The examples using maximum expenses reflect the annual administrative charge of \$50 as

an annual charge of 0.05%.

Examples for a Flexible Purchase Payment Contract

Example I assumes that you withdraw all your Contract Value at the end of each year shown.

Example II assumes you do not withdraw any Contract Value at the end of each year shown, or that you decide to begin the Income Phase at the end of each year shown and we do not deduct a Contingent Deferred Sales Charge.

Both Example I and Example II assume:

- that you invest \$100,000 in the Contract for the time periods indicated,
- that you allocate it to a Division that has a 5% gross return each year,
- that either the current or maximum fees and expenses in the “Table of Fees and Expenses” apply, and
- that you selected one of two Divisions:
 - the one that invests in the Fund with the maximum operating expenses; or
 - the one that invests in the Fund with the minimum operating expenses.

Examples Using Maximum Expenses

Based on the above assumptions, your costs would be as shown in the following tables. Your actual costs may be higher or lower.

Years	Example I				Example II			
	1	3	5	10	1	3	5	10
Division with maximum operating expenses	\$9,753	\$14,092	\$17,587	\$26,660	\$2,361	\$7,274	\$12,453	\$26,660
Division with minimum operating expenses	\$9,297	\$12,703	\$15,212	\$21,585	\$1,869	\$5,786	\$9,955	\$21,585

Examples Using Current Expenses

Based on the above assumptions, your costs would be as shown in the following tables. Your actual costs may be higher or lower.

Years	Example I				Example II			
	1	3	5	10	1	3	5	10
Division with maximum operating expenses	\$9,693	\$13,909	\$17,275	\$26,002	\$2,296	\$7,078	\$12,125	\$26,002
Division with minimum operating expenses	\$9,236	\$12,517	\$14,893	\$20,892	\$1,804	\$5,587	\$9,619	\$20,892

For the Flexible Purchase Payment Contract, the examples using current expenses reflect the annual administrative charge of \$35 as an annual charge of 0.04%. The examples using maximum expenses reflect the annual administrative charge of \$50 as an annual charge of 0.05%.

The examples should not be considered a representation of past or future expenses. Your actual expenses may be higher or lower than those shown in the examples. The assumed 5% annual rate of return is hypothetical. Actual returns may be greater or less than the assumed hypothetical return.

Principal Risks of Investing in the Contract

There are risks associated with investing in the Contract. You can lose money in a variable annuity, including potential loss of your original investment. The value of your investment and any returns will depend on the performance of the Funds you select. Each Fund may have its own unique risks. You bear the risk of any decline in your Contract Value resulting from the poor performance of the Funds you have selected.

Variable annuities are not a short-term investment vehicle. The CDSC may apply for a number of years, so the Contract should only be purchased for the long-term. Under some circumstances, you may receive less than the sum of your Purchase Payments. In addition, full or partial withdrawals will be subject to income tax to the extent that they consist of earnings and may be subject to a 10% additional income tax if taken before age 59½. Accordingly, you should carefully consider your income and liquidity needs before purchasing a Contract. Additional information about these risks appear in “Important Information You Should Consider About the MassMutual Flex Extra Variable Annuity,” “Withdrawals,” and “Taxes.”

Investment Risk. You bear the risk of any decline in the Contract Value caused by the performance of the Funds held by the Divisions. Those Funds could decline in value very significantly, and there is a risk of loss of your entire amount invested. The risk of loss varies with each Fund. The investment risks are described in the prospectuses for the Funds.

Insurance Company Insolvency. It is possible that we could experience financial difficulty in the future and even become insolvent, and therefore unable to provide all of the guarantees and benefits that we promise that exceed the value of the assets in the Separate Account. Similarly, our experiencing financial difficulty could interfere with our ability to fulfill our obligations under the GPA option and other General Account obligations.

Tax Consequences. Withdrawals are generally taxable to the extent of any earnings in the Contract, and prior to age 59½ an additional income tax may apply to the taxable portion of the withdrawal. In addition, even if the Contract is held for years before any withdrawal is made, earnings are taxable as ordinary income rather than capital gains. Earnings for this purpose consist of Contract Value in excess of your after-tax investment in the Contract.

Cybersecurity and Certain Business Continuity Risks. Our operations support complex transactions and are highly dependent on the proper functioning of information technology and communication systems. Any failure of or gap in the systems and processes necessary to support complex transactions and avoid systems failure, fraud, information security failures, processing errors, cyber intrusion, loss of data and breaches of regulation may lead to a materially adverse effect on our results of operations and corporate reputation. In addition, we must commit significant resources to maintain and enhance our existing systems in order to keep pace with applicable regulatory requirements, industry standards and customer preferences. If we fail to maintain secure and well-functioning information systems, we may not be able to rely on information for product pricing, compliance obligations, risk management and underwriting decisions. In addition, we cannot assure investors or consumers that interruptions, failures or breaches in security of these processes and systems will not occur, or if they do occur, that they can be timely detected and remediated. The occurrence of any of these events may have a materially adverse effect on our businesses, results of operations and financial condition.

For additional detail regarding cybersecurity and related risks, please see “Other Information – Computer System, Cybersecurity, and Service Disruption Risks” in this prospectus.

General Information about Massachusetts Mutual Life Insurance Company, the Separate Account and the Investment Choices

The Company

MassMutual and its domestic life insurance subsidiaries provide individual and group life insurance, disability insurance, individual and group annuities and guaranteed interest contracts to individual and institutional customers in all 50 states of the U.S., the District of Columbia and Puerto Rico. Products and services are offered primarily through MassMutual's distribution channels: MassMutual Financial Advisors, MassMutual Strategic Distributors, Institutional Solutions and Worksite.

MassMutual is organized as a mutual life insurance company. MassMutual's home office is located at 1295 State Street, Springfield, Massachusetts 01111-0001.

Financial Condition of the Company

We use General Account assets for many purposes, including to pay death benefits, Annuity Payments, withdrawals and transfers from fixed account investment choices and to pay amounts we provide to you through any elected additional feature that are in excess of your Contract Value allocated to the Separate Account. Any amounts that we may be obligated to pay under the Contract in excess of Contract Value are subject to our financial strength and claims-paying ability and our long-term ability to make such payments. The assets of the Separate Account, however, are also available to cover the liabilities of our General Account, but only to the extent they exceed our liabilities under the Contract and other contracts we issue that are funded by the Separate Account.

We issue other types of insurance policies and financial products as well, and we pay our obligations under those products from our assets in the General Account.

As an insurance company, we are required by state insurance regulation to hold a specified amount of reserves in order to meet the contractual obligations of our General Account to our insurance policies and financial products. We monitor our reserves so that we hold sufficient amounts to cover actual or expected Contract and claims payments. In addition, we hedge our investments in our General Account and may require that purchasers of certain of our variable insurance products allocate Purchase Payments and Contract Value according to specified investment requirements. Even with these safeguards in place, there are risks to purchasing any insurance product and there is no guarantee that we will always be able to meet our claims-paying obligations.

State insurance regulators also require insurance companies to maintain a minimum amount of capital, which acts as a cushion if the insurer suffers a financial setback because of the inherent risks in the insurer's operations. These risks include losses that we may incur as the result of defaults on the payment of interest or principal on our General Account assets – e.g., bonds, mortgages, general real estate investments, and stocks – as well as the loss in market value of these investments.

We continue to evaluate our investment portfolio to mitigate market risk and actively manage the investment in that portfolio.

The MassMutual financial information in the SAI includes a more detailed discussion of the risks inherent in our General Account assets. We encourage both existing and prospective Contract Owners to read and understand our financial statements.

The Separate Accounts

We established Massachusetts Mutual Variable Annuity Separate Account 1 (Separate Account 1) as a separate account for Qualified Contracts under Massachusetts law on April 8, 1981. We established Massachusetts Mutual Variable Annuity Separate Account 2 (Separate Account 2) as a separate account for Non-Qualified Contracts under Massachusetts law on October 14, 1981. The Separate Accounts are registered with the SEC as unit investment trusts under the 1940 Act.

The Separate Accounts hold the assets that underlie the Contracts (and certain other contracts that we issue), except any assets allocated to our General Account. We keep the assets of each Separate Account separate from the assets of our General Account and other Separate Accounts. The Separate Accounts are divided into Divisions, each of which invests exclusively in a single Fund.

We own the assets of the Separate Accounts. We credit gains to, or charge losses against, the Separate Accounts, whether or not realized, without regard to the performance of other investment accounts. The assets of the Separate Accounts may not be used to pay any of our liabilities other than those arising from the Contracts (or other contracts that we issue and that are funded by the Separate

Account). If assets of the Separate Accounts exceed the required reserves and other liabilities, we may transfer the excess to our General Account. The obligations of each Separate Account are not our generalized obligations and will be satisfied solely by the assets of each Separate Account. We are obligated to pay all amounts promised to investors under the Contract.

The Guaranteed Principal Account (GPA)

We offer one fixed account as an investment choice within our General Account, referred to as the Guaranteed Principal Account (GPA).

Purchase Payments allocated to the GPA and transfers to the GPA become part of our General Account which supports insurance and annuity obligations. The General Account has not been registered under the Securities Act of 1933 (1933 Act) nor is the General Account registered under the 1940 Act because of exemptive and exclusionary provisions. Accordingly, neither the General Account nor any interests therein are generally subject to the provisions of the 1933 Act or the 1940 Act. Disclosures regarding the GPA or the General Account, however, are subject to certain generally applicable provisions of the federal securities laws relating to the accuracy and completeness of statements made in this prospectus.

Subject to restrictions detailed under "Transfers and Transfer Programs" and "Withdrawals," you may make transfers of your Contract Value into or from the GPA and withdrawals from the GPA. You do not participate in the investment performance of the assets in the GPA. Instead, we credit your Contract with interest at a specified rate that we declare in advance. We guarantee this rate will be at least 3.5% per year. We may also credit a higher rate of interest at our discretion.

Although we are not obligated to credit interest at a rate higher than 3.5%, we will credit and guarantee a secondary interest rate, that may be higher but will never be lower than 3.5%, for each calendar year period. In addition, we may pay a rate of interest in excess of the secondary guarantee for periods we deem appropriate.

For tax-sheltered annuities (TSAs), we credit interest on loaned amounts held in the GPA at a daily rate equivalent to the greater of:

- 3.5% per year, or
- the adjustable loan interest rate in effect, less an amount that will not exceed 4%.

The Funds

Information about each Fund, including its name, type or investment objective, investment adviser(s), expenses and performance is available in an appendix to this Prospectus. See "Appendix A – Funds Available Under the Contract." There is no assurance that any of the Funds will achieve their stated objectives.

These Funds are only available to insurance company separate accounts and qualified retirement plans, are not available for purchase directly by the general public, and are not the same as other mutual fund portfolios with very similar or nearly identical names and investment goals and policies that are sold directly to the public. While a Fund may have many similarities to these other publicly available mutual funds, you should not expect the investment results of the Fund to be the same as the investment results of those publicly available mutual funds. We do not guarantee or make any representation that the investment results of the Funds will be comparable to the investment results of any other mutual fund, even a mutual fund with the same investment adviser or manager.

The prospectus for each Fund contains more detailed information about the Fund. You may obtain copies of the Fund prospectuses by contacting our Service Center. If you received a summary prospectus for a Fund, please follow the directions on the first page of the summary prospectus to obtain a copy of the full Fund prospectus.

Addition, Removal, Closure or Substitution of Funds

We have the right to change the Funds offered through the Contract, but only as permitted by law. If the law requires, we will also get your approval and the approval of any appropriate regulatory authorities. Changes may only impact certain Contract Owners. Examples of possible changes include: adding new Funds or fund classes; removing existing Funds or fund classes; closing existing Funds or fund classes; or substituting a Fund with a different Fund. New or substitute Funds may have different fees and expenses. We will not add, remove, close or substitute any shares attributable to your interest in a Division without notice to you and prior approval of the SEC, to the extent required by applicable law. We reserve the right to transfer Separate Account assets to another separate account that we determine to be associated with the class of contracts to which your Contract belongs.

Conflicts of Interest

The Funds available with the Contract may also be available to registered separate accounts offering variable annuity and variable life products of other affiliated and unaffiliated insurance companies, as well as to the Separate Account and other separate accounts of MassMutual. Although we do not anticipate any disadvantages to this, it is possible that a material conflict may arise between the interests of the Separate Account and one or more of the other separate accounts participating in the Funds. A conflict may occur, for example, as a result of a change in law affecting the operations of variable life and variable annuity separate accounts, differences in the voting instructions of the owners and payees and those of other insurance companies, or some other reason. In the event of a conflict of interest, we will take steps necessary to protect owners and payees, including withdrawing the Separate Account from participation in the Funds involved in the conflict or substituting shares of other funds.

We do not recommend or endorse any particular Fund, and we do not provide investment advice. You are responsible for choosing the Funds, and the amounts allocated to each, that are appropriate for your own individual circumstances and your investment goals, financial situation, and risk tolerance. You bear the risk of any decline in your Contract Value resulting from the performance of the Funds that you choose.

Selection of Funds

When we select the Funds offered through the Contract, we consider various factors, including, but not limited to, asset class coverage, the strength of the adviser's or sub-adviser's reputation and tenure, brand recognition, performance, and the capabilities and qualifications of each investment firm. We may also consider whether the Fund, its service providers (e.g., the investment adviser or sub-advisers), or its affiliates will make payments to us or our affiliates in connection with certain administrative, marketing, and support services, or whether affiliates of the Fund can provide marketing and distribution support for sales of the Contracts. (For additional information on these arrangements, see the section below entitled "Compensation We Receive from Funds, Advisers and Sub-Advisers.") We review the Funds periodically and may remove a Fund or limit its availability to new Purchase Payments and/or transfers of Contract Value if we determine that a Fund no longer satisfies one or more of the selection criteria, and/or if the Fund has not attracted significant allocation from Contract Owners.

Compensation We Receive from Funds, Advisers and Sub-Advisers

Compensation We Receive from Advisers and Sub-Advisers

We and certain of our insurance affiliates receive compensation from the advisers and sub-advisers to some of the Funds. We may use this compensation to pay expenses that we incur in promoting, issuing, distributing and administering the Contract and in providing services on behalf of the Funds in our role as intermediary to the Funds. The amount of this compensation is determined by multiplying a specified annual percentage rate by the average net assets held in that Fund that are attributable to the variable annuity and variable life insurance products issued by us and certain of our insurance affiliates that offer the particular Fund. These percentage rates differ, but currently do not exceed 0.22%.

Some advisers and sub-advisers pay us more than others; some do not pay us any such compensation.

The compensation may not be reflected in a Fund's expenses because this compensation may not be paid directly out of a Fund's assets. These payments also may be derived, in whole or in part, from the advisory fee deducted from Fund assets. Contract Owners, through their indirect investment in the Funds, bear the costs of these advisory fees (see the Funds' prospectuses for more information).

In addition, we may receive fixed dollar payments from the advisers and sub-advisers to certain funds so that the adviser and sub-adviser can participate in sales meetings conducted by us. Attending such meetings provides advisers and sub-advisers with opportunities to discuss and promote their funds. For a list of the Funds whose advisers and sub-advisers currently pay such compensation, visit www.MassMutual.com/legal/compensation-arrangements or call our Service Center.

Voting Rights

We are the legal owner of the Fund shares. When a Fund solicits proxies in conjunction with a vote of shareholders, we are required to obtain, from you and other Contract Owners, instructions as to how to vote those shares.

When we receive those instructions, we will vote all the shares for which we do not receive voting instructions in proportion to those instructions. This will also include any shares that we own on our own behalf. This may result in a small number of Contract Owners controlling the outcome of a vote. If we determine that we are no longer required to vote shares in accordance with Contract Owner instructions, we will vote the shares in our own right.

During the Accumulation Phase, we determine the number of shares you may vote by dividing your Contract Value in each Fund by \$100, including fractional shares. You do not have any voting rights during the Annuity Phase.

We may, when required by state insurance regulatory authorities, disregard voting instructions, if such instructions would require shares to be voted so as to cause a change in the sub-classification or investment objective of a Fund or to approve or disapprove an investment advisory contract for the Fund. In addition, we may disregard voting instructions that would require a change in the investment policy or investment adviser of one or more of the available Funds. Our disapproval of such change must be reasonable and based on a good faith determination that the change would be contrary to state law or otherwise inappropriate, considering the Fund's objectives and purpose. If we disregard Contract Owner voting instructions, we will advise Contract Owners of our action and the reasons for such action.

Charges and Deductions

This section describes the charges and deductions we make under the Contract to compensate us for the services and benefits we provide, costs and expenses we incur and risks we assume. We may profit from the charges deducted and we may use any such profits for any purpose, including payment of marketing and distribution expenses. These charges and deductions reduce the return on your investment in the Contract.

Insurance Charges

Each Business Day we deduct our insurance charges from the assets of the Separate Account. This charge is calculated based on a percentage of the daily value of the assets invested in each Fund, after Fund expenses are deducted. We do this as part of our calculation of the value of the Accumulation Units and the annuity units. The insurance charge has two parts:

- the mortality and expense risk charge; and
- the administrative expense charge.

Mortality and Expense Risk Charge

The mortality and expense risk is for:

- the mortality risk associated with the insurance benefits provided, including our obligation to make Annuity Payments after the Maturity Date regardless of how long all Annuitants live, the death benefits, and the guarantee of rates used to determine your Annuity Payments during the Income Phase; and
- the expense risk that the current charges will be insufficient to cover the actual cost of administering the Contract.

We may increase the mortality and expense risk charge at any time while you own the Contract, but the charge will never exceed 1.25%.

Mortality and Expense Risk Charge		
<i>When Charge is Deducted</i>	<i>Current (annual rate)</i>	<i>Maximum (annual rate)</i>
Daily as a percentage of the daily value of the assets invested in each Division	1.15%	1.25%

For all Contracts, if the amount of the charge is more than sufficient to cover the mortality and expense risk, we will make a profit on the charge. We may use this profit for any purpose, including the payment of marketing and distribution expenses for the Contract. If the mortality and expense risk charge is not sufficient to cover the mortality and expense risk, we will bear the loss. If this is the case, we may raise the mortality and expense risk charge in order to restore profitability. In no case will we raise the charge above the maximum amount.

Administrative Expense Charge

This charge reimburses us for the expenses associated with the administration of the Contract and the Separate Account. Some of these expenses are: preparation of the Contract, confirmations, annual reports and statements, maintenance of Contract records, personnel costs, legal and accounting fees, filing fees, and computer and systems costs.

Administrative Expense Charge		
<i>When Charge is Deducted</i>	<i>Current (annual rate)</i>	<i>Maximum (annual rate)</i>
Daily as a percentage of the daily value of the assets invested in each Division	0.15%	0.25%

Administrative Charge

Starting in the second Contract Year, we impose a charge against each Contract to reimburse us for expenses relating to the issuance and maintenance of the Contract. We may increase this charge at any time while you own the Contract, but the charge will never exceed \$50.

Administrative Charge			
<i>When Charge is Deducted</i>	<i>Current</i>	<i>Maximum</i>	
On the first day of the Contract Year	Single Purchase Payment Contract Flexible Purchase Payment Contract	\$30 \$35	\$50 \$50

We have set the administrative charge and the administrative expense charge so that we will not make a profit on these charges. We make this deduction from the Funds you have selected in the order noted in your Contract and then from the GPA. The charge we impose against amounts in the GPA will not be greater than 1% of your Contract Value in the GPA on the Contract Anniversary.

Transfer Fee

There is no charge for transfers during the Accumulation Phase. We do not allow transfers during the Income Phase.

Contingent Deferred Sales Charge (CDSC)

We do not deduct a sales charge when we receive a Purchase Payment. However, we may assess a CDSC for withdrawals that exceed the free withdrawal amount. We may also apply the charge if you elect a Fixed Time Payment Option with a payment period of less than ten years. See "The Income Phase – Annuity Options – Fixed Time Payment Option." We use this charge to cover certain expenses relating to the sale of the Contract. The charge is a percentage of the amount you withdraw that exceeds the free withdrawal amount.

If we assess a CDSC, we will deduct it from the amount you withdraw or apply to the Fixed Time Payment Option.

The CDSC is assessed as follows:

CDSC	<i>Contract Year When Withdrawal is Made or Contract Value is Applied to Certain Annuity Options*</i>	<i>CDSC for Flexible Purchase Payment Contracts (as a percentage of the amount you withdraw or apply to certain Annuity Options*)</i>	<i>CDSC for Single Purchase Payment Contracts (as a percentage of the amount you withdraw or apply to certain Annuity Options*)</i>
	1	8%	5%
	2	8%	4%
	3	7%	3%
	4	6%	2%
	5	5%	1%
	6	4%	0%
	7	3%	0%
	8	2%	0%
	9	1%	0%
	10 and later	0%	0%

* See "The Income Phase – Annuity Options – Fixed Time Payment Option."

See "Appendix B – Contingent Deferred Sales Charge and Free Withdrawal Amount Examples."

In addition to the free withdrawals described later in this section, we will not impose a CDSC under the following circumstances.

- Upon payment of the death benefit.
- On amounts withdrawn as RMDs, to the extent they exceed the free withdrawal amount. In order to qualify for this exception, the annual RMD must be calculated by us, based solely on the fair market value of the Contract. If you choose to take withdrawals from the Contract to satisfy your RMDs for other qualified assets, a CDSC may apply.
- Upon application of the Contract Value to any Single Life or Joint and Survivor Life Annuity Option, or to a Period Certain Annuity of at least ten years.
- If you redeem excess contributions from a plan qualifying for special income tax treatment. These types of plans are referred to as qualified plans, including Individual Retirement Annuities (IRAs). We look to the Internal Revenue Code for the definition and description of excess contributions.
- Under a replacement program offered by us, when the Contract is exchanged for another variable annuity contract issued by us or one of our affiliated insurance companies, of the type and class which we determine is eligible for such an exchange. A CDSC may apply to the contract received in the exchange. A reduced CDSC schedule may apply under the Contract if another variable annuity contract issued by us or one of our affiliated insurance companies is exchanged for the Contract. Exchange programs may not be available in all states. We have the right to modify, suspend or terminate any exchange program any time without prior notification. If you want more information about our current exchange programs, if any, contact your registered representative or us at our Service Center.
- If you apply your entire Contract Value to purchase a single premium immediate life annuity or a fixed deferred annuity issued by us or one of our affiliates, subject to certain restrictions.
- On any withdrawals made or amounts applied to an Annuity Option when you reach the latest permitted Maturity Date for your Contract.

Free Withdrawals

Each Contract Year and on the Maturity Date, you may withdraw or apply to an Annuity Option, without incurring a Contingent Deferred Sales Charge, up to 10% of your Contract Value. You may take this 10% in multiple withdrawals each Contract Year.

We have a different free withdrawal provision for Contracts purchased by a Charitable Remainder Trust. Subject to state availability, we will not impose a Contingent Deferred Sales Charge on withdrawals in each Contract Year equal to the greater of:

- 10% of the Contract Value on the date of the first withdrawal in the Contract Year; or
- earnings in the Contract as of the date of the withdrawal.

Any unused free withdrawal amount(s) during any particular Contract Year may not be carried over to any succeeding Contract Year.

See "Appendix B – Contingent Deferred Sales Charge and Free Withdrawal Amount Examples."

Premium Taxes

Some states and other governmental entities charge Premium Taxes or similar taxes. We are responsible for the payment of these taxes and will make a deduction either for them from your Purchase Payments when they are made, from your Contract Value when you make withdrawals, when you enter the Income Phase, or upon your death, depending on your state of residence, or we may adjust the annuity rates for Premium Tax assessed. Premium Taxes generally range from 0% to 3.5%, depending on the state.

Income Taxes

We will deduct from the Contract any income taxes which we incur because of the operation of the Separate Account. At the present time, we are not making any such deductions. We will deduct any withholding taxes required by law.

Fund Expenses

The Separate Accounts purchase shares of the Funds at net asset value. The net asset value of each Fund reflects investment management fees and other expenses already deducted from the assets of the Fund. In addition, one or more of the Funds available as an investment choice may pay a distribution fee out of the Fund's assets to us known as a 12b-1 fee. Any investment in one or more of the Funds with a 12b-1 fee will increase the cost of your investment in the Contract. Please refer to the Fund prospectuses for more information regarding these expenses.

Ownership

Contract Owner

In this prospectus, "you" and "your" refer to the Contract Owner. The Contract Owner is named at the time you apply for a Contract. The Contract Owner can be an individual or a non-natural person (e.g., a corporation, limited liability company, partnership or certain other entities).

If your Contract is Non-Qualified and owned by a non-natural person, the Contract will generally not be treated as an annuity for tax purposes. This means that gain in the Contract will be taxed each year while the Contract is in the Accumulation Phase. This treatment is not generally applied to a Contract held by a trust or other entity as an agent for a natural person. Before purchasing a Contract to be owned by a non-natural person or before changing ownership on an existing Contract that will result in it being owned by a non-natural person, you should consult a tax adviser to determine the tax impact. See "Taxes – Non-Natural Owner."

In most states, we would not issue a Flexible Purchase Payment Contract to you if you were 75½ years or older as of the date we proposed to issue the Contract.

As the Contract Owner of the Contract, you exercise all rights under the Contract. The Contract Owner names the Beneficiary.

Contracts under qualified plans, including section 457 deferred compensation plans, generally must be held by the plan sponsor or plan trustee. Except for TSAs, Keogh plans, and Individual Retirement Annuities (IRAs), an individual cannot be the Contract Owner under a Contract held to fund a qualified plan. Therefore, the individuals covered by the qualified plan have no ownership rights.

Annuitant

The Annuitant is the person on whose life we base Annuity Payments. You may change the Annuitant before the Maturity Date subject to our approval. However, the Annuitant may not be changed on a Contract owned by a non-natural person unless the Contract was issued under a plan pursuant to IRC Section 401(a), 408(a), 408(b) or 408A. We will use the age of the Annuitant to determine all applicable benefits under a Contract owned by a non-natural person.

Beneficiary

The Beneficiary is the person(s) or entity(ies) you name to receive any death benefit. You name the Beneficiary at the time of application. You may change the Beneficiary at any time before you die. To change an irrevocable Beneficiary, we must receive written authorization on our form in Good Order at our Service Center from the irrevocable Beneficiary.

You can name different classes of Beneficiaries, such as primary or secondary. These classes set the order of payment. There may be more than one Beneficiary in a class.

If you are married and your Contract is issued under an ERISA plan, your ability to name a primary Beneficiary other than your spouse is restricted.

Beneficiary IRA

Beneficiary, Inherited, Legacy or “Stretch” IRAs are all terms used to describe an IRA that is used exclusively to distribute death proceeds of an IRA or other qualified investment to the Beneficiary over that Beneficiary’s life expectancy in order to meet the Required Minimum Distribution (RMD) rules. Upon the contract owner’s death under an IRA or other qualified contract, an “Eligible Designated Beneficiary” may generally establish a Beneficiary IRA by either purchasing a new annuity contract or, in some circumstances, by electing the Beneficiary IRA payout option under the current contract. Until withdrawn, amounts in a Beneficiary IRA continue to be tax-deferred. Amounts withdrawn each year, including amounts that are required to be withdrawn under the RMD rules, are subject to tax.

If the contract owner died on or before December 31, 2019 (on or before December 31, 2021 for participants of a governmental plan or a plan maintained pursuant to a collective bargaining agreement), an individual designated Beneficiary, and certain trusts as Beneficiary, are treated as Eligible Designated Beneficiaries, and can elect to take distributions over their life expectancy (life expectancy of the oldest trust Beneficiary).

However, if the contract owner dies on or after January 1, 2020 (on or after January 1, 2022 for participants of a governmental plan or a plan maintained pursuant to a collective bargaining agreement), only certain designated Beneficiaries are treated as Eligible Designated Beneficiaries, and we will only offer the Beneficiary IRA payout option to a designated beneficiary who either (1) is the surviving spouse of the deceased qualified plan participant or IRA owner or, (2) is not more than 10 years younger than the deceased qualified plan participant or IRA owner. In the future, we may allow additional classes of Eligible Designated Beneficiaries to elect the Beneficiary IRA payout option. See “Death Benefit – Beneficiary IRA.”

Purchasing a Contract

We no longer sell the Flex Extra variable annuity contract. However, we do continue to administer existing Contracts. If you have a flexible Purchase Payment Contract, you may continue making additional Purchase Payments to your Contract.

Purchase Payments

The minimum amount we accepted for an initial Purchase Payment was:

- \$2,000, if you intend to make only one Purchase Payment over the lifetime of the Contract; or
- \$600, divided by the number of installments (not more than 12) which you expect to make each year.

The maximum amount total Purchase Payments we will allow without home office approval is \$1 million (\$500,000 in New Jersey).

You can make additional Purchase Payments by sending payments to one of our purchase payment processing centers:

- **by check** that clearly indicates your name and Contract number mailed to:

First Class Mail
MassMutual VA
Annuity Payment
Services
MassMutual
PO Box 92714
Chicago, IL 60675-2714

Overnight Mail
MassMutual VA
Annuity Payment Services
5450 N. Cumberland Ave.
Suite 100
Lockbox 92714
Chicago, IL 60656

- **by wire transfer** to:

JP Morgan Chase Bank
New York, New York
ABA #021000021
MassMutual Account #323956297
Ref: Annuity Contract #
Name: (Your Name)

You may also send Purchase Payments to our Service Center.

We have the right to reject any application or Purchase Payment.

Automatic Investment Plan (AIP)

Under the AIP, you may authorize us to periodically draw funds from an account of your choosing (restrictions may apply) for the purpose of making Purchase Payments to your Contract. Contact our Service Center for information regarding setting up an AIP and any restrictions regarding use of the AIP.

Allocation of Purchase Payments

When you purchased your Contract, we allocated your Purchase Payment among the investment choices according to the allocation instructions you provided. If you make additional Purchase Payments, we will allocate them based on your current allocation instructions, unless you request a different allocation by sending us a Written Request.

Any allocations to the Divisions that invest in the Funds that you have selected must be in whole percentages and must total 100%.

If you add more money to your Contract by making additional Purchase Payments, we will credit these amounts to your Contract on the Business Day we receive them and all necessary information in Good Order at our Service Center or lockbox.

If we receive your Purchase Payment at our Service Center or lockbox on a Non-Business Day or after the Business Day closes, we will credit the amount to your Contract effective the next Business Day. Our Business Day closes when the New York Stock Exchange (NYSE) closes, usually 4:00 p.m. Eastern Time.

Contract Value

Your Contract Value is the sum of your value in the Divisions and the GPA.

The value of your investments in the Separate Account will vary depending on the investment performance of the Funds you choose. In order to keep track of your Contract Value in the Separate Account, we use a unit of measure called an Accumulation Unit.

During the Income Phase of your Contract, we call the unit an annuity unit if a variable Annuity Option is elected.

Accumulation Units

During the Accumulation Phase, Accumulation Units shall be used to account for all amounts allocated to or withdrawn from the Divisions as a result of Purchase Payments, withdrawals, transfers, or fees and charges. The Company will determine the number of Accumulation Units of a Division purchased or sold. This will be done by dividing the amount allocated to (or the amount withdrawn from) the Division by the dollar value of one Accumulation Unit of the Division as of the end of the Business Day during which the transaction is received in Good Order at our Service Center.

The Accumulation Unit value for each Division was arbitrarily set initially at \$10. Subsequent Accumulation Unit values for each Division are determined for each day in which the New York Stock Exchange is open for business (Business Day) by multiplying the Accumulation Unit value for the immediately preceding Business Day by the net investment factor for the Division for the current Business Day.

The net investment factor for each Division is determined by dividing A by B and subtracting C where:

A is (i) the net asset value per share of the funding vehicle or portfolio of a funding vehicle held by the Division for the current Business Day; plus (ii) any dividend per share declared on behalf of such funding vehicle or portfolio of a funding vehicle that has an ex-dividend date within the current Business Day; less (iii) the cumulative charge or credit for taxes reserved which is determined by the Company to have resulted from the operation or maintenance of the Division.

B is the net asset value per share of the funding vehicle or portfolio held by the Division for the immediately preceding Business Day, minus the cumulative charge or credit for taxes reserved which is determined by MassMutual to have resulted from the operation or maintenance of the Division as of the immediately preceding Business Day.

C is the cumulative charge since the immediately preceding Business Day for the insurance charges.

The Accumulation Unit value may increase or decrease from Business Day to Business Day.

Example:

On Monday we receive an additional Purchase Payment of \$5,000 from you. You have told us you want this to go to the MML Managed Bond Division. When the NYSE closes on that Monday, we determine that the value of an Accumulation Unit for the MML Managed Bond Division is \$13.90. We then divide \$5,000 by \$13.90 and credit your Contract on Monday night with 359.71 Accumulation Units for the MML Managed Bond Division.

Right to Cancel Your Contract

You have a right to examine your Contract (sometimes referred to as a free look period). If you change your mind about owning your Contract, you can cancel it within ten calendar days after receiving it. However, this time period may vary by state. When you cancel the Contract within this time period, we will not assess a CDSC and your Contract will be terminated. The value you will receive back is based on the formula shown in your Contract.

Sending Requests in Good Order

From time to time you may want to submit a request for transfer among investment choices, a withdrawal, a change of Beneficiary, or some other action. We can only act upon your request if we receive it in "Good Order." Generally, your request must include the information and/or documentation we need to complete the action without using our own discretion to carry it out. Additionally, some actions may require that you submit your request on our form. We may, in our sole discretion, determine whether any particular transaction request is in Good Order, and we reserve the right to change or waive any Good Order requirements at any time. To help protect against unauthorized or fraudulent telephone instructions, we will use reasonable procedures to confirm that telephone instructions given to us are genuine. We may record all telephone instructions.

In addition to Written Requests, we may allow requests to our Service Center:

- by fax at (866) 329-4272,
- by email at ANNfax@MassMutual.com,
- by telephone at (800) 272-2216, or
- by internet at www.MassMutual.com.

Fax, telephone, email, or internet transactions may not always be available. Fax, telephone, email, and computer systems can experience outages or slowdowns for a variety of reasons. These outages or slowdowns may prevent or delay our receipt of your request. We may make these additional methods available at our discretion. They may be suspended or discontinued at any time without notice. Not all transaction types can be requested by fax, telephone, email, or the internet.

Transfers and Transfer Programs

General Overview

Generally, you can transfer all or part of your Contract Value among investment choices. However, there are restrictions that are detailed later in this section. You can make transfers by Written Request, email, telephone, fax, or other authorized means. You must clearly indicate the amount and investment choices from and to which you wish to transfer.

We reserve the right, at any time and without prior notice to any party, to terminate, suspend, or modify the transfer provisions of this Contract.

Your registered representative may provide us with instructions on your behalf involving Fund transfers subject to our rules and requirements, including the restrictions on frequent trading and market timing activities.

Your transfer is effective at the Close of Business on the Business Day we receive your Written Request, in Good Order, at our Service Center. If we receive your transfer request at our Service Center in Good Order on a Non-Business Day or after the Close of Business, your transfer request will be effective on the next Business Day.

Transfers During the Accumulation Phase

You may transfer all or part of your Contract Value allocated to a Division or the GPA. You can make a transfer to or from any Division and to or from the GPA. During the Accumulation Phase, we do not assess a transfer fee. We reserve the right to limit transfers to once every 90 days and to not allow transfers during the 30-day period before your Contract enters the Income Phase.

Transfers from the GPA to the Funds are subject to the following restrictions. Due to these restrictions, if you allocate assets to the GPA, it may take several years to transfer the full allocation out of the GPA.

- You are limited to one transfer out of the GPA each Contract Year.
- Annual transfers out of the GPA cannot exceed 25% of the amount you have in the GPA on the date the transfer is made. However, if you transfer 25% of your Contract Value from the GPA for three consecutive Contract Years, the fourth consecutive annual transfer may be for the entire amount in the GPA, provided that no payments or transfers have been made into the GPA during the period.

If your Contract Value in the GPA is \$500 or less at the time of your transfer, then you may transfer the entire amount out of the GPA.

If your Contract is a tax-sheltered annuity (TSA) with a right to make loans, the maximum amount of any transfer from the GPA is the lesser of:

- 25% of the amount in the GPA on the date the transfer is made; or
- the amount in the GPA on the date the transfer is made, less the amount of any outstanding Contract loan.

If your Contract Value in the GPA is \$500 or less at the time of your transfer, then you may transfer the entire amount out of the GPA, less the amount of any outstanding Contract loan.

Finally, we reserve the right to:

- limit the sum of any transfer and partial withdrawals from the GPA during any Contract Year to no more than 25% of the amount in the GPA on the date that the transfer or first partial withdrawal from the GPA is made during that Contract Year; and
- prohibit transfers from the GPA to the MML U.S. Government Money Market Fund.

Transfers During the Income Phase

You may not make any transfers during the Income Phase.

Transfer Programs

For detailed rules and restrictions pertaining to these programs and instructions for electing a program, contact our Service Center.

Overview

We currently offer the following transfer programs: Dollar Cost Averaging Program, Asset Allocation Program, Interest Sweep Option, and GPA Liquidation Program.

These programs are only available during the Accumulation Phase of your Contract. You may participate only in one of these programs at any one time.

Dollar Cost Averaging Program

This program allows you to systematically transfer a set amount from a selected Division to any of the other Division(s) or to the GPA. By allocating amounts on a regular schedule as opposed to allocating the total amount at one particular time, you may be less susceptible to the impact of market fluctuations. Dollar cost averaging does not assure a profit and does not protect you against loss in declining markets. Since dollar cost averaging involves continuous investment in securities regardless of fluctuating price levels of such securities, you should consider your financial ability to continue the program through periods of fluctuating price levels.

Your Dollar Cost Averaging Program will terminate:

- upon payment of the death benefit;
- if the last transfer you selected has been made;
- if you apply your full Contract Value to an Annuity Option;
- if there is insufficient Contract Value in the selected Division to make the transfer; or
- if we receive from you a Written Request or a request over the telephone at our Service Center to terminate the program prior to the next transfer date.

Asset Allocation Program

The Asset Allocation Program allows you to periodically adjust the percentage of your Contract Value allocated to selected investment choices. We will automatically transfer money between investment choices to maintain your desired allocation. With the Asset Allocation Program, you may maintain a balanced and diversified approach to investing, as decreases in one Fund can be offset by gains in another.

This program will terminate:

- upon payment of the death benefit;
- if we make the last transfers you elected;
- if you apply your full Contract Value to an Annuity Option;
- if you request a loan on a TSA Contract; or

- if we receive from you a Written Request or request over the telephone at our Service Center to terminate the program prior to the next transfer date.

Interest Sweep Option

Under this program, we will automatically transfer earnings from your Contract Value in the GPA to any one Fund or combination of Funds that you select. By allocating these earnings to the Funds, you can pursue further growth in the value of your Contract through more aggressive investments. However, the Interest Sweep Option does not assure a profit and does not protect against loss in declining markets.

This program will terminate:

- if your account balance falls below the required minimum amount in the GPA;
- if you apply your full Contract Value to an Annuity Option;
- if you request a loan on a TSA Contract; or
- if we receive from you a Written Request or request over the telephone to terminate the program at our Service Center prior to the next transfer date

GPA Liquidation Program

Under the GPA Liquidation Program, you can automatically transfer 25% of your GPA balance to one or more Funds until your GPA balance is liquidated in the fourth consecutive year. This option lets you systematically transfer your money into more aggressive Funds. The GPA Liquidation Program does not assure a profit and does not protect you against loss in declining markets. There are no required minimum balances, and the program will continue until all your GPA account value is transferred. All transfers are made on an annual basis. You may adjust your allocations at any time.

Your GPA Liquidation Program will terminate:

- upon payment of the death benefit;
- if you request a loan on a TSA Contract;
- if you apply your full Contract Value to an Annuity Option;
- if you add any money to the GPA through transfers or additional Purchase Payments during the 4-year period; or
- if we receive from you a Written Request or request over the telephone at our Service Center to terminate the program prior to the next transfer date

Limits on Frequent Trading and Market Timing Activity

The Contract and its investment choices are not designed to serve as vehicles for what we have determined to be frequent trading or market timing trading activity. We consider these activities to be abusive trading practices that can disrupt the management of a Fund in the following ways:

- by requiring the Fund to keep more of its assets liquid rather than investing them for long-term growth, resulting in lost investment opportunity; and
- by causing unplanned portfolio turnover.

These disruptions, in turn, can result in increased expenses and can have an adverse effect on Fund performance that could impact all Contract Owners and Beneficiaries under the Contract, including long-term Contract Owners who do not engage in these activities. Therefore, we discourage frequent trading and market timing trading activity and will not accommodate frequent transfers of Contract Value among the Funds. Organizations and individuals that intend to trade frequently and/or use market timing investment strategies should not purchase the Contract.

We have adopted policies and procedures to help us identify those individuals or entities that we determine may be engaging in frequent trading and/or market timing trading activities. We monitor trading activity to uniformly enforce those procedures. However, those who engage in such activities may employ a variety of techniques to avoid detection. Our ability to detect frequent trading or market timing may be limited by operational or technological systems, as well as by our ability to predict strategies employed by Contract Owners (or those acting on their behalf) to avoid detection. Therefore, despite our efforts to prevent frequent trading and the market timing of Funds among the Divisions, there can be no assurance that we will be able to identify and curtail every instance of trading of those who trade frequently or those who employ a market timing strategy or those who act as intermediaries on behalf of such persons. Moreover, our ability to discourage and restrict frequent trading or

market timing may be limited by decisions of state regulatory bodies and court orders that we cannot predict.

In addition, some of the Funds are available with variable products issued by other insurance companies. We do not know the effectiveness of the policies and procedures used by these other insurance companies to detect frequent trading and/or market timing. As a result of these factors, the Funds may reflect lower performance and higher expenses across all Contracts as a result of undetected abusive trading practices.

If we, or any investment adviser to any of the Funds available with the Contract, determine that a Contract Owner's transfer patterns reflect frequent trading or employment of a market timing strategy, we will allow the Contract Owner to submit transfer requests by regular mail only. We will not accept other Contract Owner transfer requests if submitted by overnight mail, fax, the telephone, our website, or any other type of electronic medium. Additionally, we may reject any single trade that we determine to be abusive or harmful to the Fund. Orders for the purchase of Fund shares may be subject to acceptance by the Fund. Therefore, we reserve the right to reject, without prior notice, any Fund transfer request if the investment in the Fund is not accepted for any reason.

The Funds may assess a redemption fee (which we reserve the right to collect) on shares held for a relatively short period. The prospectuses for the Funds describe the Funds' frequent trading and market timing policies and procedures, which may be more or less restrictive than the policies and procedures we have adopted. We have entered into a written agreement, as required by SEC regulation, with each Fund or its principal underwriter that obligates us to provide to the Fund promptly upon request certain information about the trading activity of individual Contract Owners, and to execute instructions from the Fund to restrict or prohibit further purchases or transfers by specific Contract Owners who violate the frequent trading or market timing policies established by the Fund.

Contract Owners and other persons with interests in the Contracts should be aware that the purchase and redemption orders received by the Funds generally are "omnibus" orders from intermediaries, such as retirement plans or separate accounts funding variable insurance contracts. The omnibus orders reflect the aggregation and netting of multiple orders from individual owners of variable contracts and/or individual retirement plan participants. The omnibus nature of these orders may limit the Funds in their ability to apply their frequent trading or market timing policies and procedures. It may also require that we restrict or prohibit further purchases or transfers as requested by a Fund on all Contracts owned by a Contract Owner whose trading activity under one variable Contract has violated a Fund's frequent trading or market timing policy. If a Fund believes that an omnibus order reflects one or more transfer requests from Contract Owners engaged in frequent trading or market timing activity, the Fund may reject the entire omnibus order.

We will notify you in writing if we reject a transfer or if we implement a restriction due to frequent trading or the use of market timing investment strategies. If we do not accept a transfer request, no change will be made to your allocations per that request. We will then allow you to resubmit the rejected transfer by regular mail only.

Additionally, we may in the future take any of the following restrictive actions that are designed to prevent the employment of a frequent trading or market timing strategy:

- not accept transfer instructions from a Contract Owner or other person authorized to conduct a transfer;
- limit the number of transfer requests that can be made during a Contract Year; and
- require the value transferred into a Fund to remain in that Fund for a particular period of time before it can be transferred out of the Fund.

We will apply any restrictive action we take uniformly to all Contract Owners we believe are employing a frequent trading or market timing strategy. These restrictive actions may not work to deter frequent trading or market timing activity.

We reserve the right to revise our procedures for detecting frequent trading and/or market timing at any time without prior notice if we determine it is necessary to do so in order to better detect frequent trading and/or market timing, to comply with state or federal regulatory requirements, or to impose different restrictions on frequent traders and/or market timers. If we modify our procedures, we will apply the new procedure uniformly to all Contract Owners.

The Income Phase

Overview

If you want to receive regular income from your annuity, you can elect to apply your Contract Value so that you can receive fixed and/or variable Annuity Payments under one of the Annuity Options described in this section. If your Certificate Value is less than \$2,000 on the Maturity Date or if you elect variable payments and the Annuity Option you elect produces an initial monthly payment of less than \$20, we reserve the right to pay you a lump sum rather than a series of Annuity Payments. If you elect fixed payments and payments amount to less than \$20 each, we reserve the right to change the payment basis to equivalent quarterly, semi-annual, or annual payments.

Electing an Annuity Option

On the Maturity Date, we must have written instructions in Good Order at our Service Center regarding your Annuity Option choice, including whether you want fixed and/or variable payments.

If on the Maturity Date we do not have your instructions, we will assume you elected a variable monthly annuity under a life income option with 120 Annuity Payments guaranteed. We will transfer Contract Value in the GPA, if any, to a money market fund and use your full Contract Value to provide variable Annuity Payments based on your current Fund allocations. If your Contract is a Qualified Contract, we may default you to a different Annuity Option in order to comply with requirements applicable to qualified plans.

Annuity Payment Start Date

You can choose the day, month and year in which Annuity Payments begin; however, the day must be between the 1st and 28th day of the month. We call that date the Maturity Date or the Annuity Payment Start Date. According to your Contract, your Maturity Date must be on or before the Contract Anniversary nearest the Annuitant's 85th birthday. However, you may defer the Maturity Date to age 100 (including for a Charitable Remainder Trust if permitted by state law).

You chose your Maturity Date when you purchased your Contract. After you purchased your Contract, you can request an earlier Maturity Date by Written Request. You can request that we delay your Maturity Date by Written Request or by telephone any time before or on the Maturity Date.

Annuity Payments

On the Maturity Date, you will begin receiving Annuity Payments under the Annuity Option that you elected. Generally, the more frequently the Annuity Payments will be made or the longer the Annuity Phase will last, the lower the amount of the Annuity Payments will be.

Fixed Annuity Payments

If you choose fixed payments, the payment amount will not vary. The amount of your Annuity Payments will depend upon the following:

- the value of your Contract on the Maturity Date;
- the Annuity Option you elect;
- the age and sex of the Annuitant or joint Annuitants, if applicable;
- the minimum guaranteed payout rates associated with your Contract;
- the deduction of a Contingent Deferred Sales Charge (may be deducted under a Fixed Time Payment Option only); and
- the deduction of Premium Taxes, if applicable.

In most states, if the single premium immediate annuity rates offered by MassMutual on the Maturity Date are more favorable than the minimum guaranteed rates listed in your Contract, those rates will be used.

Variable Annuity Payments

If you choose variable payments, the payment amount will vary with the investment performance of the Funds you elect. The first payment amount will depend on the following:

- the value of your Contract on the Maturity Date;
- the Annuity Option you elect;
- the age and sex of the Annuitant or joint Annuitants, if applicable;
- the minimum guaranteed payout rates associated with your Contract;
- an assumed investment rate (AIR) of 4% per year;
- the deduction of a Contingent Deferred Sales Charge (may be deducted under a Fixed Time Payment Option only); and
- the deduction of Premium Taxes, if applicable.

Future variable payments will depend on the performance of the Funds you elected. If the actual performance on an annualized basis exceeds the 4% assumed investment rate plus the deductions for expenses, your Annuity Payments will increase. Similarly, if the actual rate is less than 4% annualized plus the amount of the deductions, your Annuity Payments will decrease.

Annuity Unit Values

In order to keep track of the value of your variable Annuity Payments, we use a unit of measure called an annuity unit. The value of your annuity units will fluctuate to reflect the investment performance of the Funds you elected. We calculate the number of your annuity units at the beginning of the Income Phase. During the Income Phase, the number of annuity units will not change unless you make a withdrawal as permitted under certain Annuity Options or you elect an Annuity Option with reduced payments to the survivor and those payments to the survivor commence.

RMDs for Qualified Contracts

In order to avoid adverse tax consequences, you should begin to take distributions from your Qualified Contract no later than the beginning date required by the IRC. These distributions can be withdrawals or Annuity Payments. The distributions should be at least equal to the minimum amount required by the IRC or paid through an Annuity Option that complies with the RMD rules of IRC Section 401(a)(9). If your Contract is an individual retirement annuity, the required beginning date is no later than April 1 of the calendar year after you reach the "applicable age" specified in IRC Section 401(a)(9)(C). If you were born after December 31, 1950 and before January 1, 1960, your applicable age is 73. If you were born after December 31, 1959, your applicable age is 75. Previously, the age at which RMDs were required to begin was 70½ for those born before July 1, 1949, and 72 for those born after June 30, 1949 and before January 1, 1951. For qualified plans and tax-sheltered annuities, if you are still working for the sponsor when you reach the specified RMD age, you may defer RMDs until the year in which you retire. The option of deferring to retirement is not available if you are a 5% or greater owner of the employer sponsoring your qualified plan.

Limitations on Annuity Options

If you purchased the Contract as a Qualified Contract, the RMD rules that apply to annuitized Contracts during your lifetime may impose restrictions on which Annuity Option you may elect. In addition, in order to ensure that the Contract will comply with the RMD requirements that apply upon your death, you may not elect a joint and survivor Annuity Option with a non-spouse joint Annuitant who is more than 10 years younger than you. Furthermore, if your Contract is issued under an ERISA plan, and you are married when your Contract enters the Income Phase, your ability to elect certain Annuity Options may be limited and/or require spousal consent.

Annuity Options

The following Annuity Options are available. After Annuity Payments begin, you cannot change the Annuity Option or the frequency of Annuity Payments. Also, you may not transfer among the Funds and the GPA. In addition, during the Income Phase we do not allow withdrawals, except under options A, B and D. The Annuity Options below are described in terms of monthly payments. However, if you elect to receive fixed payments, you may request annual, semiannual, or quarterly payments instead. For Qualified Contracts, if, upon the death of the Contract Owner (Annuitant if the Contract is owned by a non-natural person), there are Annuity Payment remaining, we may shorten the remaining payment period in order to ensure that payments do not continue beyond the 10 year post-death distribution period provided under IRC Section 401(a)(9), or

beyond the Beneficiary's life or life expectancy for certain classes of beneficiaries, such as a spouse or an individual who is not more than 10 years younger than the decedent.

(A) *Fixed Income Payment Option (available as a fixed payment only)*. We will make each monthly payment for an agreed fixed amount. Each monthly payment will be at least \$10 for each \$1,000 applied. We will pay interest on the unpaid balance each month at a rate we determine. This rate will not be less than 3% per year. Payments will continue until the amount we hold runs out. The last payment will be for the remaining balance. All or part of the unpaid balance may be withdrawn or applied to another available Annuity Option.

(B) *Fixed Time Payment Option*. We will make fixed and/or variable monthly Annuity Payments for any period elected, up to 30 years. We may deduct a Contingent Deferred Sales Charge if you elect a payment period of less than ten years.

You may elect to withdraw the commuted value of the remaining unpaid monthly Annuity Payments. We may deduct a Contingent Deferred Sales Charge if we did not do so on the Maturity Date.

(C) *Lifetime Payment Option*. We will make fixed and/or variable payments based on the life of the Annuitant. If you elect this option, we will make Annuity Payments:

- without any guaranteed number of payments;
- with payments guaranteed for the amount applied; or
- with a guaranteed number of payments for 5, 10 or 20 years.

(D) *Interest Payment Option (available only on Non-Qualified Contracts and available only as a fixed payment option)*. We will hold any amount applied to this option. We will pay any interest on the unpaid balance each month at a rate we determine. This rate will not be less than 3% per year. All or part of the unpaid balance may be withdrawn or applied to another available Annuity Option.

(E) *Joint Lifetime Payment Option*. We will make fixed and/or variable Annuity Payments, based on the lives of two Annuitants. When one dies, payments continue for the lifetime of the other. The two variations of this option are:

- Payments for two lives only. No specific number of payments is guaranteed. Payments stop when both Annuitants have died.
- Payments guaranteed for ten years. Payments stop at the end of ten years, or when both Annuitants have died, whichever is later.

(F) *Joint Lifetime Payment Option with Reduced Payments*. We will make fixed and/or variable monthly payments based on the lives of two Annuitants. Payments will continue while both are living. When one dies, reduced payments will continue for the lifetime of the other. These reduced payments will be two-thirds of what we would have paid if both persons had continued to live. Payments stop when both persons have died.

Benefits Available Under the Contract

The following table summarizes information about the benefits available under the Contract.

Benefit	Purpose	Benefit is Standard or Optional	Fee	Restrictions/Limitations
Death Benefit	Upon your death, we will pay your designated Beneficiaries the greater of (1) the Contract Value determined as of the Business Day we receive due proof of death in Good Order at our Service Center; or (2) an amount based on your Purchase Payments less any withdrawals and any applicable charges.	Standard	None	<ul style="list-style-type: none">• This benefit terminates upon full surrender or annuitization of the Contract Value.
Asset Allocation Program	Automatically transfers money between the Divisions you select to maintain your original percentage allocation of Contract Value.	Optional	None	<ul style="list-style-type: none">• Cannot use if the Dollar Cost Averaging Program, Interest Sweep Option, or GPA Liquidation Program are in effect.
Dollar Cost Averaging Program	Automatically transfers a specific amount of Contract Value from a Division to other Divisions you have selected, at set intervals.	Optional	None	<ul style="list-style-type: none">• Cannot use if the Asset Allocation Program, Interest Sweep Option, or GPA Liquidation Program are in effect.
Automatic Withdrawal Program	Automatically withdraws a specific amount of Contract Value proportionally from all Divisions you have selected.	Optional	None, but we reserve the right to charge \$3 per withdrawal in the future.	<ul style="list-style-type: none">• In order to participate in this program: (1) there must be at least \$25,000 in Contract Value, and (2) the minimum withdrawal amount must be \$100.
Interest Sweep Option	Automatically transfers earnings from your Contract Value in the GPA to any one Division or combination of Divisions you select.	Optional	None	<ul style="list-style-type: none">• In order to participate in this program there must be at least \$5,000 in Contract Value.• Cannot use if the Asset Allocation Program, Dollar Cost Averaging Program, or GPA Liquidation Program are in effect.
GPA Liquidation Program	Automatically transfers 25% of your GPA balance to one or more Funds until your GPA balance is liquidated in the fourth consecutive year.	Optional	None	<ul style="list-style-type: none">• Cannot use if the Asset Allocation Program, Dollar Cost Averaging Program, or Interest Sweep Option are in effect.
Right to Take Loans	If your certificate is a non-ERISA and non-Texas Optional Retirement Program tax-sheltered annuity, you may be able to take a loan.	Standard	None	<ul style="list-style-type: none">• A portion of your Certificate Value equal to the loan amount is held in the loaned portion of the GPA.• We charge daily interest on any outstanding loan at an effective annual interest rate.• Interest on outstanding loans is due and payable quarterly.• If a required loan repayment is not paid in full within 90 days after its due date, the total existing loan balance will be in default and will be considered a taxable distribution.

Some of the benefits identified in the Benefits Available Under the Contract table are described in more detail following the table and other benefits are disclosed in more detail in other sections of the prospectus.

Death Benefit

Death of Contract Owner During the Accumulation Phase

If you die during the Accumulation Phase, we will pay a death benefit to the primary Beneficiary.

The Beneficiary may request that the death benefit be paid under one of the death benefit options. See "Death Benefit – Death Benefit Payment Options During the Accumulation Phase." If your Contract is a Non-Qualified Contract or is held as a traditional IRA (including SEP IRAs) or Roth IRA and your surviving spouse is the sole primary beneficiary, he or she may elect to become the Contract Owner at the then current Contract Value subject to certain restrictions. See "Payments on Death – Death Benefit Payment Options During the Accumulation Phase."

Death Benefit During the Accumulation Phase

The death benefit values are determined as of the Business Day we receive due proof of death in Good Order at our Service Center. From the time the death benefit is determined until complete distribution is made, any amount in a Division will be subject to investment risk. As a result, the death benefit amount may increase or decrease over time. The risk is borne by the Beneficiary(ies).

The death benefit will be the greater of:

- your Contract Value; or
- your total Purchase Payments, less any withdrawals, and less any applicable charges.

We will deduct the amount of any applicable Premium Taxes, and the amount of any outstanding Contract debt if the Contract is a TSA. We do not impose a Contingent Deferred Sales Charge on death benefit payments.

See "Appendix C – Death Benefit Examples."

Death Benefit Payment Options During the Accumulation Phase

The availability of certain death benefit options may be limited for Qualified Contracts in order to comply with RMD rules.

For Non-Qualified Contracts, a Beneficiary must elect to receive the death benefit under one of the following options in the event that a death benefit becomes payable during the Accumulation Phase:

- **Option 1** – Lump sum payment of the death benefit within five years of the date of death.
- **Option 2** – Payment of the death benefit under an Annuity Option over the lifetime of the Beneficiary or over a period not extending beyond the life expectancy of the Beneficiary with distribution beginning within one year of the date of your death.

For Qualified Contracts, a Beneficiary must elect to receive the death benefit under one of the following options, in the event that a death benefit becomes payable during the Accumulation Phase:

- **Option 1** – Lump sum payment of the death benefit by the end of the calendar year that contains the tenth anniversary of your death (fifth anniversary of your death if you do not have a designated Beneficiary as defined for purposes of IRC Section 401(a)(9), including where your Beneficiary is your estate or certain trusts). If you die after reaching the age at which RMDs must begin, your beneficiary may not elect to defer payment of the lump sum beyond the end of the calendar year after the year of your death.
- **Option 2** – If the Beneficiary is your surviving spouse, or is not more than 10 years younger than you, payment of the death benefit under an Annuity Option over the lifetime of the Beneficiary or over a period not extending beyond the life

expectancy of the Beneficiary. Distribution must generally begin by the end of the calendar year following the year of your death.

Additional Option for a Spouse Who is the Sole Primary Beneficiary

A surviving spouse who is the sole primary Beneficiary under a Contract that is either non-qualified or is held as a traditional IRA (including SEP IRAs) or Roth IRA may elect option 1, option 2, or may elect to continue the Contract. Generally, if the Contract is continued, then:

- the initial value will equal the then-current Contract Value;
- all applicable Contract features and benefits will be in the surviving spouse's name; and
- the surviving spouse will exercise all of the Contract Owner's rights under the Contract.

Exceptions are as follows:

- if at the time the Contract Owner purchased the Contract the surviving spouse was over the maximum Contract issue age, then the Contract cannot be continued.

If the sole primary Beneficiary is a domestic partner or civil union partner, as defined under applicable state laws, we will treat him or her as a spouse for this provision, and he or she may elect to continue the Contract as described herein. However, a domestic partner or civil union partner cannot elect to continue the Contract if it is a traditional IRA or Roth IRA. Since current federal tax law does not define a spouse to include a domestic partner or civil union partner, such domestic partner or civil union partner who elects to continue the Contract must still meet the distribution requirements of IRC Section 72(s). In order to meet these requirements, the amount of any gain in the Contract will become subject to income tax at the time the election to continue the Contract is made.

The right to continue the Contract by a surviving spouse, a domestic partner, or a civil union partner can only be exercised once while the Contract is in effect.

See "Taxes – Civil Unions and Domestic Partnerships" if you are in a domestic partnership or civil union.

Lump Sum Payment

If a lump sum payment is requested, we will pay the amount within seven calendar days after we receive due proof of death and election of the payment method all required forms in Good Order at our Service Center.

Beneficiary IRA

Beneficiary, Inherited, Legacy or "Stretch" IRAs are all terms used to describe an IRA that is used exclusively to distribute death proceeds of an IRA or other qualified investment to the Beneficiary over that Beneficiary's life expectancy in order to meet the Required Minimum Distribution (RMD) rules. Upon the contract owner's death under an IRA or other Qualified Contract, an "Eligible Designated Beneficiary" may generally establish a Beneficiary IRA by either purchasing a new annuity contract or, in some circumstances, by electing the Beneficiary IRA payout option under the current contract. Until withdrawn, amounts in a Beneficiary IRA continue to be tax-deferred. Amounts withdrawn each year, including amounts that are required to be withdrawn under the RMD rules, are subject to tax.

If the contract owner died on or before December 31, 2019 (on or before December 31, 2021 for participants of a governmental plan or a plan maintained pursuant to a collective bargaining agreement), an individual designated Beneficiary, and certain trusts as beneficiary, are treated as Eligible Designated Beneficiaries, and can elect to take distributions over their life expectancy (life expectancy of the oldest trust beneficiary).

However, if the contract owner dies on or after January 1, 2020 (on or after January 1, 2022 for participants of a governmental plan or a plan maintained pursuant to a collective bargaining agreement), only certain designated Beneficiaries are treated as Eligible Designated Beneficiaries, and we will only offer the Beneficiary IRA payout option to a designated Beneficiary who either (1) is the surviving spouse of the deceased qualified plan participant or IRA owner or, (2) is not more than 10 years younger than the deceased qualified plan participant or IRA owner. In the future, we may allow additional classes of Eligible Designated Beneficiaries to elect the Beneficiary IRA payout option.

See "Taxes – Required Minimum Distributions for Qualified Contracts" for more information.

Eligibility Requirements/Restrictions:

If a Beneficiary(ies) elects to establish a Beneficiary IRA after the death of the Owner, or if a Contract was issued as a Beneficiary IRA, the following rules apply:

- For a contract with a single Beneficiary, the Beneficiary will have the option of electing a Beneficiary IRA payout option under the Contract. Should the Beneficiary decide to elect the Beneficiary IRA payout option under the current Contract, any withdrawals in excess of the RMD will not be subject to a CDSC.
- For a contract with multiple Beneficiaries, a Beneficiary IRA payout option is not available under the Contract. However, a Beneficiary wishing to establish a Beneficiary IRA may elect a direct transfer of the lump sum death benefit to a Beneficiary IRA established for their benefit.
- If a contract was issued as a Beneficiary IRA, any withdrawals under a new Beneficiary IRA Contract in excess of the RMD may be subject to a CDSC as indicated by the terms of the Contract purchased.
- The source of funds to be invested must be from a traditional IRA, SEP IRA, SIMPLE IRA, Beneficiary IRA, TSA, 401(a) or a Qualified Employee Plan (includes Pension Plan, Money Purchase Pension Plan, Profit Sharing Plan, Keogh (HR10), Target Benefit Plan).
- The annuity contract will be titled in the Beneficiary's name as Beneficiary for the deceased owner. The Beneficiary must be the Annuitant, and the Annuitant cannot be changed.
- For non-spousal Beneficiary IRAs, RMDs must begin by December 31st of the year following the year of the date of the owner's death. For spousal Beneficiary IRAs, RMDs may be deferred until the year for which the original owner would have been required to begin RMDs. The RMD amount will generally be calculated based on the Beneficiary's life expectancy and will be withdrawn from each Division in the ratio that your value in each bears to your Contract Value. If the original owner died on or before December 31, 2019 (on or before December 31, 2021 for participants of a governmental plan or a plan maintained pursuant to a collective bargaining agreement), after RMDs were required to begin, and was younger than the Beneficiary, the RMD amount may be calculated based on the original owner's life expectancy in the year of his or her death. If there is a Beneficiary IRA previously established with another carrier and an RMD is required in the current calendar year, we will process the RMD. If however, an RMD is not required in the current calendar year, an RMD will not be processed until the year it is required.
- The Contract Value at time the Beneficiary IRA is established will be equal to either the death benefit that would have been payable to the Beneficiary if a lump sum distribution had been elected, or, if a Contract is issued as a Beneficiary IRA, the amount transferred to the Contract.
- Additional contributions cannot be applied to the Beneficiary IRA.
- If a beneficiary elects the Beneficiary IRA payout option under a Contract, upon the death of the Annuitant of the Beneficiary IRA, any remaining Contract Value will be paid to the the succeeding Beneficiary in a lump sum or over the Annuitant's remaining life expectancy as determined under the applicable IRS table, but in no case may payments extend beyond the end of the calendar year that contains the tenth anniversary of the Annuitant's death.
- If a contract was issued as a Beneficiary IRA, upon the death of the Annuitant of the Beneficiary IRA, a death benefit, under the terms of the Contract, will be paid to the succeeding Beneficiary in a lump sum or over the Annuitant's remaining life expectancy as determined by the applicable IRS table, but in no case may payments extend beyond the end of the calendar year that contains the tenth anniversary of the Annuitant's death.
- If the original owner died before January 1, 2020 (before January 1, 2022 for participants of a governmental plan or a plan maintained pursuant to a collective bargaining agreement) and the Beneficiary is a trust, a Beneficiary IRA may only be established if the trust qualifies as a "see-through" trust. For see-through trusts, Required Minimum Distributions must be calculated based upon the life expectancy of the oldest trust Beneficiary and the oldest trust Beneficiary must be the Annuitant. In order to be a see-through trust, the trust must be valid under state law and be irrevocable, and all Beneficiaries, current and future, must be identifiable from the trust instrument. If any Beneficiary of the trust is not an individual, the trust is not a see-through trust and cannot establish a Beneficiary IRA. If the original owner died after December 31, 2019 (after December 31, 2021 for participants of a governmental plan or a plan maintained pursuant to a collective bargaining agreement), we will not offer a Beneficiary IRA to a trust.
- Additional rules may apply. Please consult your registered representative for further information.
- We have the right to modify, suspend or terminate the Beneficiary IRA program at any time without prior notification.

- A Beneficiary IRA may only be established by the Beneficiary of the IRA owner/qualified plan participant whose death triggered the RMD requirements of IRC Section 401(a)(9). A Beneficiary IRA may not be established as a “second generation” Beneficiary IRA by a successor Beneficiary.
- Joint Ownership of a Beneficiary IRA is not allowed.

Beneficiaries should consult a qualified tax adviser for advice prior to establishing a Beneficiary IRA.

Death of Contract Owner During the Income Phase

If you die during the Income Phase and the Annuitant is still alive, we will pay the remaining payments under the Annuity Option elected at least as rapidly as under the method of distribution in effect at the time of your death. For Qualified Contracts, the Beneficiary(ies) may be required to receive an adjusted payment stream in order to comply with Required Minimum Distribution rules that apply upon the Contract Owner/Annuitant’s death. If the Beneficiary is not an “Eligible Designated Beneficiary” as defined by IRC Section 401(a)(9), Annuity Payments may only continue through the end of the calendar year that contains the tenth anniversary of the Contract Owner/Annuitant’s death, even if a longer Annuity Payment option was elected, including a Joint and Last Survivor Annuity Option where the joint Annuitant is still living.

Death of Annuitant

If the Annuitant, who is not the Contract Owner, dies during the Accumulation Phase, you can name a new Annuitant subject to our approval. If you do not name an Annuitant within 30 days of the death of the Annuitant, you will become the Annuitant. If the Contract Owner is a non-natural person and an Annuitant dies, you may not name a new Annuitant. In this case we will treat the death of the Annuitant as the death of the Contract Owner and pay the death benefit as described in “Death Benefit – Death of Contract Owner During the Accumulation Phase.” You cannot name a new Annuitant during the Annuity Phase.

Upon the death of the last surviving Annuitant on or after the Maturity Date, the death benefit, if any, is as specified in the Annuity Option elected. Upon the death of the last surviving Annuitant during the Annuity Phase, any remaining payment under the elected Annuity Option will be paid to the Beneficiary. For Qualified Contracts, the Beneficiary(ies) may be required to receive an adjusted payment stream in order to comply with RMD rules that apply upon the Contract Owner/Annuitant’s death. If the Beneficiary is not an “Eligible Designated Beneficiary” as defined by IRC Section 401(a)(9), Annuity Payments may only continue through the end of the calendar year that contains the tenth anniversary of the Contract Owner/Annuitant’s death, even if a longer Annuity Payment option was elected, including a Joint and Last Survivor Annuity Option where the joint Annuitant is still living.

Due Proof of Death

For purposes of determining due proof of death, we require:

- a certified death certificate; or
- a certified decree of a court of competent jurisdiction as to the finding of death; or
- any other proof satisfactory to us.

Additional Benefits

Right to Take Loans from a TSA Contract

In some states, if your Contract is a non-ERISA and non-Texas Optional Retirement Program tax-sheltered annuity, you may be able to take a loan under your Contract. All such loans must conform to the requirements of the Internal Revenue Code and your specific plan. You must request a loan by mailing, faxing or emailing all required forms in Good Order to our Service Center. Loan proceeds generally are mailed within ten Business Days of the loan being approved.

You are required to repay your loan according to the loan repayment schedule. Loan repayments (including interest due) must be sent to our Service Center and are credited as of the Business Day received. Loan repayments are due quarterly; however, you may make additional repayments. The first repayment will be due three months after the loan was issued. Any repayment will be applied first to the interest accrued to the date your repayment is received, and then to the loan principal. Loan repayments made in addition to regularly scheduled quarterly repayments will be applied to loan principal only and will not change the due dates or amounts of subsequent quarterly payments, but will shorten the term of the loan.

If you request a loan, we will deduct your requested loan amount from your investment choice(s) in proportion to the non-loaned value of each on the date of your loan request. As long as your loan is outstanding, a portion of your Contract Value equal to the loan amount is held in the loaned portion of the GPA. On each Contract Anniversary while a loan is outstanding, an amount of Contract Value equal to any due and unpaid loan interest is also transferred to the loaned portion of the GPA. Upon each loan repayment, we will transfer value equal to the repayment amount from the loaned portion of the GPA to the non-loaned portion of the GPA, unless you request for us to transfer the repayment amount to your investment choice(s) based upon your current Purchase Payment allocation.

We charge interest daily on any outstanding loan at an effective annual interest rate which may change annually. Interest is due and payable quarterly (based on the date the loan was taken). We also credit interest on the loan amount held in the loaned portion of the GPA. The difference between the rate of interest we charge on the loan amount and the rate we credit on the loan amount is the net cost of the loan, which will not exceed 4%.

If a required loan repayment is not paid in full within 90 days after its due date, the total existing loan balance will be determined to be in default. If you default, the outstanding debt will be considered a taxable distribution and we will do appropriate tax reporting. We will withdraw sufficient Contract Value to repay the debt to the extent such withdrawals are not restricted under the Internal Revenue Code. If we cannot make such withdrawals because they are restricted under the Internal Revenue Code, the loan will remain outstanding and continue to accrue interest until it is satisfied.

If you own a TSA Contract with an outstanding loan and are taking an eligible distribution of your entire Contract Value, we will deduct any outstanding Contract Debt from the amount you withdraw. If you make a partial withdrawal, the Contract Value remaining after the withdrawal must not be less than:

- the amount of any loan outstanding; plus
- interest on the loan for 12 months based on the loan interest rate then in effect; plus
- any Contingent Deferred Sales Charge that would apply to such an amount otherwise withdrawn.

Amounts held in the GPA equal to the amount of any outstanding loan are not available for withdrawal

A loan, whether or not repaid, may have a permanent effect on the death benefit and Contract Value because the investment results of the Funds and current interest rates credited to the non-loaned portion of the GPA do not apply to amounts held in the loaned portion of the GPA. Depending on the investment results of the Funds or credited interest rates for the non-loaned portion of the GPA while the loan is outstanding, the effect could be favorable or unfavorable.

Withdrawals

Your ability to take a withdrawal may be restricted by certain provisions of the Internal Revenue Code. Furthermore, if your Contract is issued under a qualified plan, your ability to take a withdrawal may be restricted by your plan documents. Income taxes, tax penalties, CDSC and certain restrictions may apply to any withdrawal you make.

During the Accumulation Phase you may make either partial or full withdrawals of your Contract Value. If you withdraw your full Contract Value, the Contract terminates and does not provide a death benefit.

If you make a partial withdrawal, you must tell us from which investment choices you want the withdrawal taken. When making a partial withdrawal, you must withdraw at least \$100 or the entire value in a Fund or the non-loaned portion of the GPA, if less. We require that after you make a partial withdrawal you keep at least \$500 in the Contract, unless your partial withdrawal is a minimum required distribution. Partial withdrawals may be subject to a Contingent Deferred Sales Charge.

If you request a full withdrawal of your Contract Value, you may ask us to make the payment in one sum or apply the amount to one or more Annuity Options.

We reserve the right to limit the sum of any transfer and partial withdrawals from the GPA during any Contract Year to no more than 25% of the amount in the GPA on the date that the transfer or first partial withdrawal from the GPA is made during that Contract Year.

When you make a full withdrawal you will receive your Contract Value:

- less any applicable CDSC;
- less any applicable Premium Tax; and
- less any Purchase Payments we credited to your Contract that have not cleared the bank, until they clear the bank.

See "Appendix B – Contingent Deferred Sales Charge and Free Withdrawal Amount Examples."

Requests in Writing

To request a withdrawal in writing, submit either a partial withdrawal or full withdrawal form in Good Order to our Service Center. If your withdrawal involves an exchange or transfer of assets to another financial institution, we also require a "letter of acceptance" from the financial institution.

Requests by Other Means

You may request certain partial and full withdrawals by other means we authorize such as email, telephone, or fax. Contact our Service Center for details.

Withdrawal Effective Date

For Written Requests, your withdrawal is effective on the Business Day we receive, in Good Order at our Service Center:

- a partial withdrawal or full withdrawal form acceptable to us; and
- if applicable, a "letter of acceptance."

If we receive this/these item(s) at our Service Center on a Non-Business Day or after the Close of Business, your withdrawal request will be effective on the next Business Day. For email, telephone or fax requests, your withdrawal is effective on the Business Day we receive your request in Good Order, provided it is received prior to the Close of Business. For requests received after the Close of Business, your withdrawal will be effective on the next Business Day.

Delivery of Withdrawal Amount

We will pay any withdrawal amount within seven calendar days of the withdrawal effective date unless we are required to suspend or postpone withdrawal payments. See "Other Information – Payments We Make."

We will pay any full or partial withdrawal to the qualified plan trustee or plan administrator, if you purchased your Contract under a tax-qualified retirement plan, a non-qualified deferred compensation plan or a deferred compensation plan for a tax-exempt organization. The only exceptions are for required minimum distribution payments and for withdrawals from individually-owned Qualified Contracts or Contracts owned under a governmental 457(b) deferred compensation plan.

Automatic Withdrawal Option Program

We may from time to time refer to this as the Systematic Withdrawal Program (SWP).

For detailed rules and restrictions pertaining to this program and instructions for electing the program contact our Service Center.

The Automatic Withdrawal Option Program allows you to set up automatic periodic withdrawals from your Contract Value. We do not charge you for participation in the Automatic Withdrawal Option Program, but we reserve the right to charge up to \$3 per withdrawal in the future.

Your Automatic Withdrawal Option Program will end:

- if you withdraw your total Contract Value;
- if we receive, in Good Order, a notification of the Contract Owner's death;
- if we receive, in Good Order, a notification of the Annuitant's death if the Contract Owner is a non-natural person;
- if we process the last withdrawal for the period you selected, if applicable;
- if the next withdrawal will lower your Contract Value below \$500, unless your withdrawal is an RMD or is made under a SWP intended to qualify as a series of substantially equal periodic payments for purposes of avoiding the additional 10% tax applicable to distributions that occur prior to age 59½;
- if you begin receiving Annuity Payments; or
- if you give us a Written Request or request over the telephone, in Good Order, to terminate the program any time before or on the next withdrawal date. If your Contract is a Beneficiary IRA, your Automatic Withdrawal Option Program cannot be terminated.

Taxes

The information in this prospectus is general and is not an exhaustive discussion of all tax questions that might arise under the Contract. The information is not written or intended as tax or legal advice. You should consult a tax adviser about your own circumstances. In addition, we do not profess to know the likelihood that current federal income tax laws and Treasury Regulations or the current interpretations of the Internal Revenue Code, Regulations, and other guidance will continue. We cannot make any guarantee regarding the future tax treatment of any Contract. We reserve the right to make changes in the Contract to assure that it continues to qualify as an annuity for tax purposes.

No attempt is made in this prospectus to consider any applicable state or other tax laws.

Taxation of the Company

MassMutual is taxed as a life insurance company under the Internal Revenue Code of 1986, as amended (IRC). For federal income tax purposes, the Separate Accounts are not a separate entity from MassMutual, and its operations form a part of MassMutual.

Investment income and any realized gains on Separate Account assets generally are reflected in the Contract Value, although treated as accruing to the Company and not to you. As a result, no taxes are due currently on interest, dividends and short or

long-term gains earned by the Separate Account with respect to your Contract. The Company may be entitled to certain tax benefits related to the

investment of Company assets, including assets of the Separate Account. These tax benefits, which may include foreign tax credits and the corporate dividends received deduction, are not passed back to you since the Company is the owner of the assets from which the tax benefits are derived.

Annuities in General

Annuity contracts are a means of both setting aside money for future needs – usually retirement – and for providing a mechanism to administer the payout of those funds. Congress recognized how important providing for retirement was and created special rules in the IRC for annuities. Simply stated, these rules provide that you will generally not be taxed on the earnings on the money held in your annuity contract until you take the money out. This is referred to as tax deferral.

Diversification

IRC Section 817(h) imposes certain diversification standards on the underlying assets of variable annuity contracts. The IRC provides that a variable annuity contract will not be treated as an annuity contract for any period (and any subsequent period) for which the investments are not, in accordance with regulations prescribed by the United States Treasury Department, adequately diversified. Disqualification of the Contract as an annuity contract would result in a loss of tax deferral, meaning the imposition of federal income tax to the owner with respect to earnings under the Contract prior to the receipt of payments under the Contract. We intend that all investment portfolios underlying the Contracts will be managed in such a manner as to comply with these diversification requirements.

Investor Control of Assets

For variable annuity contracts, tax deferral also depends on the insurance company, and not you, having control of the assets held in the separate accounts. You can transfer among the Divisions but cannot direct the investments each underlying Fund makes. If you have too much investor control of the assets supporting the Separate Account Funds, then you will be taxed on the gain in the Contract as it is earned rather than when it is withdrawn. The IRS has provided some guidance on investor control by issuing Revenue Rulings 2003-91 and 2003-92, but some issues remain unclear. One unanswered question is whether a Contract Owner will be deemed to own the assets in the Contract if a variable contract offers too large a choice of Funds in which to invest, and if so, what that number might be. We do not know if the IRS will issue any further guidance on this question. We do not know if any guidance would have a retroactive effect. Consequently, we reserve the right to modify the Contract, as necessary, so that you will not be treated as having investor control of the assets held under the Separate Account.

Non-Qualified Contracts

Your Contract is referred to as a Non-Qualified Contract if you do not purchase the Contract under a qualified plan such as an Individual Retirement Annuity (IRA), Roth IRA, tax-sheltered annuity plan (TSA or TSA plan), corporate pension and profit-sharing plan (including 401(k) plans and H.R. 10 plans), or a governmental 457(b) deferred compensation plan.

Qualified Contracts

Your Contract is referred to as a Qualified Contract if it is purchased under a qualified retirement plan (qualified plan) such as an Individual Retirement Annuity (IRA), Roth IRA, tax-sheltered annuity plan (TSA or TSA plan), corporate pension and profit-sharing plan (including 401(k) plans and H.R. 10 plans), or a governmental 457(b) deferred compensation plan. Qualified plans are subject to various limitations on eligibility, contributions, transferability and distributions based on the type of plan. The tax rules regarding qualified plans are very complex and will have differing applications depending on individual facts and circumstances. You should consult a tax adviser as to the tax treatment and suitability of such an investment.

Taxation of participants in each qualified plan varies with the type of plan and terms and conditions of each specific plan. Contract Owners, annuitants and beneficiaries are cautioned that benefits under a qualified plan may be subject to the terms and conditions of the plan regardless of the terms and conditions of the contracts issued pursuant to the plan. Some retirement plans are subject to distribution and other requirements that are not incorporated into our administrative procedures. Contract Owners, participants and beneficiaries are responsible for determining that contributions, distributions and other transactions with respect to the contracts comply with applicable law.

Contracts issued under a qualified plan include special provisions restricting contract provisions that may otherwise be available as described in this prospectus. Generally, contracts issued under a qualified plan are not transferable. Various penalty and excise taxes may apply to contributions or distributions made in violation of applicable limitations.

Furthermore, certain withdrawal penalties and restrictions may apply to distributions from Qualified Contracts. See "Taxes – Taxation of Qualified Contracts."

Eligible rollover distributions from an IRA, TSA, qualified plan or governmental 457(b) deferred compensation plan may generally be rolled over into another IRA, TSA, qualified plan or governmental 457(b) deferred compensation plan, if permitted by the plan. These amounts may be transferred directly from one qualified plan or account to another, or as an indirect rollover, in which the plan participant receives a distribution from the qualified plan or account, and reinvests it in the receiving qualified plan or account within 60 days of receiving the distribution.

IRC Section 408(d)(3)(B) provides that an individual is only permitted to make one indirect rollover from an IRA to another IRA in any 1-year period. The IRS previously applied this limitation on an IRA-by-IRA basis, allowing a taxpayer to make an indirect rollover from an IRA, so long as he or she had not made an indirect rollover from that same IRA within the preceding 1-year period, even if he or she had made indirect rollovers from a different IRA. Effective for distributions on or after January 1, 2015, the limitation applies on an aggregate basis, meaning that an individual cannot make an indirect rollover from one IRA to another if he or she has made an indirect rollover involving any IRA (including a Roth, SEP, or SIMPLE IRA) within one year. It is important to note that the one rollover per year limitation does not apply to amounts transferred directly between IRAs in a trustee-to-trustee transfer.

On July 6, 1983, the Supreme Court decided in *Arizona Governing Committee v. Norris* that optional annuity benefits provided under an employer's deferred compensation plan could not, under Title VII of the Civil Rights Act of 1964, vary between men and women. The contracts we sell in connection with employer-sponsored qualified plans use annuity tables which do not differentiate on the basis of sex. Such annuity tables are also available for use in connection with certain non-qualified deferred compensation plans.

Following are general descriptions of the types of qualified plans with which the Contracts may be used. Such descriptions are not exhaustive and are for general informational purposes only. The tax rules regarding qualified plans are very complex and will have differing applications depending on individual facts and circumstances. You should consult a tax adviser as to the tax treatment and suitability of your investment. The contribution limits referenced in the plan descriptions below are the limits for 2024, and may change in subsequent years.

Individual Retirement Annuities

IRC Section 408(b) permits eligible individuals to contribute to an individual retirement program known as an Individual Retirement Annuity (IRA). IRAs are subject to limitations on eligibility, contributions, transferability and distributions. See "Taxes – Taxation of Qualified Contracts." IRA contributions are limited to the lesser of \$7,000 or 100% of compensation, and an additional catch-up contribution of \$1,000 is available for individuals age 50 and over. Contributions are deductible, unless you are an active participant in a qualified plan and your modified adjusted gross income exceeds certain limits. Contracts issued for use with IRAs are subject to special requirements by the IRC, including the requirement that certain informational disclosure be given to persons desiring to establish an IRA. You should consult a tax adviser as to the tax treatment and suitability of such an investment.

SEP IRAs

IRC Section 408(k) permits certain employers to establish IRAs for employees that qualify as Simplified Employee Pension (SEP) IRAs. Contributions to the plan for the benefit of employees will not be includable in the gross income of the employees until distributed from the plan. SEP IRAs are treated as defined contribution plans for purposes of the limits on employer contributions. Employer contributions cannot exceed the lesser of:

- \$69,000; or
- 25% of compensation (a maximum of \$345,000 of compensation may be considered).

The employee may treat the SEP account as a traditional IRA and make deductible and non-deductible contributions if the general IRA requirements are met. SEP IRAs are subject to additional restrictions, including on items such as: the form, manner and timing of distributions; transferability of benefits; vesting and nonforfeitality of interests; nondiscrimination in eligibility and participation;

and the tax treatment of distributions, withdrawals and surrenders. See "Taxes – Taxation of Qualified Contracts." You should consult a tax adviser as to tax treatment and suitability of such an investment.

Roth IRAs

IRC Section 408A permits eligible individuals to contribute to a non-deductible IRA, known as a Roth IRA. Roth IRAs are subject to limitations on eligibility, contributions, transferability and distributions. Roth IRA contributions are limited to the lesser of \$7,000 or 100% of compensation, and an additional catch-up contribution of \$1,000 is available for individuals age 50 or over. The maximums are decreased by any contributions made to a traditional IRA for the same tax year. Lower maximum Roth IRA contribution limits apply to individuals whose modified adjusted gross income exceeds certain limits. Amounts may be rolled over from one Roth IRA to another Roth IRA. Furthermore, an individual may make a rollover contribution from a non-Roth IRA to a Roth IRA, known as a conversion. The individual must pay tax on any portion of the IRA being rolled over that represents income or previously deductible IRA contributions. The determination of taxable income is based on the fair market value of the IRA at the time of the conversion. See "Taxes – Required Minimum Distributions for Qualified Contracts" for information on the determination of the fair market value of an annuity contract that provides additional benefits (such as certain living or death benefits). You should consult a tax adviser as to the tax treatment and suitability of such an investment.

Corporate Pension and Profit-Sharing Plans

IRC Sections 401(a) and 401(k) permit employers to establish various types of retirement plans for employees. Contributions made to the plan for the benefit of the employees and the earnings on those contributions are generally not included in gross income of the employees until distributed from the plan. The tax consequences to plan participants may vary depending upon the particular plan design. In general, annual contributions made by an employer and employee to a defined contribution plan may not exceed the lesser of:

- \$69,000; or
- 100% of compensation or earned income (a maximum of \$345,000 of compensation may be considered).

An employee's elective salary reduction contributions under a cash or deferred arrangement (i.e. a 401(k) plan) are limited to \$23,000, with an additional catch-up contribution of up to \$7,500 available for eligible plan participants age 50 or over. Defined benefit plans are limited to contributions necessary to fund a promised level of benefit. The annual benefit under a defined benefit plan is limited to:

- 100% of compensation for a plan participant's highest three years; or
- \$275,000.

Plans are subject to additional restrictions, including on such items as: the form, manner and timing of distributions; transferability of benefits; vesting and nonforfeitality of interests; nondiscrimination in eligibility and participation; and the tax treatment of distributions, withdrawals and surrenders. See "Taxes – Taxation of Qualified Contracts." You should consult a tax adviser as to the tax treatment and suitability of such an investment.

H.R. 10 Plans

IRC Section 401(a) permits self-employed individuals to establish qualified plans for themselves and their employees, commonly referred to as "H.R.10" or "Keogh" plans. Contributions made to the plan for the benefit of the employees and the earnings on those contributions are generally not included in gross income of the employees until distributed from the plan. The tax consequences to plan participants may vary depending upon the particular plan design. In general, H.R. 10 Plans are subject to the same restrictions as corporate pension and profit-sharing plans (see "Taxes – Qualified Contracts – Corporate Pension and Profit-Sharing Plans"), including limitations on eligibility, participation, contributions, time and manner of distributions, transferability and taxation of distributions. See "Taxes – Taxation of Qualified Contracts." You should consult a tax adviser as to the tax treatment and suitability of such an investment.

Tax-Sheltered Annuities

IRC Section 403(b) permits certain eligible employers to purchase annuity contracts, known as Tax-Sheltered Annuities (TSAs), under a section 403(b) program. Eligible employers are organizations that are exempt from tax under IRC Section 501(c)(3) and public

educational organizations. Contributions made to a TSA and the earnings on those contributions are generally not included in gross income of the employee until distributed from the plan. TSAs are subject to limitations on contributions, which may be made as "elective deferrals" (contributions made pursuant to a salary reduction agreement) or as non-elective or matching contributions by an employer. In general, annual contributions made by an employer and employee to a TSA may not exceed the lesser of:

- \$69,000; or
- 100% of includible compensation (a maximum of \$345,000 of includible compensation may be considered).

An employee's elective salary reduction contributions are limited to \$23,000. In addition, certain catch-up contributions may be made by eligible plan participants age 50 or over and those with 15 or more years of service with the same employer. TSAs are subject to additional restrictions, including on such items as: the form, manner and timing of distributions; transferability of benefits; vesting and nonforfeitality of interests; nondiscrimination in eligibility and participation; and the tax treatment of distributions, withdrawals and surrenders. See "Taxes – Tax-Sheltered Annuities Taxation and Withdrawal Restrictions." You should consult a tax adviser as to the tax treatment and suitability of such an investment.

Governmental 457(b) Deferred Compensation Plans

Employees of (and independent contractors who perform services for) certain state and local governmental units, or certain tax-exempt employers, may participate in an IRC Section 457(b) plan of the employer, allowing them to defer part of their salary or other compensation. Contributions made to an IRC Section 457(b) plan and the earnings on those contributions are generally not included in gross income of the employee until distributed from the plan. IRC Section 457(b) deferrals are limited to the lesser of:

- \$23,000; or
- 100% of includible compensation.

In addition, certain catch-up contributions may be made by eligible plan participants age 50 or over, and those within three years of normal retirement age under the plan. The Contract purchased is issued to the employer or trustee, as applicable. All Contract Value in a governmental 457(b) deferred compensation plan must be held for the exclusive benefit of the employee, and such plans are subject to limitations on distributions. See "Taxes – Withdrawal Restrictions – Governmental 457(b) Deferred Compensation Contract." You should consult a tax adviser as to the tax treatment and suitability of such an investment.

This Contract could not be purchased as part of a governmental 457(b) deferred compensation plan in New York. See "Appendix D – State Variations of Certain Contract Features."

Taxation of Non-Qualified Contracts

You, as the owner of a non-qualified annuity, will generally not be taxed on any increases in the value of your Contract until a distribution occurs. There are different rules as to how you are taxed depending on whether the distribution is a withdrawal or an Annuity Payment.

Withdrawals

The IRC generally treats any withdrawal (1) allocable to investment in the Contract made after August 13, 1982 in an annuity contract entered into prior to August 14, 1982 and (2) from an annuity contract entered into after August 13, 1982, as first coming from earnings and then from your investment in the Contract. The withdrawn earnings are subject to tax as ordinary income.

Annuity Payments

Annuity Payments occur as the result of the Contract reaching its annuity starting date, also known as the Maturity Date. A portion of each Annuity Payment is treated as a partial return of your investment in the Contract and is not taxed. The remaining portion of the Annuity Payment is treated as ordinary income. The Annuity Payment is divided between these taxable and non-taxable portions based on the calculation of an exclusion amount. The exclusion amount for Annuity Payments based on a fixed Annuity Option is determined by multiplying the payment by the ratio that the cost basis of the Contract (adjusted for any period certain or refund feature) bears to the expected return under the Contract. The exclusion amount for Annuity Payments based on a variable Annuity Option is determined by dividing the cost basis of the Contract (adjusted for any period certain or refund guarantee) by the number of years over which the

annuity is expected to be paid. Annuity Payments received after you have recovered all of your investment in the Contract are fully taxable.

The IRC also provides that any amount received (both Annuity Payments and withdrawals) under an annuity Contract which is included in income may be subject to an additional income tax. This additional tax is equal to 10% of the amount that is includable in income. Some withdrawals will be exempt from the additional tax. They include any amounts:

- (1) paid on or after you reach age 59½;
- (2) paid to your Beneficiary after you die;
- (3) paid if you become totally disabled (as that term is defined in the IRC);
- (4) paid in a series of substantially equal periodic payments made annually (or more frequently) for your life or life expectancy or for the joint lives or joint life expectancies of you and your designated Beneficiary. Annuity Payments may qualify for this exception if they satisfy the RMD rules applicable to Annuity Payments from qualified plans and IRAs;
- (5) paid under an immediate annuity; or
- (6) which come from investment in the Contract made before August 14, 1982.

With respect to (4) above, if the series of substantially equal periodic payments is modified before the later of your attaining age 59½ or five years from the date of the first periodic payment, then the tax for the year of the modification is increased by an amount equal to the tax which would have been imposed (the 10% additional income tax), but for the exception, plus interest for the tax years in which the exception was used. A withdrawal outside of the series of substantially equal period payments, or an additional Purchase Payment into your Contract, may be considered an impermissible modification. However, after 2023, a tax-free rollover or transfer to another qualified plan or IRA, from which a series of substantially equal periodic payments is received, will not result in a modification if the combined distributions from the old and new arrangements continue to satisfy the exception. The rules governing substantially equal periodic payments are complex. You should consult a tax adviser for more specific information.

Multiple Contracts

The IRC provides that multiple non-qualified annuity contracts which are issued within a calendar year to the same owner by one company or its affiliates are treated as one deferred annuity contract for purposes of determining the tax consequences of any distribution. Such treatment may result in adverse tax consequences including more rapid taxation of the distributed amounts from such combination of contracts. This rule does not apply to immediate annuities.

Tax Treatment of Assignments

An assignment or pledge of a contract may be a taxable event. You should consult a tax adviser if you wish to assign or pledge your contract. Annuity contracts issued after April 22, 1987 that are transferred for less than full and adequate consideration (including gifts) are subject to tax to the extent of gain in the contract. This does not apply to transfers between spouses or certain transfers incident to a divorce under IRC Section 1041.

Distributions After Death of an Owner

In order to be treated as an annuity contract for federal income tax purposes, IRC Section 72(s) requires any Non-Qualified Contract to contain certain provisions specifying how your interest in the Contract will be distributed in the event of the death of an Owner of the Contract. Specifically, IRC Section 72(s) requires that:

- (a) if any Owner dies on or after the annuity starting date, but prior to the time the entire interest in the contract has been distributed, the entire interest in the contract will be distributed at least as rapidly as under the method of distribution being used as of the date of such Owner's death; and
- (b) if any Owner dies prior to the annuity starting date, the entire interest in the Contract will be distributed within five years after the date of such Owner's death.

These requirements will be considered satisfied as to any portion of an Owner's interest which is payable to or for the benefit of a designated Beneficiary and which is distributed over the life of such designated Beneficiary or over a period not extending beyond the

life expectancy of that Beneficiary, provided that such distributions begin within one year of the Owner's death. The designated Beneficiary refers to a natural person designated by the Owner as a Beneficiary and to whom ownership of the Contract passes by reason of death. However, if the designated Beneficiary is the surviving spouse of the deceased Owner, the Contract may be continued with the surviving spouse as the new Owner. The Non-Qualified Contracts contain provisions that are intended to comply with these IRC requirements, although no regulations interpreting these requirements have yet been issued. We intend to review such provisions and modify them if necessary to assure that they comply with the applicable requirements when such requirements are clarified by regulation or otherwise.

Taxation of Qualified Contracts

If you have no cost basis for your interest in a Qualified Contract, the full amount of any distribution is taxable to you as ordinary income. If you do have a cost basis for all or some of your interest, a portion of the distribution is taxable, generally based on the ratio of your cost basis to your total Contract Value. Special tax rules may be available for certain distributions from a qualified plan.

IRC Section 72(t) imposes a 10% additional income tax on the taxable portion of any distribution from qualified plans, including contracts issued and qualified under IRC Sections 401 (pension and profit-sharing plans), 403 (TSAs), 408 (IRAs), and 408A (Roth IRAs). Exceptions from the additional tax are as follows:

- (1) distributions made on or after you reach age 59½;
- (2) distributions made after your death;
- (3) distributions made that are attributable to the employee being disabled as defined in the IRC;
- (4) after severance from employment, distributions that are part of a series of substantially equal periodic payments made not less frequently than annually for your life (or life expectancy) or the joint lives (or joint life expectancies) of you and your designated Beneficiary (in applying this exception to distributions from IRAs, a severance of employment is not required). Annuity Payments may qualify for this exception if they satisfy the RMD rules applicable to Annuity Payments from qualified plans and IRAs;
- (5) distributions made after severance from employment if you have reached age 55, or after you have reached age 50 or 25 years of service for qualified public safety employees and private sector firefighters (not applicable to distributions from IRAs);
- (6) corrective distributions of amounts that exceed tax law limitations;
- (7) distributions made to you up to the amount allowable as a deduction to you under IRC Section 213 for amounts you paid during the taxable year for medical care;
- (8) distributions made on account of an IRS levy made on a qualified retirement plan or IRA;
- (9) distributions made to an alternate payee pursuant to a qualified domestic relations order (not applicable to distributions from IRAs);
- (10) distributions from an IRA for the purchase of medical insurance (as described in IRC Section 213(d)(1)(D)) for you and your spouse and dependents if you received unemployment compensation for at least 12 weeks and have not been re-employed for at least 60 days;
- (11) certain qualified reservist distributions;
- (12) distributions from an IRA to the extent they do not exceed your qualified higher education expenses (as defined in IRC Section 72(t)(7)) for the taxable year;
- (13) distributions from an IRA which are qualified first-time homebuyer distributions (as defined in IRC Section 72(t)(8));
- (14) distributions which are qualified birth or adoption distributions (as defined in IRC Section 72(t)(2)(H)). Such distributions can be recontributed within the three year period beginning on the date received;
- (15) certain distributions made after December 31, 2023 for emergency personal expenses (as provided in IRC Section 72(t)(2)(I)). Such distributions can be recontributed within the three-year period beginning on the date received;
- (16) eligible distributions made after December 31, 2023 to you if you are a victim of domestic abuse (as provided in IRC Section 72(t)(2)(K)). Such distributions may be recontributed within the three-year period beginning on the date received;
- (17) distributions made to you if you are a terminally ill individual (as provided in IRC Section 72(t)(2)(L)). Such distributions may be recontributed within the three-year period beginning on the date received; and
- (18) distributions that are qualified disaster recovery distributions under IRC Section 72(t)(2)(M). Such distributions may be recontributed within the three-year period beginning on the date received.

With respect to (4) above, if the series of substantially equal periodic payments is modified before the later of your attaining age 59½ or five years from the date of the first periodic payment, then the tax for the year of the modification is increased by an amount equal to the tax which would have been imposed (the 10% additional tax) but for the exception, plus interest for the tax years in which the exception was used. A withdrawal outside of the series of substantially equal period payments, or an additional Purchase Payment into your contract, may be considered an impermissible modification. However, after 2023, a tax-free rollover or transfer to another qualified plan or IRA, from which a series of substantially equal periodic payments is received, will not result in a modification if the combined distributions from the old and new arrangements continue to satisfy the exception. The rules governing substantially equal periodic payments are complex. You should consult a tax adviser or IRS Notice 2022-6 for more specific information.

Tax-Sheltered Annuities Taxation and Withdrawal Restrictions

Under IRS regulations, effective January 1, 2009, all TSA plans must have a written plan document which specifies the requirements that each contract must meet in order to be qualified under the plan. In addition, the document must provide a list of the providers and contracts that are permitted to be purchased by TSA plan participants under the plan. TSA plan participants should be aware that if a TSA plan removes the provider or specific contract type that the TSA plan participant owns from its approved list, the TSA plan participant may be restricted from making further salary reduction contributions into that contract. TSA plans also have the right to restrict the ability to take loans and hardship withdrawals from a TSA contract. Because a plan participant may own more than one TSA contract, before we process a transaction we may require the TSA plan to approve the transaction to ensure that rules regarding loans, hardships and distribution restrictions are met. TSA plan participants should contact their individual TSA plan to determine the specific rules that apply to them.

The IRS regulations also made significant changes to Revenue Ruling 90-24 exchanges or transfers. Under the regulations an exchange may only be done when the TSA plan allows TSA exchanges under its plan and the provider of the new TSA contract agrees to share information with the TSA plan to ensure that the requirements of the TSA plan are met. Given this restriction, before a TSA exchange is processed, the TSA plan is required to approve the transaction or provide a list of vendors for which it has an information sharing agreement (ISA). Additionally, because most of the regulations were not effective until 2009, there was great uncertainty about their application to contract exchanges that took place between September 24, 2007 and January 1, 2009. Because of this uncertainty, it is possible that an exchange that took place prior to January 1, 2009 caused a TSA plan participant to incur taxation on the value of the contract. However, it is also possible that such an exchange did not have adverse tax consequences. If a TSA plan participant exchanged a contract to a TSA contract with a provider that does not have an ISA with the TSA plan, the participant had until July 1, 2009 to avoid adverse tax consequences by exchanging the contract for a TSA contract with which the TSA plan does have an ISA.

The IRC limits the withdrawal of Purchase Payments made by TSA plan participants through salary reductions from certain TSAs. Withdrawals of salary reduction amounts and their earnings can be made when a TSA plan participant:

- reaches age 59½;
- has a severance from employment;
- dies;
- becomes disabled, as that term is defined in the IRC;
- meets the requirements for a qualified birth or adoption distribution, as defined in IRC Section 72(t)(2)(H);
- qualifies for a qualified disaster recovery distribution, as defined in IRC Section 72(t)(2)(M);
- qualifies for an eligible distribution to a domestic violence victim, as defined in IRC Section 72(t)(2)(K);
- qualifies for an emergency personal expense distribution, as defined in IRC Section 72(t)(2)(I); or
- the TSA plan terminates (starting January 1, 2009).

In the case of hardship, for plan years beginning before 2024, the TSA plan participant could only withdraw the Purchase Payments and not any earnings. However, for plan years beginning after 2023, hardship withdrawals can consist of both the Purchase Payments and any earnings.

TSA contract value as of December 31, 1988 and contract amounts attributable to service with a former employer are not subject to these restrictions. Additionally, return of excess contributions or amounts paid to a spouse as a result of a qualified

domestic relations order are not subject to these restrictions.

TSA contracts issued January 1, 2009 and after are subject to distribution restrictions on employer contributions. These restrictions are determined by the TSA plan and can be based on criteria such as completing years of service or attaining a stated age.

Withdrawal Restrictions – Texas Optional Retirement Program

No withdrawals may be made in connection with a Contract issued pursuant to the Texas Optional Retirement Program for faculty members of Texas public institutions of higher learning before you:

- terminate employment in all such institutions and repay employer contributions if termination occurs during the first 12 months of employment;
- retire;
- die; or
- attain age 70½.

Withdrawal Restrictions – Governmental 457(b) Deferred Compensation Contract

Amounts may not be paid to a participant of a governmental 457(b) deferred compensation plan prior to the plan participant's:

- attainment of age 59½;
- severance from employment;
- incurring an unforeseeable emergency;
- compliance with a qualified domestic relations order (QDRO);
- qualifying for a qualified disaster recovery distribution, as defined in IRC Section 72(t)(2)(M);
- qualifying for an eligible distribution to a domestic violence victim, as defined in IRC Section 72(t)(2)(K);
- qualifying for an emergency personal expense distribution, as defined in IRC Section 72(t)(2)(I); or
- meeting the requirements for a qualified birth or adoption distribution, as defined in IRC Section 72(t)(2)(H).

In certain circumstances, amounts may also be distributed upon termination of the deferred compensation plan or if the Contract contains \$5,000 or less, as provided by the plan.

Governmental 457(b) deferred compensation plans are subject to the Required Minimum Distribution rules of IRC Section 401(a)(9). The sections of this prospectus related to Qualified Contracts contain more detailed information regarding these rules.

Required Minimum Distributions for Qualified Contracts

For Qualified Contracts other than Roth IRAs, distributions generally must begin no later than April 1st of the calendar year following the later of:

- (1) the calendar year in which you attained the "applicable age" as defined in IRC Section 401(a)(9); or
- (2) the calendar year in which you retire.

If you were born after December 31, 1950 and before January 1, 1960, your applicable age is 73. If you were born after December 31, 1959, your applicable age is 75. Previously, the age at which RMDs were required to begin was 70½ for those born before July 1, 1949, and 72 for those born after June 30, 1949 and before January 1, 1951.

The date set forth in (2) does not apply to an IRA or to a five percent owner of the employer maintaining the plan. Required

distributions generally must be over a period not exceeding your life or life expectancy or the joint lives or joint life expectancies of you and your designated Beneficiary. Upon your death, additional distribution requirements are imposed. If your Contract is held as a Roth IRA, there are no RMDs during your life. However, upon your death your Beneficiary is subject to RMD requirements. If RMDs are not made, a penalty tax of up to 25% is imposed on the amount that should have been distributed.

These rules were significantly changed under the Setting Every Community Up for Retirement Enhancement (SECURE) Act, enacted in late 2019, and differ for Qualified Contracts when death occurs after December 31, 2019 versus those where death occurred on or

before December 31, 2019 (on or before December 31, 2021 for participants of a governmental plan or a plan maintained pursuant to a collective bargaining agreement).

Where the Owner's death occurred on or before December 31, 2019 (on or before December 31, 2021 for participants of a governmental plan or a plan maintained pursuant to a collective bargaining agreement), if the Contract had not yet entered the Income Phase and death occurred after the required beginning date, distributions must be made at least as rapidly as under the method in effect at the time of the Owner's death, or over the life or life expectancy of the designated Beneficiary. If the Contract had not entered the Income Phase and death occurred before the required beginning date, the remaining interest must be distributed within five years or over the life or life expectancy of the designated Beneficiary. If the Owner's death occurred after the Contract had entered the Income Phase, distributions must be made at least as rapidly as under the method in effect at the time of the Owner's death.

If your death occurs after December 31, 2019 (after December 31, 2021 for participants of a governmental plan or a plan maintained pursuant to a collective bargaining agreement) and your designated Beneficiary is not an "Eligible Designated Beneficiary" as defined in IRC Section 401(a)(9), the remaining interest must be distributed within ten years, regardless of whether your death occurs before or after your required beginning date or whether your contract had entered the Income Phase. In addition, if your death occurs on or after your required beginning date, proposed regulations under IRC Section 401(a)(9) would require annual RMDs during the ten year distribution period. If your designated Beneficiary is considered an Eligible Designated Beneficiary, the remaining interest must be distributed within ten years or over the life or life expectancy of the designated Beneficiary. We only offer a life or life expectancy distribution option to a designated beneficiary who either (1) is the surviving spouse of the deceased qualified plan participant or IRA owner or, (2) is not more than ten years younger than the deceased qualified plan participant or IRA owner. In the future, we may allow additional classes of Eligible Designated Beneficiaries to elect a life or life expectancy distribution option.

If your death occurs after December 31, 2019 (after December 31, 2021 for participants of a governmental plan or a plan maintained pursuant to a collective bargaining agreement) and you do not have a designated Beneficiary (including where your estate or certain trusts are the Beneficiary), the pre-2019 distribution rules generally apply. If your Contract has not yet entered the Income Phase and death occurs after your required beginning date, distributions must be made at least as rapidly as under the method in effect at the time of your death. If the Contract has not yet entered the Income Phase and your death occurs before your required beginning date, the remaining interest must be distributed within five years. If your death occurs after your Contract has entered the Income Phase, distributions must be made at least as rapidly as under the method in effect at the time of your death.

The Regulations under IRC Section 401(a)(9) include a provision that could increase the dollar amount of RMDs for individuals who fund their IRA or qualified retirement plan with an annuity contract. During the Accumulation Phase of the annuity contract, Treasury Regulations Section 1.401(a)(9)-6, Q&A-12 requires that individuals add the actuarial present value of any additional benefits provided under the annuity (such as certain living or death benefits) to the dollar amount credited to the Owner or Beneficiary under the Contract in order to determine the fair market value of the Contract. A larger fair market value will result in the calculation of a higher RMD amount. You should consult a tax adviser to determine how this may impact your specific circumstances.

Taxation of Death Benefit Proceeds

Amounts may be distributed from a Contract because of your death or the death of the Annuitant. Generally, such amounts are includible in the income of the recipient as follows:

- if distributed in a lump sum, they will be treated in the same manner as a withdrawal from the Contract; or
- if distributed under a payout option, they will be treated as Annuity Payments.

Section 1035 Tax Free Exchanges

IRC Section 1035 provides that a life insurance, endowment, or annuity contract may be exchanged for an annuity contract on a tax free basis. When this type of exchange occurs, the gain in the original contract is preserved in the new contract by transferring the cost basis under the original contract to the new contract. The IRS has provided guidance on the partial exchange of an annuity contract for another annuity contract. According to the guidance, partial exchanges occurring on or after October 24, 2011 will be tax free if no distribution takes place from either contract within 180 days after the exchange. If a distribution occurs within 180 days after the exchange, the IRS will apply general tax principles to determine the tax treatment of the transfer. The limitation on distributions within 180 days does not apply to Annuity Payments that are based on life expectancy or on a period certain of ten or more years. You should consult a tax adviser before entering into any 1035 exchange.

Partial exchanges which occurred prior to October 24, 2011 were subject to more restrictive guidance. You should consult a tax adviser if you have questions regarding the taxation of a prior exchange.

Beginning January 1, 2010, the Pension Protection Act of 2006 permits the exchange of an annuity contract for a qualified long-term care contract to qualify as a tax free 1035 exchange. However, if an annuity contract has entered the Income Phase, there is uncertainty and a lack of guidance regarding whether the exchange can qualify. Therefore, if an annuity contract has entered the Income Phase and the contract or the resulting Annuity Payments are exchanged for a qualified long-term care contract, we will not treat that as a tax free 1035 exchange.

The IRS has also issued guidance allowing a Beneficiary of a non-qualified annuity contract to enter into a 1035 exchange of the death benefit for a new annuity contract, provided that the new contract will be administered as if the owner is deceased for purposes of the death benefit requirements of IRC Section 72(s). In order to allow the death benefit under a non-qualified annuity contract to be exchanged, we may require additional documentation from the issuer of the new contract, in order to ensure that this requirement is met.

Income Tax Reporting and Withholding

Federal law requires that we file an information return on Form 1099-R with the IRS (with a copy to you) reporting any taxable amounts paid to you under the annuity contract. By January 31st of the calendar year following the year of any payment(s), we will issue the Form 1099-R to the owner of the annuity contract. Following the death of the owner the Form 1099-R will be sent to each Beneficiary who receives a payment under the Contract.

The portion of any distribution that is includable in the gross income of the owner is subject to federal income tax withholding. The amount of the withholding depends on the type of distribution. Withholding for periodic payments is at the same rate as wages and at the rate of 10% from non-periodic payments. However, the owner, in most cases, may elect not to have taxes withheld or to have withholding done at a different rate. Distributions from certain retirement plans, excluding IRAs, that are not directly rolled over to another eligible retirement plan or IRA, are subject to a mandatory 20% withholding.

The 20% withholding requirement generally does not apply to:

- a series of substantially equal payments made at least annually for:
 - the life or life expectancy of the Contract Owner, or joint and last survivor expectancy of the Contract Owner and a designated Beneficiary, or
 - for a specified period of ten years or more;
- distributions which are Required Minimum Distributions;
- hardship distributions from a 401(k) plan or a tax-sheltered annuity; or
- distributions that are qualified birth or adoption distributions as defined in IRC Section 72(t)(2)(H).

You should consult a tax adviser regarding withholding requirements.

Generation Skipping Transfer Tax Withholding

Under certain circumstances, the IRC may impose a generation skipping transfer tax when all or part of an annuity contract is transferred to, or a death benefit is paid to, an individual two or more generations younger than the Owner. Regulations issued under the IRC may require us to deduct the tax from your Contract, or from any applicable payment, and pay it directly to the IRS.

Medicare Hospital Insurance Tax

A Medicare Hospital Insurance Tax (known as the Unearned Income Medicare Contribution) applies to all or part of a taxpayer's net investment income, at a rate of 3.8%, when certain income thresholds are met. Net investment income is defined to include, among other things, non-qualified annuities and net gain attributable to the disposition of property. Under final tax regulations, the taxable portion of any distribution from a non-qualified annuity contract – including surrenders, withdrawals, and Annuity Payments – is included in net investment income. Net investment income also includes the gain from the sale of a non-qualified annuity contract.

Under current guidance, we are required to report to the IRS whether a distribution is potentially subject to the tax. You should consult a tax adviser as to the potential impact of the Medicare Hospital Insurance Tax on your Contract.

Non-Resident Aliens and Foreign Entities

Generally, a distribution from a contract to a non-resident alien or foreign entity is subject to federal tax withholding at a rate of 30% of the amount of income that is distributed. A non-resident alien is a person who is neither a citizen, nor a resident, of the United States of America (U.S.). We are required to withhold the tax and send it to the IRS. Some distributions to non-resident aliens or foreign entities may be subject to a lower (or no) tax if a treaty applies. In order to obtain the benefits of such a treaty, the non-resident alien must claim the treaty benefit on Form W-8BEN (or the equivalent form), providing us with:

- proof of residency (in accordance with IRS requirements); and
- the applicable taxpayer identification number.

If the above conditions are not met, we will withhold 30% of the income from the distribution. Additionally, under the Foreign Account Tax Compliance Act effective July 1, 2014, U.S. withholding may occur with respect to certain foreign entity owners (including foreign financial institutions and non-financial foreign entities (such as corporations, partnerships, and trusts)) at a 30% rate without regard to lower treaty rates.

Civil Unions and Domestic Partnerships

Parties to a civil union or domestic partnership are not treated as spouses under federal law. Consequently, certain transactions, such as a change of ownership or continuation of the Contract after death, may be taxable to those individuals. You should consult a tax adviser for more information on this subject.

Non-Natural Owner

When a Non-Qualified Contract is owned by a non-natural person (e.g., a corporation, limited liability company, partnership, trust or certain other entities) the Contract will generally not be treated as an annuity for tax purposes. This means that gain in the Contract will be taxed each year while the Contract is in the Accumulation Phase. This treatment is not generally applied to a Contract held by a trust or other entity as an agent for a natural person. If a trust is not a grantor trust for income tax purposes, and any Beneficiary (including a contingent Beneficiary) of a trust is a non-natural person, the Contract will not be treated as owned by an agent for a natural person, and gain in the Contract will be taxed annually.

This treatment also does not apply to a Contract that qualifies as an immediate annuity. Before purchasing a Contract to be owned by a non-natural person or changing ownership on an existing Contract that will result in it being owned by a non-natural person, you should consult a tax adviser to determine the tax impact.

Distribution

The Contracts are no longer for sale to the public. While the Contracts were offered for sale, registered representatives of MML Investors Services, LLC (MMLIS), a subsidiary of MassMutual, sold the Contracts. Pursuant to an underwriting agreement with MassMutual, on its own behalf and on behalf of the Separate Accounts, MMLIS serves as principal underwriter of the Contracts.

MMLIS is registered with the SEC as a broker-dealer under the Securities Exchange Act of 1934 and is a member of the Financial Industry Regulatory Authority (FINRA). MMLIS also receives compensation for its actions as principal underwriter of the Contracts.

Commissions and Allowances Paid

Commissions for sales of the Contract by MMLIS registered representatives are paid on behalf of MMLIS by MassMutual to MMLIS registered representatives. We also pay expense allowances in connection with the sales of the Contracts. The maximum commission payable for the Contract is 8.63% of Purchase Payments made to a Contract and/or up to 2.4% of Contract Value annually.

Additional Compensation Paid to MMLIS

Most MMLIS registered representatives are also MassMutual insurance agents, and as such, are eligible for certain cash and non-cash benefits from MassMutual. Cash compensation includes bonuses and allowances based on factors such as sales, productivity and persistency. Non-cash compensation includes various recognition items such as prizes and awards as well as attendance at, and payment of the costs associated with attendance at, conferences, seminars and recognition trips, and also includes contributions to certain individual plans such as pension and medical plans. Sales of the Contract may help these registered representatives and their supervisors qualify for such benefits. MMLIS registered representatives who are also general agents or sales managers of MassMutual also may receive overrides, allowances and other compensation that is based on sales of the Contract by their registered representatives.

Compensation in General

The compensation arrangements described above may provide a registered representative with an incentive to sell the Contract over other available variable annuity Contracts whose issuers do not provide such compensation or who provide lower levels of such compensation. Your registered representative typically receives a portion of the compensation that is payable to his or her broker-dealer, depending on the agreement between the representative and their firm. MassMutual is not involved in determining compensation paid to a registered representative of an unaffiliated broker-dealer. You may contact your broker-dealer or registered representative to find out more information about the compensation they may receive in connection with your purchase of a Contract. You may want to take these compensation arrangements into account when evaluating any recommendation regarding the Contract.

We intend to recoup a portion of the cash and non-cash compensation payments that we make through the assessment of certain charges described in this prospectus.

You may want to contact MMLIS or your registered representative to find out more about the compensation they receive in connection with your purchase of a Contract.

Commissions or overrides may also be paid to broker-dealers providing wholesaling services (such as providing sales support and training for sales representatives who sell the Contracts).

Other Information

Assignment

You can assign the Contract at any time during your lifetime. We will not be bound by the assignment until we receive Written Notice of the assignment in Good Order. We will not be liable for any payment or other action we take in accordance with the Contract before we receive notice of the assignment. We are not responsible for the validity of an assignment. You may be subject to tax consequences if you assign your Contract. If the Contract is issued pursuant to a qualified plan, there may be limitations on your ability to assign the Contract. If you assign your Contract, your rights may only be exercised with the consent of the assignee of record. We require consent of any irrevocable Beneficiary before we assign proceeds.

Unclaimed Property

Every state has some form of unclaimed property law that imposes varying legal and practical obligations on insurers and, indirectly, on Owners, Beneficiaries, and any other payees of proceeds from a Contract.

Unclaimed property laws generally provide for the transfer of benefits or payments under various circumstances to the abandoned property division or unclaimed property office in the state of last residence. This process is known as escheatment. To help avoid escheatment, keep your own information, as well as Beneficiary and any other payee information up-to-date, including: full names, postal and electronic media addresses, telephone numbers, dates of birth, and social security numbers. To update this information, contact our Service Center. IRS guidance requires us to withhold federal income tax from escheated payments from certain Qualified Contracts, and to report such payments to the IRS on Form 1099-R.

Anti-Money Laundering

Federal laws designed to counter terrorism and prevent money laundering might, in certain circumstances, require us to reject a Purchase Payment or block an owner's ability to make certain transactions and thereby refuse to accept any request for transfers, withdrawals, or death benefits, until instructions are received from the appropriate regulator. We may also be required to provide additional information about you and your Contract to government regulators.

Payments We Make

We may be required to suspend or postpone payments, withdrawals, or transfers from the Divisions for any period when:

- the NYSE is closed (other than customary weekend and holiday closings);
- trading on the NYSE is restricted;
- an emergency exists as a result of which disposal of shares of the Funds is not reasonably practicable or we cannot reasonably value the shares of the Funds; or
- during any other period when the SEC, by order, so permits for your protection.

We reserve the right to defer payment for a withdrawal from the GPA or payment of loan proceeds from the GPA for the period permitted by law, but not for more than six months.

In addition, if, pursuant to the SEC's rules, a money market fund suspends payment of redemption proceeds in connection with a liquidation of that Fund, we will delay payment of any transfer, withdrawal or death benefit from the applicable money market Division until the Fund is liquidated.

Federal laws designed to counter terrorism and prevent money laundering might, in certain circumstances, require us to reject a Purchase Payment or block an owner's ability to make certain transactions and thereby refuse to accept any request for transfers, withdrawals, or death benefits, until instructions are received from the appropriate regulator. We may also be required to provide additional information about you and your Contract to government regulators.

Changes to the Contract

We reserve the right to amend the Contract to meet the requirements of applicable federal or state laws or regulations, or as otherwise provided in the Contract. We will notify you by written notice of such amendments.

Termination of the Contract

We will terminate your Contract upon the occurrence of any of the following events:

- the date of the last Annuity Payment;
- the date withdrawal is made of the entire Contract Value;
- the date of the last payment upon death to the last Beneficiary; or
- the date your Contract is returned under the right to examine Contract provision.

Computer System, Cybersecurity, and Service Disruption Risks

The Company and its business partners rely on computer systems to conduct business, including customer service, marketing and sales activities, customer relationship management and producing financial statements. While the Company and its business partners have policies, procedures, automation and backup plans designed to prevent or limit the effect of failures, our respective computer systems may be vulnerable to disruptions or breaches as the result of natural disasters, man-made disasters, criminal activity, pandemics, or other events beyond our control. The failure of our or our business partners' computer systems for any reason could disrupt operations, result in the loss of customer business and adversely impact profitability.

The Company and its business partners retain confidential information on our respective computer systems, including customer information and proprietary business information. Any compromise of the security of our or our business partners' computer systems that results in the disclosure of personally identifiable customer information could damage our reputation, expose us to litigation, increase regulatory scrutiny and require us to incur significant technical, legal, and other expenses. The risk of cyber-attacks may be higher during periods of geopolitical turmoil (such as the Russian invasion of Ukraine and the responses by the United States and other governments).

Geopolitical and other events, including natural disasters, war, terrorism, economic uncertainty, trade disputes, public health crises and related geopolitical events, and widespread disease, including pandemics (such as COVID-19) and epidemics, have led, and in the future may lead, to increased market volatility, which may disrupt U.S. and world economies and markets and may have significant adverse direct or indirect effects on the Company. These events may adversely affect computer and other systems on which the Company relies, interfere with the processing of Contract-related transactions (including the processing of orders from owners and orders with the Funds) and the Company's ability to administer this Contract in a timely manner, or have other possible negative effects. These events may also impact the issuers of securities in which the Funds invest, which may cause the Funds underlying the Contract to lose value. There can be no assurance that we, the Funds or our service providers will avoid losses affecting the Contract due to these geopolitical and other events. If we are unable to receive U.S. mail or fax transmissions due to a closure of U.S. mail delivery by the government or due to the need to protect the health of our employees, you may still be able to submit transaction requests to the Company electronically or over the telephone. Our inability to receive U.S. mail or fax transmissions may cause delays in the pricing and processing of transaction requests submitted to us by U.S. mail or by fax during that time period.

Legal Proceedings

The Company is subject to legal and regulatory actions, including class action lawsuits, in the ordinary course of its business. Our pending legal and regulatory actions include proceedings specific to us, as well as proceedings generally applicable to business practices in the industry in which we operate. From time to time, we also are subject to governmental and administrative proceedings and regulatory inquiries, examinations, and investigations in the ordinary course of our business. In addition, we, along with other industry Contract Owners, may occasionally be subject to investigations, examinations, and inquiries (in some cases industry-wide) concerning issues upon which regulators have decided to focus. Some of these proceedings involve requests for substantial and/or unspecified amounts, including compensatory or punitive damages.

While it is not possible to predict with certainty the ultimate outcome of any pending litigation proceedings or regulatory action, management believes, based on information currently known to it, that the ultimate outcome of all pending litigation and regulatory matters, after consideration of applicable reserves and rights to indemnification, is not likely to have a material adverse effect upon the Separate Account, the ability of the principal underwriter(s) to perform in accordance with its contracts with the Company on behalf of the Separate Account, or the ability of the Company to meet its obligations under the Contract.

For more information regarding the Company's litigation and other legal proceedings, see the notes to the Company's financial statements contained within the SAI.

Our Financial Statements

The financial statements for the Separate Account and the Company are included in the SAI. Our financial statements should be distinguished from the financial statements of the Separate Account, and you should consider our financial statements as bearing only upon our ability to meet our obligations under the Contracts. Contact us at our Service Center for a free copy of these financial statements and the SAI.

Appendix A

Funds Available Under the Contract

The following is a list of Funds currently available under the Contract. The list of Funds is subject to change, as discussed in the prospectus for the Contract. Before you invest, you should review the prospectuses for the Funds. These prospectuses contain more information about the Funds and their risks and may be amended from time to time. You can find prospectuses and other information about the Funds online at www.MassMutual.com/FlexExtra. You can also request this information at no cost by calling (800) 272-2216 or sending an email request to ANNfax@MassMutual.com.

The current expenses and performance information below reflects fees and expenses of the Funds, but does not reflect the other fees and expenses that your Contract may charge. Expenses would be higher and performance would be lower if these charges were included. Each Fund's past performance is not necessarily an indication of future performance.

Fund Type	Fund and Adviser/Sub-Adviser	Current Expenses (expenses/average assets)	Average Annual Total Returns (as of 12/31/2023)		
			1 Year	5 Year	10 Year
Money Market	MML U.S. Government Money Market Fund (Initial Class) ⁽¹⁾ Adviser: MML Investment Advisers, LLC Sub-Adviser: Barings LLC	0.52%	4.64%	1.54%	0.95%
Fixed Income	Invesco V.I. Global Strategic Income Fund (Series I) Adviser: Invesco Advisers, Inc. Sub-Adviser: N/A	0.92% ^(*)	8.88%	1.30%	1.50%
Fixed Income	MML Managed Bond Fund (Initial Class) Adviser: MML Investment Advisers, LLC Sub-Adviser: Barings LLC	0.45%	6.70%	1.58%	2.04%
Balanced	MML Blend Fund (Initial Class) ⁽²⁾ Adviser: MML Investment Advisers, LLC Sub-Adviser: BlackRock Investment Management, LLC	0.50%	17.62%	9.10%	7.55%
Large Cap Value	MML Equity Fund (Initial Class) Adviser: MML Investment Advisers, LLC Sub-Adviser: Brandywine Global Investment Management, LLC	0.44%	9.32%	11.99%	8.34%
Small/Mid-Cap Growth	Invesco V.I. Discovery Mid Cap Growth Fund (Series I) Adviser: Invesco Advisers, Inc. Sub-Adviser: N/A	0.87%	13.15%	12.77%	9.79%
International/Global	Invesco V.I. Global Fund (Series I) Adviser: Invesco Advisers, Inc. Sub-Adviser: N/A	0.82%	34.73%	12.30%	8.47%

(*) These Funds and their investment advisers have entered into contractual fee waivers or expense reimbursements. These temporary fee reductions are reflected in their current expenses. Those contractual arrangements are designed to reduce the Fund's total current expenses for Owners and will continue past the current year.

- (1) You could lose money by investing in the Fund. Although the Fund seeks to preserve the value of your investment at \$1.00 per share, it cannot guarantee it will do so. An investment in the Fund is not insured or guaranteed by the Federal Deposit Insurance Corporation or any other government agency. The Fund's sponsor has no legal obligation to provide financial support to the Fund, and you should not expect that the sponsor will provide financial support to the Fund at any time. The yield of this Fund may become very low during periods of low interest rates. After deduction of Separate Account charges, the yield in the division that invests in this Fund could be negative.
- (2) These are fund-of-funds investment choices. They are known as fund-of-funds because they invest in other underlying funds. A fund offered in a fund-of-funds structure may have higher expenses than a direct investment in its underlying funds because a fund-of-funds bears its own expenses and indirectly bears its proportionate share of expenses of the underlying funds in which it invests.

Appendix B

Contingent Deferred Sales Charge and Free Withdrawal Amount Examples

Example 1 ~ CDSC for Flexible Purchase Payment Contracts

- The following Purchase Payments are made:

Purchase Payment	Contract Year	Date	Amount	End of Year Contract Value
1 (on Issue Date)	1	January 15	\$100,000	\$105,000
2	1	May 15	10,000	120,000
3	2	January 15	200,000	340,000
4	7	January 15	120,000	480,000

- At the beginning of Contract Year 8, a partial withdrawal of \$250,000 is made.
- To calculate the CDSC, we first determine the Free Withdrawal Amount (FWA) not subject to a CDSC. The FWA is 10% of the Contract Value which is \$48,000 ($10\% \times \$480,000$).
- We next determine the remaining withdrawal amount after the deduction of the free withdrawal amount which is \$202,000 ($\$250,000 - \$48,000$).
- Since the withdrawal is being made in Contract Year 8, the CDSC charge is 2% or \$4,040 ($\$202,000 \times 2\%$).
- The total CDSC for this withdrawal is \$4,040, which is deducted from the withdrawal amount of \$250,000. The net amount of \$245,960 ($\$250,000 - \$4,040$) is paid to the Contract Owner, unless otherwise instructed.

Example 2 ~ CDSC for Single Purchase Payment Contracts

- The following Purchase Payments are made:

Contract Year	Purchase Payment	Withdrawal	End of Year Contract Value
1	\$100,000		\$105,000
2			110,000
3			106,000
4			120,000
5		\$50,000	75,000

- At the beginning of Contract Year 5, a partial withdrawal of \$50,000 is made.
- To calculate the CDSC, we first determine the Free Withdrawal Amount (FWA) not subject to a CDSC. The FWA is 10% of the Contract Value which is \$12,000 ($10\% \times \$120,000$).
- We next determine the remaining withdrawal amount after the deduction of the free withdrawal amount which is \$38,000 ($\$50,000 - \$12,000$).

- Since the withdrawal is being made in Contract Year 5, the CDSC charge is 1% or \$380 ($\$38,000 \times 1\%$).
- The total CDSC for this withdrawal is \$380, which is deducted from the withdrawal amount of \$50,000. The net amount of \$49,620 ($\$50,000 - \380) is paid to the Contract Owner, unless otherwise instructed.

Appendix C

Death Benefit Examples

Example 1 ~ Impact of Purchase Payments and Determination of Benefit

The values shown are based on the following assumptions:

- Initial Purchase Payment = \$100,000
- A subsequent Purchase Payment of \$10,000 is made at beginning of Contract Year 2.
- Contract Owner dies in Contract Year 5.

Beginning of Contract Year	Purchase Payment	Contract Value After Purchase Payment	Total Purchase Payments Less Withdrawals
1	\$100,000	\$100,000	\$100,000
2	10,000	115,000	110,000
5 (receive due proof of Contract Owner's death and election of the payment method)		101,000	110,000

- On the Issue Date, a \$100,000 Purchase Payment is made. This is the initial total Purchase Payments less withdrawals.
- At the beginning of Contract Year 2, a \$10,000 subsequent Purchase Payment is made, bringing the total Purchase Payments less withdrawals to \$110,000.
- Contract Owner dies in Contract Year 5. When we receive due proof of death and election of the payment method for the death benefit, the Contract Value is \$101,000. The total Purchase Payments adjusted for withdrawals is \$110,000. The Death Benefit is the greater of these two values. Therefore, the death benefit is \$110,000.

Example 2 ~ Impact of Withdrawal and Determination of Death Benefit

The values shown are based on the following assumptions:

- Initial Purchase Payment = \$100,000
- A subsequent Purchase Payment of \$10,000 is made at beginning of Contract Year 2.
- A withdrawal of \$30,000 is made at beginning of Contract Year 5.
- Contract Owner dies in Contract Year 6.

Beginning of Contract Year	Purchase Payment	Withdrawal	Contract Value After Purchase Payment	Total Purchase Payments Less Withdrawals
1	\$100,000		\$100,000	\$100,000
2	10,000		115,000	110,000
5 (immediately prior to withdrawal)			120,000	110,000
5 (immediately after withdrawal)		\$30,000	90,000	80,000
6 (receive due proof of Contract Owner's death)			95,000	80,000

- On the Issue Date, a \$100,000 Purchase Payment is made. This is the initial total Purchase Payments less withdrawals.
- At the beginning of Contract Year 2, a \$10,000 subsequent deposit is made, bringing the total Purchase Payments less withdrawals to \$110,000.
- At the beginning of Contract Year 5, a \$30,000 withdrawal (including any CDSC) is made.
- Immediately prior to when the withdrawal is made, the Contract Value is \$120,000, and the total Purchase Payments less withdrawals is \$110,000.
- Immediately after the withdrawal is made, the Contract Value becomes \$90,000 ($\$120,000 - \$30,000 = \$90,000$). The total Purchase Payments less withdrawals is \$80,000 ($\$110,000 - \$30,000$).
- Contract Owner dies in Contract Year 6. When we receive due proof of death, the Contract Value is \$95,000. The total Purchase Payments less withdrawals is \$80,000. Therefore, the death benefit is \$95,000 (the greater of \$95,000 and \$80,000).

Example 3 ~ Impact of an Outstanding Loan

The values shown are based on the following assumptions:

- Initial Purchase Payment = \$100,000
- A subsequent Purchase Payment of \$10,000 is made at beginning of Contract Year 2.
- A \$30,000 loan is taken in Contract Year 3 and repayments begin 3 months later.
- Contract Owner dies in Contract Year 5.

Beginning of Contract Year	Purchase Payment	Loan	Contract Value After Purchase Payment and Loan	Total Purchase Payments Less Outstanding Loans
1	\$100,000		\$100,000	\$100,000
2	10,000		115,000	110,000
3		\$30,000	\$85,000	\$80,000
5 (receive due proof of Contract Owner's death)			90,000	85,000

- On the Issue Date, a \$100,000 Purchase Payment is made. This is the initial total Purchase Payments less withdrawals.
- At the beginning of Contract Year 2, a \$10,000 subsequent Purchase Payment is made, bringing the total Purchase Payments less withdrawals to \$110,000.
- At the beginning of Contract Year 3, a \$30,000 loan is taken, bringing the total Purchase Payments less loans to \$80,000 (\$110,000 – \$30,000).
- Contract Owner dies in Contract Year 5. When we receive due proof of death, the Contract Value is \$90,000. With the loan repayments the total Purchase Payments less withdrawals is \$85,000. The Basic Death Benefit is the greater of these two values. Therefore, the death benefit is \$90,000.

Appendix D

State Variations of Certain Contract Features

State	Feature	Variation
New Jersey	Purchase Payments	The maximum amount total Purchase Payments we will allow without home office approval is \$500,000.
New York	457(b) Deferred Compensation Plan Contracts	Not available.

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The SAI contains additional information about the Separate Account. The SAI is incorporated into this prospectus by reference and it is legally part of this prospectus. We filed the SAI with the SEC. The SEC maintains a website (www.sec.gov) that contains the SAI, material incorporated by reference and other information regarding companies that file electronically with the SEC.

Reports and other information about the Separate Account, including the SAI, are available on the SEC website (www.sec.gov).

For a free copy of the SAI, other information about this Contract, or general inquiries, contact our Service Center:

MassMutual
Document Management Services – Annuities W360
PO Box 9067
Springfield, MA 01102-9067
(800) 272-2216
(Fax) (866) 329-4272
(Email) ANNfax@MassMutual.com
www.MassMutual.com

Qualified Contracts:
Investment Company Act file number: 811-03200
Securities Act file number: 033-07724
Class (Contract) Identifier: C000021296

Non-Qualified Contracts:
Investment Company Act file number: 811-03354
Securities Act file number: 033-07723
Class (Contract) Identifier: C000021298

STATEMENT OF ADDITIONAL INFORMATION
MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
(Depositor)
MASSACHUSETTS MUTUAL VARIABLE ANNUITY SEPARATE ACCOUNT 1
MASSACHUSETTS MUTUAL VARIABLE ANNUITY SEPARATE ACCOUNT 2
(Registrants)

FLEX EXTRA

April 29, 2024

This Statement of Additional Information is not a prospectus. It should be read in conjunction with the prospectus of Massachusetts Mutual Variable Annuity Separate Accounts 1 and 2 dated April 29, 2024 (the Prospectus).

The Prospectus is available upon written or oral request from MassMutual®, Document Management Services – Annuities W360, PO Box 9067, Springfield, MA 01102-9067, (800) 272-2216.

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THE COMPANY

In this Statement of Additional Information, the "Company," "we," "us," and "our" refer to Massachusetts Mutual Life Insurance Company (MassMutual). MassMutual and its domestic life insurance subsidiaries provide individual and group life insurance, disability insurance, individual and group annuities and guaranteed interest contracts to individual and institutional customers in all 50 states of the U.S., the District of Columbia and Puerto Rico. Products and services are offered primarily through MassMutual's distribution channels: MassMutual Financial Advisors, MassMutual Strategic Distributors, Institutional Solutions and Worksite.

MassMutual was established on May 15, 1851 and is organized as a mutual life insurance company in the Commonwealth of Massachusetts. MassMutual's home office is located at 1295 State Street, Springfield, Massachusetts 01111-0001.

THE SEPARATE ACCOUNTS

Separate Account 1 was established as a separate investment account of MassMutual on April 8, 1981 in accordance with the provisions of Chapter 175 of the Massachusetts General Laws. Separate Account 2 was established as a separate investment account of MassMutual on October 14, 1981 in accordance with the provisions of Chapter 175 of the Massachusetts General Laws.

Each Separate Account is registered as a unit investment trust under the Investment Company Act of 1940. A unit investment trust is a type of investment company which invests its assets in the shares of one or more management investment companies rather than directly in its own portfolio of investment securities. Registration under the Investment Company Act of 1940 does not involve supervision of the management or investment practices or policies of the Separate Accounts or of MassMutual. Under Massachusetts law, however, both MassMutual and each Separate Account are subject to regulation by the Division of Insurance of the Commonwealth of Massachusetts.

Although the assets of each Separate Account are assets of MassMutual, assets of each Separate Account equal to the reserves and other annuity contract liabilities which depend on the investment performance of the Separate Account are not chargeable with liabilities arising out of any other business MassMutual may conduct. The income and capital gains and losses, realized or unrealized, of each Division of a Separate Account are credited to or charged against such Division without regard to the income and capital gains and losses of the other Divisions or other accounts of MassMutual. All obligations arising under the Flex Extra Contracts (the Contracts), however, are general corporate obligations of MassMutual.

ASSIGNMENT OF CONTRACT

MassMutual will not be charged with notice of any assignment of a Contract or of the interest of any Beneficiary or of any other person unless the assignment is in writing and the original or a true copy thereof is received at its Home Office. MassMutual assumes no responsibility for the validity of any assignment.

For qualified (Separate Account 1) Contracts, the following exceptions and provisions should be noted:

(1) No person entitled to receive Annuity Payments under a Contract or part or all of the Contract's Value will be permitted to commute, anticipate, encumber, alienate or assign such amounts, except upon the written authority of the Contract Owner given during the Annuitant's lifetime and received in Good Order by MassMutual at its Home Office. To the extent permitted by law, no Contract nor any proceeds or interest payable thereunder will be subject to the Annuitant's or any other person's debts, Contracts or engagements, nor to any levy or attachment for payment thereof;

(2) If an assignment of a Contract is in effect on the Maturity Date, MassMutual reserves the right to pay to the assignee in one sum the amount of the Contract's maturity value to which he is entitled, and to pay any balance of such value in one sum to the Contract Owner, regardless of any payment options which the Contract Owner may have elected. Moreover, if an assignment of a Contract is in effect at the death of the Annuitant prior to the Maturity Date, MassMutual will pay to the assignee in one sum, to the extent that he is entitled, the greater of (a) the total of all Purchase Payments, less the net amount of all partial redemptions, and (b) the Accumulated Value of the Contract, and any balance of such value will be paid to the Beneficiary in one sum or applied under one or more of the payment options elected;

(3) Contracts used in connection with a tax-qualified retirement plan must be endorsed to provide that they may not be sold, assigned or pledged for any purpose unless they are owned by the trustee of a trust described in Section 401(a) or by the administrator of an annuity plan described under Section 403(a) of the Internal Revenue Code of 1986, as amended;

(4) Contracts used in connection with annuity purchase plans adopted by public school systems and certain tax exempt organizations pursuant to IRC Section 403(b) (tax-sheltered annuities or TSAs) must be endorsed to provide that they are non-transferable. Non-ERISA TSA values may be pledged, however, as collateral for Contract loans; and

(5) Contracts issued under a plan for an Individual Retirement Annuity pursuant to IRC Section 408, or for a Roth Individual Retirement Annuity pursuant to IRC Section 408A, must be endorsed to provide that they are non-transferable. Such Contracts may not be sold, assigned, discounted, or pledged as collateral for a loan or as security for the performance of an obligation or for any other purpose by the Annuitant to any person or party other than MassMutual, except to a former spouse of the Annuitant in accordance with the terms of a divorce decree or other written instrument incident to a divorce.

Assignments may be subject to federal income tax.

SERVICE ARRANGEMENTS AND DISTRIBUTION

The Contracts were sold by registered representatives of MML Investors Services, LLC (MMLIS), a subsidiary of MassMutual. Pursuant to an underwriting agreement with MassMutual, on its own behalf and on behalf of the Separate Accounts, MMLIS, serves as principal underwriter of the Contracts sold by its registered representatives.

MMLIS is located at 1295 State Street, Springfield, MA 01111-0001. MMLIS is registered with the SEC as a broker-dealer under the Securities Exchange Act of 1934 and is a member of the Financial Industry Regulatory Authority (FINRA).

During the last three years, MMLIS was paid the compensation amounts shown below for its actions as principal underwriter for the Separate Accounts.

MMLIS		
Year	Massachusetts Mutual Variable Annuity Separate Account 1	Massachusetts Mutual Variable Annuity Separate Account 2
2023	\$52,098	\$67,750
2022	\$112,651	\$146,496
2021	\$65,931	\$85,740

Commissions for sales of the Contracts by MMLIS registered representatives are paid by MassMutual on behalf of MMLIS to its registered representatives.

During the last three years, commissions, as described in the prospectus, were paid by MassMutual through MMLIS as shown below.

MMLIS		
Year	Massachusetts Mutual Variable Annuity Separate Account 1	Massachusetts Mutual Variable Annuity Separate Account 2
2023	\$301,559	\$237,324
2022	\$696,302	\$657,055
2021	\$751,658	\$977,484

We no longer offer the Contract for sale to the public.

The offering is on a continuous basis.

CONTRACT VALUE CALCULATIONS FOR AMOUNTS ALLOCATED TO A DIVISION

The Accumulation Phase

Valuation Date, Valuation Time and Valuation Period

Each day on which the net asset value of the shares of any of the Funds is determined is a "Valuation Date." The value of shares of the Funds held in each Separate Account is determined as of the "Valuation Time," which is the time of the close of trading on the New York Stock Exchange (currently 4:00 p.m. Eastern Time) on a Valuation Date. A "Valuation Period" is the period, consisting of one or more days, from one Valuation Time to the next succeeding Valuation Time.

Accumulation Unit Value

The value of an Accumulation Unit (the Accumulation Unit Value) for each Division will vary from Valuation Date to Valuation Date. The initial Accumulation Unit Value for each Division was set at \$1.00000000. The Accumulation Unit Value for each Division on any date thereafter is equal to the product of the "Net Investment Factor" for that Division (as defined below) for the Valuation Period which includes such date and the Accumulation Unit Value for that Division on the preceding Valuation Date.

Purchase of Accumulation Units in a Division of a Separate Account

You may allocate Purchase Payments among the available Divisions and the GPA. At the end of each Valuation Period, MassMutual will apply Your Purchase Payment (after deducting any applicable Premium Taxes) to each Division that you have allocated in order to purchase Accumulation Units of the designated Division(s). These Accumulation Units will be used in determining the value of amounts in the Separate Account credited to the Contract on or prior to the Maturity Date and the amount of variable annuity benefits at maturity. The value of the Accumulation Units in each Division will vary with and will reflect the investment performance and expenses of that Division (which in turn will reflect the investment performance of the Fund in which the assets of the Division are invested), any applicable taxes and the applicable asset charge.

The Accumulation Unit Value is determined as of the Valuation Time. Provided that the Contract application is complete, Accumulation Units are purchased at their Accumulation Unit Value within two days of the date on which a Purchase Payment is received in Good Order in the mail or by wire transfer at MassMutual's Service Center or a designated bank lockbox. If such date is not a Valuation Date, or if the Purchase Payment is received after the Valuation Time or other than by mail or wire transfer, the value of the Accumulation Units purchased will be determined as of the next Valuation Time following the date the payment is received. If an initial Purchase Payment is not applied to purchase Accumulation Units within five Business Days after receipt at MassMutual's Service Center (due to incomplete or ambiguous application information, for example), the payment amount will be refunded unless specific consent to retain the payment for a longer period is obtained from the prospective purchaser.

Net Investment Factor

The Net Investment Factor for each Division for any Valuation Period is equal to the sum of the gross investment rate for that Division (as defined below) for the Valuation Period and 1.00000000, decreased by the applicable asset charge. The Net Investment Factor may be greater than or less than 1.00000000.

Gross Investment Rate

The gross investment rate for each Division is equal to the net earnings of that Division during the Valuation Period, divided by the value of the net assets of that Division at the beginning of the Valuation Period. The net earnings of each Division are equal to the accrued investment income and capital gains and losses (realized and unrealized) of that Division and an adjustment for taxes paid or provided for. The gross investment rate will be determined in accordance with generally accepted accounting principles and applicable laws, rules and regulations. The gross investment rate may be positive or negative.

The policy of each Separate Account is to take dividends and capital gain distributions on shares of the Funds held by each Separate Account in additional shares and not in cash.

See "General Formulas" for the general formulas used to compute the value of an Accumulation Unit for any Division, and for a hypothetical illustration using such formulas.

The Income Phase

When your Contract approaches its Maturity Date, you may choose to have the Contract Value provide you at maturity with either fixed Annuity Payments (referred to as the Fixed Income Option in your Contract), variable monthly Annuity Payments (referred to as the Variable Income Option in your Contract), or a combination of the two. You also may elect to receive the Contract Value in one

lump sum. A Contingent Deferred Sales Charge (as described in the Prospectus) may be deducted from the Accumulated Value of your Contract at maturity. Fixed or variable monthly Annuity Payments may be received under several different payment options.

Fixed Annuity

If you select a fixed annuity, then each Annuity Payment will be for a fixed-dollar amount and will not vary with or reflect the investment performance of a Separate Account or its Divisions. For further information regarding the type of annuity benefit and the payment options available thereunder, you should refer to the Contracts.

Variable Monthly Annuity

If you select a variable monthly annuity, then each Annuity Payment will be based upon the value of the Annuity Units. This value will vary with and reflect the investment performance of each Division to which Annuity Units are credited. The number of Annuity Units will not vary, but will remain fixed during the annuity period unless a joint and survivor payment option with reduced survivor income is elected. Variable monthly Annuity Payments will be made by withdrawal of assets from the Separate Account.

Annuity Units and Monthly Payments

The number of Annuity Units in each Division to be credited to a Contract is determined in the following manner. First, the value of amounts attributable to a Contract to each Division is determined by multiplying the number of Accumulation Units credited to a Division on the maturity date of the Contract by the Accumulation Unit Value of that Division on the payment calculation date for the first variable monthly annuity payment. Such value is then multiplied by the "purchase rate" (as defined below) to determine the amount of the first variable monthly annuity payment attributable to each Division. Finally, the amount of the first variable monthly annuity payment attributable to each Division is divided by the Annuity Unit Value for that Division on the payment calculation date for such payment to determine the number of Annuity Units for that Division.

The dollar amount of each variable monthly annuity payment (other than the first payment under a Contract) is equal to the sum of the products obtained by multiplying the number of Annuity Units in each Division credited to the Contract by their value (the Annuity Unit Value) on the payment calculation date.

Purchase Rate

The purchase rate for each Division is the amount of variable monthly annuity payment purchased by \$1,000 of Accumulated Value at Maturity Date applied to that Division. The purchase rates which will be applied will be those specified in the Contract or those in use by MassMutual when the first variable monthly annuity payment is due, whichever provides the higher income. The interest rate used in calculating the purchase rates will be the assumed investment rate as described in the next section. The purchase rate will differ according to the payment option which you elect and takes into account the age and year of birth of the Annuitant or Annuitants. The sex of the Annuitant or Annuitants will also be considered unless the Contract is issued on a unisex basis, including cases issued in connection with an employer- sponsored plan covered by the United States Supreme Court case of *Arizona Governing Committee v. Norris*.

Assumed Investment Rates

The assumed investment rate for each Division will be 4% per annum unless a lower rate is required by state law. The assumed investment rate will affect the amount by which variable monthly annuity payments will vary from month to month. If the actual net investment performance for a Division for the period between the date any variable monthly annuity payment is determined and the date the next variable monthly annuity payment is determined is equivalent on an annual basis to an investment return at the assumed investment rate, then the amount of the next payment attributable to that Division will be equal to the amount of the last payment. If such net investment performance for a Division is equivalent to an investment return greater than the assumed investment rate, the next payment attributable to that Division will be larger than the last; if such net investment performance for a Division is equivalent to a return smaller than the assumed investment rate, then the next payment attributable to that Division will be smaller than the last.

Annuity Unit Value

The Annuity Unit Value for a Division depends on the Assumed Investment Rate and on the Net Investment Factor for that Division. The initial Annuity Unit Value for each Division was set at \$1.00000000. An Annuity Unit Value for a Division on any date thereafter is equal to the Net Investment Factor for the Valuation Period which includes such date divided by the sum of 1.00000000 plus the rate of interest for the number of days in such Valuation Period at an effective annual rate equal to the assumed investment rate, and multiplied by the Annuity Unit Value for the Division on the preceding Valuation Date.

General Formulas

General Formulas to Determine Accumulation Unit Value and Annuity Unit Value for any Division

Gross Investment Rate	= <u>Net Earnings during Valuation Period</u> Value of Net Assets at beginning of Valuation Period
Net Investment Factor	= Gross Investment Rate + 1.00000000 – Asset Charge
Accumulation Unit Value	= Accumulation Unit Value on Preceding Valuation Date × Net Investment Factor
Annuity Unit Value	= Accumulation Unit Value on Preceding <u>Valuation Date × Net Investment Factor</u> 1.00000000 + rate of interest for number of days in current Valuation Period at Assumed Investment Rate

Illustration of Computation of Accumulation and Annuity Unit Value Using Hypothetical Example

The above computations may be illustrated by the following hypothetical example: Assume that the net earnings of the Division for the Valuation Period were \$11,760; that the value of net assets at the beginning of the Valuation Period was \$30,000,000; that the asset charge was 0.00003562 per day; that the values of an Accumulation Unit and an Annuity Unit in the Division on the preceding Valuation Date were \$1.13500000 and \$1.06700000, respectively, that the corresponding assumed investment rate was 4% and that the Valuation Period was one day.

The gross investment rate for the Valuation Period would be 0.00039200 (\$11,760 divided by \$30,000,000). The Net Investment Factor would be 1.00035638 (0.00039200 plus 1.00000000 minus 0.00003562). The new Accumulation Unit Value would be \$1.13540449 (\$1.13500000 × 1.00035638). At an effective annual rate of 4%, the rate of interest for one day is 0.00010746, and the new Annuity Unit Value would be \$1.06726557 (\$1.06700000 × 1.00035638 divided by 1.00010746).

General Formulas to Determine Variable Monthly Annuity Payments and Number of Annuity Units for any Division

First Variable Monthly Annuity Payment	= Accumulation Units Applied × Accumulation Unit Value on Payment Calculation Date for First Variable Monthly Annuity Payment × Purchase Rate
Number of Annuity Units	= <u>First Variable Monthly Annuity Payment</u> Annuity Unit Value on Payment Calculation Date for First Variable Monthly Annuity Payment
Amount of Subsequent Variable Monthly Annuity Payments	= Number of Annuity Units × Annuity Unit Value on the Applicable Payment Calculation Date

Illustration of Computation of Variable Monthly Annuity Payments for a Contract Using Hypothetical Example

The above computations may be illustrated by the following hypothetical example: Assume that 35,000 Accumulation Units in a Division were to be applied; that the purchase rate for the assumed investment rate and payment option elected was \$5.65 per \$1,000; that the Accumulation Unit Value of such Division on the payment calculation date for the first variable monthly annuity payment was \$1.35000000; and that the Annuity Unit Value of such Division on the payment calculation date for the first variable monthly annuity payment was \$1.20000000 and for the second variable monthly annuity payment was \$1.20050000.

The first variable monthly annuity payment would be \$266.96 (35,000 × 1.35000000 × 0.00565). The number of Annuity Units of such Division credited would be 222.467 (\$266.96 divided by \$1.20000000). The amount of the second variable monthly annuity payment would be \$267.07 (222.467 × \$1.20050000). If the Contract has Annuity Units credited in more than one Division, the above computation would be made for each Division and the variable monthly annuity payment would be equal to the sum thereof.

EXPERTS

The financial statements of Massachusetts Mutual Variable Annuity Separate Account 1 and Massachusetts Mutual Variable Annuity Separate Account 2 as of December 31, 2023 and for each of the years in the two-year period then ended and the financial highlights for each of the years in the five-year period then ended and the statutory financial statements of Massachusetts Mutual Life Insurance Company (the Company) as of December 31, 2023 and 2022, and for each of the years in the three-year period ended December 31, 2023, each have been included in this Statement of Additional Information herein in reliance upon the reports of KPMG LLP, an independent registered public accounting firm, each of which are also included herein, and upon the authority of said firm as experts in accounting and auditing. KPMG LLP's report, dated February 27, 2024, states that the Company prepared its financial statements using statutory accounting practices prescribed or permitted by the Commonwealth of Massachusetts Division of Insurance (statutory accounting practices), which is a basis of accounting other than U.S. generally accepted accounting principles. Accordingly, KPMG LLP's report states that the financial statements of the Company are not intended to be and, therefore, are not presented fairly in accordance with U.S. generally accepted accounting principles and further states that those statements are presented fairly, in all material respects, in accordance with the statutory accounting practices. The principal business address of KPMG LLP is One Financial Plaza, 755 Main Street, Hartford, Connecticut 06103.

FINANCIAL STATEMENTS

The Registrant

Report of Independent Registered Public Accounting Firm

Statement of Assets and Liabilities as of December 31, 2023

Statements of Operations and Changes in Net Assets for the years ended December 31, 2023 and 2022

Notes to Financial Statements

The Depositor

Independent Auditors' Report

Statutory Statements of Financial Position as of December 31, 2023 and 2022

Statutory Statements of Operations for the years ended December 31, 2023, 2022 and 2021

Statutory Statements of Changes in Surplus for the years ended December 31, 2023, 2022 and 2021

Statutory Statements of Cash Flows for the years ended December 31, 2023, 2022 and 2021

Notes to Statutory Financial Statements

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY

STATUTORY FINANCIAL STATEMENTS

As of December 31, 2023 and 2022 and
for the years ended December 31, 2023, 2022 and 2021

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
STATUTORY FINANCIAL STATEMENTS

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KPMG LLP
One Financial Plaza
755 Main Street
Hartford, CT 06103

Independent Auditors' Report

Audit Committee of the Board of Directors
Massachusetts Mutual Life Insurance Company:

Opinions

We have audited the financial statements of Massachusetts Mutual Life Insurance Company (the Company), which comprise the statutory statements of financial position as of December 31, 2023 and 2022, and the related statutory statements of operations and changes in surplus, and cash flows for the three-year period ended December 31, 2023, and the related notes to the financial statements.

Unmodified Opinion on Statutory Basis of Accounting

In our opinion, the accompanying financial statements present fairly, in all material respects, the financial position of the Company as of December 31, 2023 and 2022, and the results of its operations and its cash flows for the three-year period ended December 31, 2023 in accordance with accounting practices prescribed or permitted by the Commonwealth of Massachusetts Division of Insurance described in Note 2.

Adverse Opinion on U.S. Generally Accepted Accounting Principles

In our opinion, because of the significance of the matter discussed in the Basis for Adverse Opinion on U.S. Generally Accepted Accounting Principles section of our report, the financial statements do not present fairly, in accordance with U.S. generally accepted accounting principles, the financial position of the Company as of December 31, 2023 and 2022, or the results of its operations or its cash flows for the three-year period ended December 31, 2023.

Basis for Opinions

We conducted our audits in accordance with auditing standards generally accepted in the United States of America (GAAS). Our responsibilities under those standards are further described in the Auditors' Responsibilities for the Audit of the Financial Statements section of our report. We are required to be independent of the Company and to meet our other ethical responsibilities, in accordance with the relevant ethical requirements relating to our audits. We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our audit opinions.

Basis for Adverse Opinion on U.S. Generally Accepted Accounting Principles

As described in Note 2 to the financial statements, the financial statements are prepared by the Company using accounting practices prescribed or permitted by the Commonwealth of Massachusetts Division of Insurance, which is a basis of accounting other than U.S. generally accepted accounting principles. Accordingly, the financial statements are not intended to be presented in accordance with U.S. generally accepted accounting principles. The effects on the financial statements of the variances between the statutory accounting practices described in Note 2 and U.S. generally accepted accounting principles, although not reasonably determinable, are presumed to be material and pervasive.

Emphasis of Matter

As discussed in Note 3 to the financial statements, in 2023, the Company adopted INT 23-01T - Disallowed IMR. Our opinions are not modified with respect to this matter.

KPMG LLP, a Delaware limited liability partnership and a member firm of the KPMG global organization of independent member firms affiliated with KPMG International Limited, a private English company limited by guarantee.

Responsibilities of Management for the Financial Statements

Management is responsible for the preparation and fair presentation of the financial statements in accordance with accounting practices prescribed or permitted by the Commonwealth of Massachusetts Division of Insurance. Management is also responsible for the design, implementation, and maintenance of internal control relevant to the preparation and fair presentation of financial statements that are free from material misstatement, whether due to fraud or error.

In preparing the financial statements, management is required to evaluate whether there are conditions or events, considered in the aggregate, that raise substantial doubt about the Company's ability to continue as a going concern for one year after the date that the financial statements are issued.

Auditors' Responsibilities for the Audit of the Financial Statements

Our objectives are to obtain reasonable assurance about whether the financial statements as a whole are free from material misstatement, whether due to fraud or error, and to issue an auditors' report that includes our opinion. Reasonable assurance is a high level of assurance but is not absolute assurance and therefore is not a guarantee that an audit conducted in accordance with GAAS will always detect a material misstatement when it exists. The risk of not detecting a material misstatement resulting from fraud is higher than for one resulting from error, as fraud may involve collusion, forgery, intentional omissions, misrepresentations, or the override of internal control. Misstatements are considered material if there is a substantial likelihood that, individually or in the aggregate, they would influence the judgment made by a reasonable user based on the financial statements.

In performing an audit in accordance with GAAS, we:

- Exercise professional judgment and maintain professional skepticism throughout the audit.
- Identify and assess the risks of material misstatement of the financial statements, whether due to fraud or error, and design and perform audit procedures responsive to those risks. Such procedures include examining, on a test basis, evidence regarding the amounts and disclosures in the financial statements.
- Obtain an understanding of internal control relevant to the audit in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the Company's internal control. Accordingly, no such opinion is expressed.
- Evaluate the appropriateness of accounting policies used and the reasonableness of significant accounting estimates made by management, as well as evaluate the overall presentation of the financial statements.
- Conclude whether, in our judgment, there are conditions or events, considered in the aggregate, that raise substantial doubt about the Company's ability to continue as a going concern for a reasonable period of time.



We are required to communicate with those charged with governance regarding, among other matters, the planned scope and timing of the audit, significant audit findings, and certain internal control related matters that we identified during the audit.

/s/ KPMG LLP

Hartford, Connecticut
February 27, 2024

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
STATUTORY STATEMENTS OF FINANCIAL POSITION

	December 31, 2023	December 31, 2022
	(In Millions)	
Assets:		
Bonds	\$ 144,433	\$ 136,445
Preferred stocks	446	451
Common stocks – subsidiaries and affiliates	25,496	24,683
Common stocks – unaffiliated	1,623	1,477
Mortgage loans	24,021	24,972
Policy loans	15,897	17,054
Real estate	329	355
Partnerships and limited liability companies	12,907	12,296
Derivatives	20,740	22,032
Cash, cash equivalents and short-term investments	11,134	5,568
Other invested assets	2,401	1,865
Total invested assets	259,427	247,198
Investment income due and accrued	5,236	4,223
Federal income taxes	280	231
Net deferred income taxes	1,660	1,229
Other than invested assets	5,670	4,285
Total assets excluding separate accounts	272,273	257,166
Separate account assets	52,593	53,414
Total assets	\$ 324,866	\$ 310,580
Liabilities and Surplus:		
Policyholders' reserves	\$ 167,250	\$ 153,216
Liabilities for deposit-type contracts	19,645	18,089
Contract claims and other benefits	714	701
Policyholders' dividends	2,150	1,927
General expenses due or accrued	1,049	1,108
Asset valuation reserve	5,989	5,674
Repurchase agreements	3,219	3,042
Commercial paper	50	250
Collateral	2,073	4,065
Derivatives	13,734	14,003
Funds held under coinsurance	22,520	21,916
Other liabilities	5,141	5,364
Total liabilities excluding separate accounts	243,534	229,355
Separate account liabilities	52,455	53,284
Total liabilities	295,989	282,639
Surplus	28,877	27,941
Total liabilities and surplus	\$ 324,866	\$ 310,580

See accompanying notes to statutory financial statements

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
STATUTORY STATEMENTS OF OPERATIONS

	Years Ended December 31,		
	2023	2022	2021
	(In Millions)		
Revenue:			
Premium income	\$ 25,490	\$ 23,524	19,891
Net investment income	11,043	9,302	8,845
Fees and other income	1,028	1,139	1,253
Total revenue	<u>37,561</u>	<u>33,965</u>	<u>29,989</u>
Benefits, expenses and other deductions:			
Policyholders' benefits	17,369	16,937	11,513
Change in policyholders' reserves	12,273	10,278	11,649
General insurance expenses	2,333	2,191	2,269
Commissions	1,423	1,324	1,224
State taxes, licenses and fees	329	310	326
Other deductions	1,122	677	810
Total benefits, expenses and other deductions	<u>34,849</u>	<u>31,717</u>	<u>27,791</u>
Net gain from operations before dividends and federal income taxes	2,712	2,248	2,198
Dividends to policyholders	2,131	1,906	1,808
Net gain from operations before federal income taxes	581	342	390
Federal income tax expense (benefit)	116	(64)	72
Net gain from operations	465	406	318
Net realized capital (losses) gains	(490)	326	(534)
Net (loss) income	<u>\$ (25)</u>	<u>\$ 732</u>	<u>(216)</u>

See accompanying notes to statutory financial statements

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
STATUTORY STATEMENTS OF CHANGES IN SURPLUS

	Years Ended December 31,		
	2023	2022	2021
	(In Millions)		
Surplus, beginning of year	\$ 27,941	\$ 26,979	\$ 24,327
Net increase due to:			
Net (loss) income	(25)	732	(216)
Change in net unrealized capital gains (losses), net of tax	8	871	3,366
Change in net unrealized foreign exchange capital gains (losses), net of tax	376	(1,739)	(673)
Change in other net deferred income taxes	462	662	544
Change in nonadmitted assets	365	(563)	20
Change in asset valuation reserve	(315)	740	(1,209)
Change in reserve valuation basis	-	(12)	-
Change in surplus notes	(149)	413	841
Change in minimum pension liability	(7)	40	21
Prior period adjustments	173	(44)	31
Other	48	(138)	(73)
Net increase:	<u>936</u>	<u>962</u>	<u>2,652</u>
Surplus, end of year	\$ 28,877	\$ 27,941	\$ 26,979

See accompanying notes to statutory financial statements

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
STATUTORY STATEMENTS OF CASH FLOWS

	Years Ended December 31,		
	2023	2022	2021
	(In Millions)		
Cash from operations:			
Premium and other income collected	\$ 26,418	\$ 24,719	\$ 20,237
Net investment income	12,269	8,172	9,238
Benefit payments	(17,077)	(16,698)	(11,349)
Net transfers from separate accounts	1,611	4,947	1,129
Commissions and other expenses	(5,208)	(5,292)	(4,557)
Dividends paid to policyholders	(1,908)	(1,806)	(1,688)
Federal and foreign income taxes recovered (paid)	58	5	(849)
Net cash from operations	<u>16,163</u>	<u>14,047</u>	<u>12,161</u>
Cash from investments:			
Proceeds from investments sold, matured or repaid:			
Bonds	23,801	28,498	37,911
Preferred and common stocks – unaffiliated	290	422	584
Common stocks – affiliated	105	72	45
Mortgage loans	3,621	3,784	4,889
Real estate	5	177	75
Partnerships and limited liability companies	1,830	2,910	1,629
Derivatives	(214)	(384)	(490)
Other	(518)	(655)	198
Total investment proceeds	<u>28,920</u>	<u>34,824</u>	<u>44,841</u>
Cost of investments acquired:			
Bonds	(32,278)	(43,003)	(47,343)
Preferred and common stocks – unaffiliated	(316)	(572)	(515)
Common stocks – affiliated	(256)	(624)	(3,966)
Mortgage loans	(2,896)	(2,095)	(5,170)
Real estate	(8)	(13)	(174)
Partnerships and limited liability companies	(2,988)	(3,932)	(4,033)
Derivatives	-	(267)	(66)
Other	153	11	86
Total investments acquired	<u>(38,589)</u>	<u>(50,495)</u>	<u>(61,181)</u>
Net increase in policy loans	1,158	(935)	(522)
Net cash used in investing activities	<u>(8,511)</u>	<u>(16,606)</u>	<u>(16,862)</u>
Cash from financing and miscellaneous sources:			
Net deposits on deposit-type contracts	1,238	806	2,359
Change in surplus notes	(150)	413	607
Change in repurchase agreements	171	241	(1,204)
Change in collateral	(2,024)	(2,089)	574
Other cash (used) provided	(1,321)	2,813	2,570
Net cash (used in) from financing and miscellaneous sources	<u>(2,086)</u>	<u>2,184</u>	<u>4,906</u>
Net change in cash, cash equivalents and short-term investments	5,566	(375)	205
Cash, cash equivalents and short-term investments:			
Beginning of year	5,568	5,943	5,738
End of year	<u>\$ 11,134</u>	<u>\$ 5,568</u>	<u>\$ 5,943</u>

See accompanying notes to statutory financial statements

**MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS**

1. Nature of operations

Massachusetts Mutual Life Insurance Company (MassMutual or the Company), a mutual life insurance company domiciled in the Commonwealth of Massachusetts, and its domestic life insurance subsidiaries provide individual and group life insurance, disability insurance (DI), individual and group annuities and guaranteed interest contracts (GIC) to individual and institutional customers in all 50 states of the United States of America (U.S.), the District of Columbia and Puerto Rico. Products and services are offered primarily through the Company's MassMutual Financial Advisors (MMFA), MassMutual Strategic Distributors (MMSD), Institutional Solutions (IS) and Worksite distribution channels.

MMFA is a sales force of financial professionals that operate in the U.S. MMFA sells individual life, individual annuities, hybrid life and long-term care (LTC) and DI. The Company's MMSD channel sells life insurance, disability, annuity, and hybrid life and LTC solutions through a network of third-party distribution partners. The Company's IS distribution channel places group annuities, life insurance and GIC primarily through retirement advisory firms, actuarial consulting firms, investment banks, insurance benefit advisors and investment management companies. The Company's Worksite channel works with advisors and employers across the country to provide American workers with voluntary and executive benefits such as group whole life, critical illness, accident insurance and DI, through the workplace.

2. Summary of significant accounting policies

a. Basis of presentation

The statutory financial statements have been prepared in conformity with the statutory accounting practices of the National Association of Insurance Commissioners (NAIC) and the accounting practices prescribed or permitted by the Commonwealth of Massachusetts Division of Insurance (the Division).

Statutory accounting practices are different in some respects from financial statements prepared in accordance with U.S. generally accepted accounting principles (U.S. GAAP). The more significant differences between statutory accounting practices and U.S. GAAP are as follows:

Invested assets

- Bonds are generally carried at amortized cost, whereas U.S. GAAP reports bonds at fair value for bonds available for sale and trading or at amortized cost for bonds held to maturity (HTM)
- Changes in the fair value of derivative financial instruments are recorded as changes in surplus, whereas U.S. GAAP generally reports these changes in revenue unless deemed an effective hedge
- Interest rate and credit default swaps associated with replicated synthetic investment transactions are carried at amortized cost, whereas U.S. GAAP would carry them at fair value
- Embedded derivatives are recorded as part of the underlying contract, whereas U.S. GAAP would identify and bifurcate certain embedded derivatives from the underlying contract or security and account for them separately at fair value
- Income recognition on partnerships and limited liability companies, which are accounted for under the equity method, is limited to the amount of cash distribution, whereas U.S. GAAP is without limitation
- Certain majority-owned subsidiaries and variable interest entities are accounted for using the equity method, whereas U.S. GAAP would consolidate these entities
- Starting on January 1, 2022, the Company adopted the current expected credit loss (CECL) impairment model for U.S. GAAP, which only applies to financial assets carried at amortized cost, including mortgage and other commercial loans, equipment loans, HTM debt securities, and trade, lease, reinsurance and other receivables. CECL is based on expected credit losses rather than incurred losses. All financial assets within scope of CECL will have a credit loss allowance. The adopted guidance also changes the incurred loss model on AFS debt securities to be an allowance for credit losses with potential recoverability. Statutory accounting continues to utilize the other-than-temporary impairment(s) (OTTI) model described in *Note 2dd*.

Policyholders' liabilities

**MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued**

- Statutory policy reserves are generally based upon prescribed methods, such as the Commissioners' Reserve Valuation Method, Commissioners' Annuity Reserve Valuation Method or net level premium method, and prescribed statutory mortality, morbidity and interest assumptions at the time of issuance, whereas U.S. GAAP policy reserves would generally be based upon the net level premium method or the estimated gross margin method with estimates, at time of issuance, of future mortality, morbidity, persistency and interest
- Liabilities for policyholders' reserves, unearned premium, and unpaid claims are presented net of reinsurance ceded, whereas U.S. GAAP would present the liabilities on a direct basis and report an asset for the amounts recoverable or due from reinsurers
- Payments received for universal and variable life insurance products, certain variable and fixed deferred annuities and group annuity contracts are reported as premium income and corresponding change in reserves, whereas U.S. GAAP would treat these payments as deposits to policyholders' account balances

General insurance expenses and commissions

Certain acquisition costs, such as commissions and other variable costs, directly related to successfully acquiring new business are charged to current operations as incurred, whereas U.S. GAAP generally would capitalize these expenses and amortize them based on profit emergence over the expected life of the policies or over the premium payment period.

Net realized capital (losses) gains

- After-tax realized capital gains (losses) that result from changes in the overall level of interest rates for all types of fixed-income investments and interest-related hedging activities are deferred into the interest maintenance reserve (IMR) and amortized into revenue, whereas U.S. GAAP reports these gains and losses as revenue

Surplus

- Changes in the balances of deferred income taxes, which provide for book versus tax temporary differences, are subject to limitation and are recorded in surplus, whereas U.S. GAAP would generally include the change in deferred taxes in net income without limitation
- Assets are reported at admitted asset value and assets designated as nonadmitted are excluded through a charge against surplus, whereas U.S. GAAP recognizes all assets, net of any valuation allowances
- An asset valuation reserve (AVR) is reported as a contingency reserve to stabilize surplus against fluctuations in the statement value of real estate, partnerships and limited liability companies and certain common stocks as well as credit-related changes in the value of bonds, mortgage loans and certain derivatives, whereas U.S. GAAP does not record this reserve
- Changes to the mortgage loan valuation allowance are recognized in net unrealized capital gains (losses), net of tax, in the Consolidated Statutory Statements of Changes in Surplus, whereas U.S. GAAP follows the CECL impairment model effective 1/1/2022
- The overfunded status of pension and other postretirement plans, which is the excess of the fair value of the plan assets over the projected benefit obligation, is a nonadmitted asset for statutory accounting whereas U.S. GAAP recognizes the overfunded status as an asset
- Surplus notes are reported in surplus, whereas U.S. GAAP reports these notes as liabilities
- Statutory Statements of Changes in Surplus includes net income, change in net unrealized capital gains (losses), change in net unrealized foreign exchange capital gains (losses), change in other net deferred income taxes, change in nonadmitted assets, change in AVR, prior period adjustments and change in minimum pension liability, whereas U.S. GAAP presents net income as retained earnings and net unrealized capital gains (losses), change in net unrealized foreign exchange capital gains (losses), change in minimum pension liability as other comprehensive income
- The change in the fair value for unaffiliated common stock is recorded in surplus, whereas the change in the fair value for ownership interests in an entity not accounted for under the equity method or consolidated are recorded in revenue for U.S. GAAP

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

Other

- Assets and liabilities associated with certain group annuity and variable universal life contracts, which do not pass-through all investment experience to contract holders, are maintained in separate accounts and are presented on a single line in the statutory financial statements, whereas U.S. GAAP reports these contracts as general investments and liabilities of the Company

The preparation of financial statements requires management to make estimates and assumptions that impact the reported amounts of assets and liabilities, the disclosure of assets and liabilities as of the date of the statutory financial statements and the reported amounts of revenues and expenses during the reporting periods. The most significant estimates and assumptions include those used in determining the carrying values of investments including the amount of mortgage loan investment valuation reserves, OTTI, the value of the investment in MassMutual Holding LLC (MMHLLC), the liabilities for policyholders' reserves, the determination of admissible deferred tax assets (DTA), the liability for taxes and the liability for litigation or other contingencies. Future events including, but not limited to, changes in the level of mortality, morbidity, interest rates, persistency, asset valuations and defaults could cause results to differ from the estimates used in the statutory financial statements. Although some variability is inherent in these estimates, management believes the amounts presented are appropriate.

Certain prior year amounts within these financial statements have been reclassified to conform to the current year presentation.

b. Corrections of errors and reclassifications

For the years ended December 31, 2023 and 2022, corrections of prior years' errors were recorded in surplus, net of tax:

	Years Ended December 31, 2023 and 2022						
	Increase (Decrease) to:						
	Prior Years' Net Income		Current Year Surplus (In Millions)		Asset or Liability Balances		
	2023	2022	2023	2022	2023	2022	2023
Common stocks -subsidiaries and affiliates	\$ 19	\$ -	\$ 19	\$ -	\$ 19	\$ -	\$ 19
Partnerships and limited liability companies	15	-	15	-	15	-	-
Derivative assets	-	-	(125)	-	(125)	-	-
Investment income due and accrued	230	-	230	-	230	-	-
Policyholders' reserves	(143)	(65)	(143)	(65)	143	65	
Derivative liabilities	-	-	7	-	(7)	-	-
Other Liabilities	30	25	30	25	30	(25)	
Other invested assets	22	-	22	-	22	-	-
Cash, cash equivalents and short-term investments	-	(4)	-	(4)	-	(4)	(4)
Total	\$ 173	\$ (44)	\$ 55	\$ (44)	\$	\$	\$

c. Bonds

Bonds are generally valued at amortized cost using the constant yield interest method with the exception of NAIC

**MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued**

Category 6 bonds, which are in or near default, and certain residential mortgage-backed securities (RMBS) and commercial mortgage-backed securities (CMBS), which are rated by outside modelers, which are carried at the lower of amortized cost or fair value. NAIC ratings are applied to bonds and other investments. Categories 1 and 2 are considered investment grade, while Categories 3 through 6 are considered below investment grade. Bonds are recorded on a trade date basis, except for private placement bonds, which are recorded on the funding date.

For loan-backed and structured securities, such as asset-backed securities (ABS), mortgage-backed securities (MBS), including RMBS and CMBS, and structured securities, including collateralized debt obligations (CDOs), amortization or accretion is revalued quarterly based on the current estimated cash flows, using either the prospective or retrospective adjustment methodologies.

Fixed income securities, with the highest ratings from a rating agency follow the retrospective method of accounting.

All other fixed income securities, such as floating rate bonds and interest only securities, including those that have been impaired, follow the prospective method of accounting.

The fair value of bonds is based on quoted market prices when available. If quoted market prices are not available, values provided by other third-party organizations are used. If values provided by other third-party organizations are unavailable, fair value is estimated using internal models by discounting expected future cash flows using observable current market rates applicable to yield, credit quality and maturity of the investment or using quoted market values for comparable investments. Internal inputs used in the determination of fair value include estimated prepayment speeds, default rates, discount rates and collateral values, among others. Structure characteristics and cash flow priority are also considered. Fair values resulting from internal models are those expected to be received in an orderly transaction between willing market participants.

Refer to *Note 2dd. "Net realized capital (losses) gains including other-than-temporary impairments and unrealized capital gains (losses)"* for information on the Company's policy for determining OTTI.

d. Preferred stocks

Preferred stocks in good standing, those that are rated Categories 1 through 3 by the Securities Valuation Office (SVO) of the NAIC, are generally valued at amortized cost. Preferred stocks not in good standing, those that are rated Categories 4 through 6 by the SVO, are valued at the lower of amortized cost or fair value. Fair values are based on quoted market prices, when available. If quoted market prices are not available, values provided by third-party organizations are used. If values provided by third-party organizations are unavailable, fair value is estimated using internal models. These models use inputs not directly observable or correlated with observable market data. Typical inputs integrated into the Company's internal discounted expected earnings models include, but are not limited to, earnings before interest, taxes, depreciation and amortization estimates. Fair values resulting from internal models are those expected to be received in an orderly transaction between willing market participants.

Refer to *Note 2dd. "Net realized capital (losses) gains including other-than-temporary impairments and unrealized capital gains (losses)"* for information on the Company's policy for determining OTTI.

e. Common stocks – subsidiaries and affiliates

On May 28, 2021, the Company, through a wholly owned subsidiary, Glidepath Holdings Inc. (Glidepath), acquired MassMutual Ascend Life Insurance Company (formerly known as Great American Life Insurance Company) and other subsidiaries and affiliated entities (MM Ascend) for \$3,570 million in cash. MM Ascend primarily offers traditional fixed and fixed indexed annuity products.

Common stocks of unconsolidated subsidiaries, primarily MMHLLC, Glidepath and MM Investment Holding (MMIH), are accounted for using the statutory equity method. The Company accounts for the value of MMHLLC at its underlying U.S. GAAP equity value less adjustments for the limited statutory basis of accounting related to foreign insurance subsidiaries and controlled affiliated entities as well as an adjustment of \$620 million as of December 31, 2023 for a portion of its noncontrolling interests (NCI). Glidepath is valued on its underlying GAAP equity with adjustment to recognize its investment in MM Ascend based on MM Ascend's underlying statutory surplus, adjusted

**MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued**

for any unamortized goodwill that would have been recognized under the statutory purchase method. Operating results, less dividends declared, for MMHLLC, Glidepath and MMIH are reflected as net unrealized capital gains in the Statutory Statements of Changes in Surplus. Dividends declared from MMHLLC, Glidepath and MMIH are recorded in net investment income when declared and are limited to MMHLLC, Glidepath and MMIH's U.S. GAAP retained earnings. The cost basis of common stocks – subsidiaries and affiliates is adjusted for impairments deemed to be other than temporary.

Refer to *Note 5c. "Common stocks - subsidiaries and affiliates"* for further information on the valuation of MMHLLC.

f. Common stocks – unaffiliated

Unaffiliated common stocks are carried at fair value, which is based on quoted market prices when available. If quoted market prices are not available, values provided by third-party organizations are used. If values from third parties are unavailable, fair values are determined by management using estimates based upon internal models. The Company's internal models include estimates based upon comparable company analysis, review of financial statements, broker quotes and last traded price. Fair values resulting from internal models are those expected to be received in an orderly transaction between willing market participants.

Refer to *Note 2dd. "Net realized capital (losses) gains including other-than-temporary impairments and unrealized capital gains (losses)"* for information on the Company's policy for determining OTTI.

g. Mortgage loans

Mortgage loans are valued at the unpaid principal balance of the loan, net of unamortized premium, discount, mortgage origination fees and valuation allowances. Interest income earned on impaired loans is accrued on the outstanding principal balance of the loan based on the loan's contractual coupon rate. Interest is not accrued for (a) impaired loans more than 60 days past due, (b) delinquent loans more than 90 days past due, or (c) loans that have interest that is not expected to be collected. The Company continually monitors mortgage loans where the accrual of interest has been discontinued, and will resume the accrual of interest on a mortgage loan when the facts and circumstances of the borrower and property indicate that the payments will continue to be received according to the terms of the original or modified mortgage loan agreement.

h. Policy loans

Policy loans are carried at the outstanding loan balance less amounts unsecured by the cash surrender value of the policy and amounts ceded to reinsurers.

i. Real estate

Investment real estate, which the Company has the intent to hold for the production of income, and real estate occupied by the Company are carried at depreciated cost, less encumbrances. Depreciation is calculated using the straight-line method over the estimated useful life of the real estate holding, not to exceed 40 years. Depreciation expense is included in net investment income.

Real estate held for sale is initially carried at the lower of depreciated cost or fair value less estimated selling costs and is no longer depreciated. Adjustments to carrying value, including for further declines in fair value, are recorded in a valuation reserve, which is included in net realized capital (losses) gains.

Fair value is generally estimated using the present value of expected future cash flows discounted at a rate commensurate with the underlying risks, net of encumbrances. The Company also obtains external appraisals for a rotating selection of properties annually. If an external appraisal is not obtained, an internal appraisal is performed.

**MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued**

j. Partnerships and limited liability companies

Partnerships and limited liability companies, except for partnerships that generate and realize low income housing tax credits (LIHTCs), are accounted for using the equity method with the change in the equity value of the underlying investment recorded in surplus. Distributions received are recognized as net investment income to the extent the distribution does not exceed previously recorded accumulated undistributed earnings.

Investments in partnerships that generate LIHTCs are carried at amortized cost unless considered impaired. Under the amortized cost method, the excess of the carrying value of the investment over its estimated residual value is amortized into net investment income during the period in which tax benefits are recognized.

The equity method is suspended if the carrying value of the investment is reduced to zero due to losses from the investment. Once the equity method is suspended, losses are not recorded until the investment returns to profitability and the equity method is resumed. However, if the Company has guaranteed obligations of the investment or is otherwise committed to provide further financial support for the investment, losses will continue to be reported up to the amount of those guaranteed obligations or commitments.

k. Derivatives

Interest rate swaps and credit default swaps associated with replicated assets are valued at amortized cost and all other derivative types are carried at fair value, which is based primarily upon quotations obtained from counterparties and independent sources. These quotations are compared to internally derived prices and a price challenge is lodged with the counterparties and independent sources when a significant difference cannot be explained by appropriate adjustments to the internal model. When quoted market values are not reliable or available, the value is based on an internal valuation process using market observable inputs that other market participants would use. Changes in the fair value of these instruments other than interest rate swaps and credit default swaps associated with replicated synthetic investments are recorded as unrealized capital gains (losses) in surplus. Gains and losses realized on settlement, termination, closing or assignment of contracts are recorded in net realized capital (losses) gains. Amounts receivable and payable are accrued as net investment income.

l. Cash, cash equivalents and short-term investments

Cash and cash equivalents, which are carried at amortized cost, consist of all highly liquid investments purchased with original maturities of three months or less.

Short-term investments, which are carried at amortized cost, consist of short-term bonds, money market mutual funds and all highly liquid investments purchased with maturities of greater than three months and less than or equal to 12 months.

The carrying value reported in the Statutory Statements of Financial Position for cash, cash equivalents and short-term investment instruments approximates the fair value.

m. Investment income due and accrued

Accrued investment income consists primarily of interest and dividends. Interest is recognized on an accrual basis and dividends are recorded as earned on the ex-dividend date.

n. Federal income taxes

Total federal income taxes are based upon the Company's best estimate of its current and DTAs or deferred tax assets or liabilities. Current tax expense (benefit) is reported in the Statutory Statements of Operations as federal income tax expense (benefit) if resulting from operations and within net realized capital (losses) gains if resulting from invested asset transactions. Changes in the balances of net deferred taxes, which provide for book-to-tax temporary differences, are subject to limitations and are reported within various lines within surplus. Accordingly, the reporting of book-to-tax temporary differences, such as reserves and policy acquisition costs, and of book-to-tax permanent differences, such as tax-exempt interest and tax credits, may result in effective tax rates in the Statutory Statements of Operations that differ from the federal statutory tax rate.

**MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued**

o. Other than invested assets

Other than invested assets primarily includes the Company's investment in corporate-owned life insurance, deferred and uncollected life insurance premium, receivable from subsidiaries and affiliates, reinsurance recoverable, fixed assets and other receivables.

p. Separate accounts

Separate accounts and sub-accounts are segregated funds administered and invested by the Company, the performance of which primarily benefits the policyholders/contract holders with an interest in the separate accounts. Group and individual variable annuity, variable life and other insurance policyholders/contract holders select from among the separate accounts and sub-accounts made available by the Company. The separate accounts and sub-accounts are offered as investment options under certain insurance contracts or policies. The returns produced by separate account assets increase or decrease separate account reserves. Separate account assets consist principally of marketable securities reported at fair value. Except for the Company's seed money, supplemental accounts and certain guaranteed separate accounts issued in Minnesota, separate account assets can only be used to satisfy separate account liabilities and are not available to satisfy the general obligations of the Company. Separate account administrative and investment advisory fees are included in fees and other income.

Assets may be transferred from the general investments of the Company to seed the separate accounts. When assets are transferred, they are transferred at fair market value. Gains related to the transfer are deferred to the extent that the Company maintains a proportionate interest in the separate account. The deferred gain is recognized as the Company's ownership decreases or when the underlying assets are sold. Losses associated with these transfers are recognized immediately.

Separate accounts reflect two categories of risk assumption: nonguaranteed separate accounts for which the policyholder/contract holder assumes the investment risk and guaranteed separate accounts for which the Company contractually guarantees a minimum return, a minimum account value, or both to the policyholder/contract holder. For certain guaranteed separate account products such as interest rate guaranteed products and indexed separate account products, reserve adequacy is performed on a contract-by-contract basis using, as applicable, prescribed interest rates, mortality rates and asset risk deductions. If the outcome from this adequacy analysis produces a deficiency relative to the current account value, a liability is recorded in policyholders' reserves or liabilities for deposit-type contracts in the Statutory Statements of Financial Position with the corresponding change in the liability recorded as change in policyholders' reserves or policyholders' benefits in the Statutory Statements of Operations.

Premium income, benefits and expenses of the separate accounts are included in the Statutory Statements of Operations with the offset recorded in the change in policyholders' reserves. Investment income, realized capital gains (losses) and unrealized capital gains (losses) on the assets of separate accounts, other than seed money, accrue to policyholders/contract holders and are not recorded in the Statutory Statements of Operations.

q. Nonadmitted assets

Assets designated as nonadmitted by the NAIC primarily include pension plan assets, intangibles, certain electronic data processing equipment, advances and prepayments, certain investments in partnerships and limited liability companies for which qualifying audits are not performed, the amount of DTAs (subject to certain limitations) that will not be realized by the end of the third calendar year following the current year end, furniture and equipment, certain other receivables and uncollected premium greater than 90 days past due. Due and accrued income is nonadmitted on: (a) bonds delinquent more than 90 days or where collection of interest is improbable; (b) impaired bonds more than 60 days past due; (c) bonds in default; (d) mortgage loans in default where interest is 180 days past due; (e) rent in arrears for more than 90 days; and (f) policy loan interest due and accrued more than 90 days past due and included in the unpaid balance of the policy loan in excess of the cash surrender value of the underlying contract. Assets that are designated as nonadmitted are excluded from the Statutory Statements of Financial Position through a change in nonadmitted assets on the Statutory Statements of Changes in Surplus.

**MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued**

r. Reinsurance

The Company enters into reinsurance agreements with affiliated and unaffiliated insurers in the normal course of business to limit its insurance risk or to assume business.

Premium income, policyholders' benefits (including unpaid claims) and policyholders' reserves are reported net of reinsurance. Premium, benefits and reserves related to reinsured business are accounted for on bases consistent with those used in accounting for the original policies issued and the terms of the reinsurance contracts. The Company records a receivable for reinsured benefits paid, but not yet reimbursed by the reinsurer and reduces policyholders' reserves for the portion of insurance liabilities that are reinsured. Commissions and expense allowances on reinsurance ceded and modified coinsurance (Modco) reserve adjustments on reinsurance ceded are recorded as revenue. Commissions and expense allowances on Retirement Plan Group reinsurance assumed and Modco reserve adjustments on reinsurance assumed are recorded as an expense.

s. Policyholders' reserves

Policyholders' reserves are developed by actuarial methods that will provide for the present value of estimated future obligations in excess of estimated future premium on policies in force and are determined based on either statutory prescribed mortality/morbidity tables using specified interest rates and valuation methods, or principles-based reserving under Valuation Manual -20 which considers a wide range of future economic conditions, computed using justified company experience factors, such as mortality, policyholder behavior and expenses.

The Company waives deduction of deferred fractional premium at death and returns any portion of the final premium beyond the date of death. Reserves are computed using continuous functions to reflect these practices.

The Company charges a higher premium on certain contracts that cover substandard mortality risk. For these policies, the reserve calculations are based on a substandard mortality rate, which is a multiple of the standard mortality tables.

Certain variable universal life and universal life contracts include features such as guaranteed minimum death benefits (GMDB) or other guarantees that ensure continued death benefit coverage when the policy would otherwise lapse. The value of the guarantee is only available to the beneficiary in the form of a death benefit. The liability for variable and universal life GMDBs and other guarantees is included in policyholders' reserves and the related change in this liability is included in change in policyholders' reserves in the Statutory Statements of Operations.

Certain individual variable annuity and fixed annuity products have a variety of additional guarantees such as GMDBs and variable annuity guaranteed living benefits (VAGLB). The primary types of VAGLBs include guaranteed minimum accumulation benefits (GMAB), guaranteed minimum income benefits (GMIB) including GMIB Basic and GMIB Plus and guaranteed lifetime withdrawal benefits (GLWB). In general, these benefit guarantees require the contract owner or policyholder to adhere to a company-approved asset allocation strategy. The liabilities for individual variable annuity GMDBs and VAGLBs are included in policyholders' reserves in the Statements of Financial Position and the related changes in these liabilities are included in change in policyholders' reserves in the Statutory Statements of Operations.

Separate accounts include certain group annuity contracts used to fund retirement plans that offer a guarantee of a contract holder's principal, which can be withdrawn over a stated period of time. These contracts offer a stated rate of return backed by the Company. Contract payments are not contingent upon the life of the retirement plan participants.

Unpaid claims and claim expense reserves are related to disability and LTC claims. Unpaid disability claim liabilities are projected based on the average of the last three disability payments. LTC unpaid claim liabilities are projected using policy specific daily benefit amounts and aggregate utilization factors. Claim expense reserves are based on an analysis of the unit expenses related to the processing and examination of new and ongoing claims. Interest accrued on reserves is calculated by applying NAIC prescribed interest rates to the average reserves by year incurred.

Tabular interest, tabular reserves, reserves released, and tabular cost for all life and annuity contracts and supplementary contracts involving life contingencies are determined in accordance with NAIC Annual Statement instructions. For tabular interest, whole life and term products use a formula that applies a weighted average interest

**MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued**

rate determined from a seriatim valuation file to the mean average reserves. Universal life, variable life, group life, annuity and supplemental contracts use a formula that applies a weighted average credited rate to the mean account value. For contracts without an account value (e.g., a Single Premium Immediate Annuity) a weighted average statutory valuation rate is applied to the mean statutory reserve or accepted actuarial methods using applicable interest rates are applied.

All policyholders' reserves and accruals are presented net of reinsurance. Management believes that these liabilities and accruals represent management's best estimate and will be sufficient, in conjunction with future revenues, to meet future anticipated obligations of policies and contracts in force.

t. Liabilities for deposit-type contracts

Liabilities for funding agreements, dividend accumulations, premium deposit funds, investment-type contracts such as supplementary contracts not involving life contingencies and certain structured settlement annuities are based on account value or accepted actuarial methods using applicable interest rates.

u. Participating contracts

Participating contracts are those that may be eligible to share in any dividends declared by the Company. Participating contracts issued by the Company represented 53% of the Company's policyholders' reserves and liabilities for deposit-type contracts as of December 31, 2023 and 56% as of December 31, 2022.

v. Policyholders' dividends

Dividends expected to be paid to policyholders in the following year are approved annually by MassMutual's Board of Directors and are recorded as an expense in the current year. The allocation of these dividends to policyholders reflects the relative contribution of each group of participating policies to surplus and considers, among other factors, investment returns, mortality and morbidity experience, expenses and taxes. The liability for policyholders' dividends includes the estimated amount of annual dividends and settlement dividends. A settlement dividend is an extra dividend payable at termination of a policy upon maturity, death or surrender.

w. Asset valuation reserve

The Company maintains an AVR that is a contingency reserve to stabilize surplus against fluctuations in the carrying value of common stocks, real estate, partnerships and limited liability companies as well as credit-related changes in the value of bonds, preferred stocks, mortgage loans, and certain derivatives. The AVR is reported as a liability within the Statutory Statements of Financial Position and the change in AVR, net of tax, is reported within the Statutory Statements of Changes in Surplus.

x. Repurchase agreements

Repurchase agreements are contracts under which the Company sells securities and simultaneously agrees to repurchase the same or substantially the same securities. These repurchase agreements are carried at cost and accounted for as collateralized borrowings with the proceeds from the sale of the securities recorded as a liability while the underlying securities continue to be recorded as an investment by the Company. Earnings on these investments are recorded as investment income and the difference between the proceeds and the amount at which the securities will be subsequently reacquired is amortized as interest expense. Repurchase agreements are used as a tool for overall portfolio management to help ensure the Company maintains adequate assets in order to provide yield, spread and duration to support liabilities and other corporate needs.

The Company provides collateral, as dictated by the repurchase agreements, to the counterparty in exchange for a loan. If the fair value of the securities sold becomes less than the loan, the counterparty may require additional collateral.

The carrying value reported in the Statutory Statements of Financial Position for repurchase agreements approximates the fair value.

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

y. ***Commercial paper***

The Company issues commercial paper (CP) in the form of unsecured notes. Interest on CP is calculated using a 360-day year based on the actual number of days elapsed. Due to the short-term nature of CP, the carrying value approximates fair value.

z. ***Interest maintenance reserve***

The Company maintains an IMR that is used to stabilize net income against fluctuations in interest rates. After-tax realized capital gains (losses), which result from changes in interest rates for all types of fixed-income investments and interest-related derivatives, are deferred into the IMR and amortized into net investment income using the grouped amortization method. In the grouped amortization method, assets are grouped based on years of maturity. IMR is reduced by the amount ceded to reinsurers when entering into in force coinsurance ceding agreements. The IMR is included as net negative (Disallowed) IMR for any admitted portion in other than invested assets. Refer to *Note 3. "New accounting standards - Adoption of new accounting standards"* for further information on the adoption of INT 23-O1T - Disallowed IMR. Refer to *Note 7. "Other than invested assets"* for further information on the amount admitted as disallowed IMR.

aa. ***Employee compensation plans***

The Company has a long-term incentive compensation plan, under which certain employees of the Company and its subsidiaries may be issued phantom share-based compensation awards. These awards include Phantom Stock Appreciation Rights (PSARs) and Phantom Restricted Stock (PRS). These awards do not grant an equity or ownership interest in the Company.

PSARs provide the participant with the opportunity to share in the value created in the total enterprise. The PSAR value is the appreciation in the phantom stock price between the grant price and the share price at the time of exercise. Awards can only be settled in cash. PSARs typically cliff vest at the end of three years and expire five years after the date of grant. Vested PSARs may be exercised during quarterly two-week exercise periods prior to expiration. The compensation expense for an individual award is recognized over the service period.

PRS provide the participant with the opportunity to share in the value created in the total enterprise. Participants receive the full phantom share value (grant price plus/minus any change in share price) over the award period. Awards can only be settled in cash. PRS typically vests on a graded basis over five years, one third per year after years three, four and five. On each vesting date, a lump sum cash settlement is paid to the participant based on the number of shares vested multiplied by the most recent phantom stock price. Compensation expense is recognized on the accelerated attribution method. The accelerated attribution method recognizes compensation expense over the vesting period by which each separate payout year is treated as if it were, in substance, a separate award.

All awards granted under the Company's plans are compensatory classified awards. Compensation costs are based on the most recent quarterly calculated intrinsic value of the PSARs (current share price less grant price per share not less than zero) and PRS (current share price per share), considering vesting provisions, net of forfeiture assumptions and are included in the Statutory Statements of Financial Position as a liability in general expenses due or accrued. The compensation expense for an individual award is recognized over the service period. The cumulative compensation expense for all outstanding awards in any period is equal to the change in calculated liability period over period. The requisite service period for the awards is the vesting period.

At the time of death or disability, awards contain vesting conditions, whereby employees' unvested awards immediately vest on an accelerated basis with a one-year exercise period for PSARs, full accelerated vesting and settlement for PRS awards.

At the time of retirement, both PRS and PSAR vest according to the original grant terms.

The phantom share price is determined using the enterprise value of each entity within the organization provided it is within a pre-established range calculated using management basis equity method. If outside the range, the maximum or minimum share price established by the management basis equity method would apply, as appropriate.

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

bb. Other liabilities

Other liabilities primarily consist of the derivative interest expense liability, remittances and items not allocated, other miscellaneous liabilities, liabilities for employee benefits and accrued separate account transfers.

cc. Premium and related expense recognition

Life insurance premium revenue is generally recognized annually on the anniversary date of the policy. However, premium for flexible products, primarily universal life and variable universal life contracts, is recognized as revenue when received. Annuity premium is recognized as revenue when received. DI and LTC premium is recognized as revenue when due.

Premium revenue is adjusted by the related deferred premium adjustment. Deferred premium adjusts for the overstatement created in the calculation of reserves as the reserve computation assumes the entire year's net premium is collected annually at the beginning of the policy year and does not take into account installment or modal payments.

Commissions and other costs related to issuance of new policies and policy maintenance and settlement costs are charged to current operations when incurred. Surrender fee charges on certain life and annuity products are recorded as a reduction of benefits and expenses.

dd. Net realized capital (losses) gains including other-than-temporary impairments and unrealized capital gains (losses)

Net realized capital (losses) gains, net of taxes, exclude gains (losses) deferred into the IMR and gains (losses) of the separate accounts. Net realized capital (losses) gains, including OTTI, are recognized in net income and are determined using the specific identification method.

Bonds - general

The Company employs a systematic methodology to evaluate OTTI by conducting a quarterly analysis of bonds. OTTI is evaluated in a manner consistent with market participant assumptions. The Company considers the following factors, where applicable depending on the type of securities, in the evaluation of whether a decline in value is other than temporary: (a) the likelihood that the Company will be able to collect all amounts due according to the contractual terms of the debt security; (b) the present value of the expected future cash flows of the security; (c) the characteristics, quality and value of the underlying collateral or issuer securing the position; (d) collateral structure; (e) the length of time and extent to which the fair value has been below amortized cost; (f) the financial condition and near-term prospects of the issuer; (g) adverse conditions related to the security or industry; (h) the rating of the security; (i) the Company's ability and intent to hold the investment for a period of time sufficient to allow for an anticipated recovery to amortized cost; and (j) other qualitative and quantitative factors in determining the existence of OTTI including, but not limited to, unrealized loss trend analysis and significant short-term changes in value.

In addition, if the Company has the intent to sell, or the inability, or lack of intent to retain the investment for a period sufficient to recover the amortized cost basis, an OTTI is recognized as a realized loss equal to the entire difference between the investment's amortized cost basis and its fair value at the balance sheet date.

When a bond is other-than-temporarily impaired, a new cost basis is established.

Bonds - corporate

For corporate securities, if it is determined that a decline in the fair value of a bond is other than temporary, OTTI is recognized as a realized loss equal to the difference between the investment's amortized cost basis and, generally, its fair value at the balance sheet date.

The Company analyzes investments whose fair value is below the cost for impairment. Generally, if the investment experiences significant credit or interest rate related deterioration, the cost of the investment is not recoverable, or the Company intends to sell the investment before anticipated recovery, an OTTI is recognized as realized investment loss.

**MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued**

Bonds - loan-backed and structured securities

For loan-backed and structured securities, if the present value of cash flows expected to be collected is less than the amortized cost basis of the security, an OTTI is recognized as a realized loss equal to the difference between the investment's amortized cost basis and the present value of cash flows expected to be collected. The expected cash flows are discounted at the security's effective interest rate. Internal inputs used in determining the amount of the OTTI on structured securities include collateral performance, prepayment speeds, default rates, and loss severity based on borrower and loan characteristics, as well as deal structure including subordination, over-collateralization and cash flow priority.

ABS and MBS are evaluated for OTTI using scenarios and assumptions based on the specifics of each security including collateral type, loan type, vintage and subordination level in the structure. Cash flow estimates are based on these assumptions and inputs obtained from external industry sources along with internal analysis and actual experience. Where applicable, assumptions include prepayment speeds, default rates and loss severity, weighted average maturity and changes in the underlying collateral values.

The Company has a review process for determining if CDOs are at risk for OTTI. For the senior, mezzanine and junior debt tranches, cash flows are modeled using multiple scenarios based on the current ratings and values of the underlying corporate credit risks and incorporating prepayment and default assumptions that vary according to collateral attributes of each CDO. The prepayment and default assumptions are varied within each model based upon rating (base case), historical expectations (default), rating change improvement (optimistic), rating change downgrade (pessimistic) and fair value (market). The default rates produced by these multiple scenarios are assigned an expectation weight according to current market and economic conditions and fed into a final scenario. OTTI is recorded if this final scenario results in the loss of any principal or interest payments due.

For the most subordinated junior CDO tranches, the present value of the projected cash flows in the final scenario is measured using an effective yield. If the current book value of the security is greater than the present value measured using an effective yield, an OTTI is taken in an amount sufficient to produce its effective yield. Certain CDOs cannot be modeled using all of the scenarios because of limitations on the data needed for all scenarios. The cash flows for these CDOs, including foreign currency denominated CDOs, are projected using a customized scenario management believes is reasonable for the applicable collateral pool.

For loan-backed and structured securities, any difference between the new amortized cost basis and any increased present value of future cash flows expected to be collected is accreted into net investment income over the expected remaining life of the bond.

Common and preferred stock

The cost basis of common and preferred stocks is adjusted for impairments deemed to be other than temporary. The Company considers the following factors in the evaluation of whether a decline in value is other than temporary: (a) the financial condition and near-term prospects of the issuer; (b) the Company's ability and intent to retain the investment for a period sufficient to allow for a near-term recovery in value; and (c) the period and degree to which the value has been below cost. The Company conducts a quarterly analysis of issuers whose common or preferred stock is not-in-good standing or valued below 80% of cost. The Company also considers other qualitative and quantitative factors in determining the existence of OTTI including, but not limited to, unrealized loss trend analysis and significant short-term changes in value.

Mortgage loans

The Company performs internal reviews at least annually to determine if individual mortgage loans are performing or nonperforming. The fair values of performing mortgage loans are estimated by discounting expected future cash flows using current interest rates for similar loans with similar credit risk. For nonperforming loans, the fair value is the estimated collateral value of the underlying real estate. If foreclosure is probable, the Company will obtain an external appraisal.

**MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued**

Mortgage loans are considered to be impaired when, based upon current available information and events, it is probable that the Company will be unable to collect all amounts of principal and interest due according to the contractual terms of the mortgage loan agreement. A valuation allowance is recorded on a loan-by-loan basis in net unrealized capital losses for the excess of the carrying value of the mortgage loan over the fair value of its underlying collateral. Such information or events could include property performance, capital budgets, future lease roll, a property inspection as well as payment trends. Collectability and estimated decreases in collateral values are also assessed on a loan-by-loan basis considering all events and conditions relevant to the loan. This evaluation is inherently subjective as it requires estimates that are susceptible to significant revisions as more information becomes available, as changes occur in the market or as negotiations with the borrowing entity evolve. If there is a change in the fair value of the underlying collateral or the estimated loss on the loan, the valuation allowance is adjusted accordingly. An OTTI occurs upon the realization of a credit loss, typically through foreclosure or after a decision is made to accept a discounted payoff, and is recognized in realized capital losses. The previously recorded valuation allowance is reversed from unrealized capital losses. When an OTTI is recorded, a new cost basis is established reflecting estimated value of the collateral.

Real estate

For real estate held for the production of income, depreciated cost is adjusted for impairments whenever events or changes in circumstances indicate the carrying amount of the asset may not be recoverable, with the impairment being included in realized capital losses. An impairment is recorded when the property's estimated future net operating cash flows over ten years, undiscounted and without interest charges, is less than book value.

Adjustments to the carrying value of real estate held for sale are recorded in a valuation reserve as realized capital losses when the fair value less estimated selling costs is less than the carrying value.

Partnerships and limited liability companies

When it is probable that the Company will be unable to recover the outstanding carrying value of an investment based on undiscounted cash flows, or there is evidence indicating an inability of the investee to sustain earnings to justify the carrying value of the investment, OTTI is recognized in realized capital losses reflecting the excess of the carrying value over the estimated fair value of the investment. The estimated fair values of limited partnership interests are generally based on the Company's share of the net asset value (NAV) as provided in the financial statements of the investees. In certain circumstances, management may adjust the NAV by a premium or discount when it has sufficient evidence to support applying such adjustments.

For determining impairments in partnerships that generate LIHTCs, the Company uses the present value of all future benefits, the majority of which are tax credits, discounted at a risk-free rate for future benefits of ten or more years and compares the results to its current book value. Impairments are recognized in realized capital losses reflecting the excess of the carrying value over the estimated fair value of the investment.

Unrealized capital gains (losses)

Unrealized capital gains (losses) include changes in the fair value of derivatives, excluding interest rate swaps and credit default index swaps associated with replicated assets; currency translation adjustments on foreign-denominated bonds; changes in the fair value of unaffiliated common stocks; changes in the fair value of bonds and preferred stocks that are carried at fair value; and changes in the inflation adjustments on U.S Treasury inflation-indexed securities. Changes in the Company's equity investments in partnerships and limited liability companies, including the earnings as reported on the financial statements, earnings recorded as accumulated undistributed earnings, foreign exchange asset valuation and mark-to-market on operating assets, and certain subsidiaries and affiliates are also reported as changes in unrealized capital gains (losses). Unrealized capital gains (losses) are recorded as a change in net unrealized capital gains (losses), net of tax, within the Statutory Statements of Changes in Surplus.

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

3. New accounting standards

Adoption of new accounting standards

In June 2022, the NAIC adopted modifications to SSAP No. 25, Affiliates and Other Related Parties and SSAP No. 43R, Loan-Backed and Structured Securities, effective December 31, 2022. The modifications clarify application of the existing affiliate definition and incorporate disclosure requirements for all investments that involve related parties, regardless of whether they meet the affiliate definition. The revisions to SSAP No. 43R also included additional clarifications that the investments from any arrangements that results in direct or indirect control, which include but are not limited to control through a servicer, shall be reported as affiliated investments. The modifications did not have a material effect on the Company's financial statements.

In August 2023, the NAIC adopted INT 23-01T — Disallowed IMR (“INT 23-01T”). INT 23-01T provides optional, limited-term guidance for the assessment of disallowed IMR for up to 10% of adjusted general account capital and surplus. An insurer's capital and surplus must first be adjusted to exclude certain “soft assets” including net positive goodwill, electronic data processing equipment and operating system software, net deferred tax assets and admitted disallowed IMR. An insurer will only be able to admit the negative IMR if the insurer's risk-based capital is over 300% authorized control level after adjusting to remove the assets described above.

As adopted, negative IMR may be admitted first in the insurer's general account and then, if all disallowed IMR in the general account is admitted and the percentage limit is not reached, to the separate account proportionately between insulated and noninsulated accounts. If the insurer can demonstrate historical practice in which acquired gains from derivatives were also reversed to IMR (as liabilities) and amortized, there is no exclusion for derivatives losses. INT 23-01T was adopted by the Company as of September 30, 2023 and will be effective through December 31, 2025. To the extent the Company's IMR balance is a net negative, the effects of INT 23-01T will be reflected in the Company's financial position, results of operations, and financial statement disclosures. The Company has adopted this guidance and the adoption resulted in an admitted disallowed IMR of \$1,112 million.

In August 2023, the NAIC adopted revisions to clarify and incorporate a new bond definition within disclosures SSAP No. 26 – *Bonds*, SSAP No. 43 – *Asset-Backed Securities*, and other related SSAPs, effective January 1, 2025. The revisions were issued in connection with its principle-based bond definition project, the Bond Project.

The Bond Project began in October 2020 through the development of a principle-based bond definition to be used for all securities in determining whether they qualify for reporting on the statutory annual statement Schedule D. Within the new bond definition, bonds are classified as an “issuer credit obligation” or an “asset-backed security.” An “issuer credit obligation” is defined as a bond where repayment is supported by the general creditworthiness of an operating entity, and an “asset-backed security” is defined as a bond issued by an entity created for the primary purpose of raising capital through debt backed by financial assets. The revisions to SSAP No. 26 reflect the principle-based bond definition, and SSAP No. 43 provides accounting and reporting guidance for investments that qualify as asset-backed securities under the new bond definition. Upon adoption, investments that do not qualify as bonds will not be permitted to be reported as bonds on Schedule D, Part 1 thereafter as there will be no grandfathering for existing investments that do not qualify under the revised SSAPs. The Company is currently assessing the impacts of the adopted SSAP No. 26, SSAP No. 43 and other related SSAPs in relation to the financial statements.

In March 2023, the NAIC adopted modifications to SSAP No. 34 – *Investment Income Due and Accrued*, effective December 31, 2023. The modifications require additional disclosures and data capture related to gross, non-admitted and admitted amounts for interest income due and accrued, deferred interest, and paid-in-kind (PIK) interest.

In August 2023, the NAIC adopted revisions to further clarify the PIK interest disclosure in SSAP No. 34, effective December 31, 2023. The revisions clarify that decreasing amounts to principal balances are first applied to any PIK interest included in the principal balance. The original principal would not be reduced until the PIK interest had been fully eliminated from the balance. The revisions also provide a practical expedient for determining the PIK interest in the cumulative balance by subtracting the original principal/ par value from the current principal/ par value, with the resulting PIK interest not to go less than zero. The modifications did not have a material effect on the Company's impact of PIK in relation to the financial statements.

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

4. Fair value of financial instruments

The following presents a summary of the carrying values and fair values of the Company's financial instruments:

	December 31, 2023					
	Carrying Value	Fair Value	Level 1	Level 2	Level 3	
	(In Millions)					
Financial assets:						
Bonds:						
U. S. government and agencies	\$ 5,060	\$ 4,744	\$ -	\$ 4,744	\$ -	\$ -
All other governments	1,242	1,092	-	1,062	30	
States, territories and possessions	231	229	-	229	-	
Political subdivisions	363	353	-	353	-	
Special revenue	4,986	4,975	-	4,938	37	
Industrial and miscellaneous	122,721	114,598	66	50,893	63,639	
Parent, subsidiaries and affiliates	9,830	9,410	-	1,406	8,004	
Preferred stocks	446	470	96	-	374	
Common stocks - subsidiaries and affiliates	430	430	253	-	177	
Common stocks - unaffiliated	1,623	1,623	666	-	957	
Mortgage loans - commercial	19,299	17,885	-	-	17,885	
Mortgage loans - residential	4,722	4,449	-	-	4,449	
Derivatives:						
Interest rate swaps	17,292	12,277	-	12,277	-	
Options	547	547	68	479	-	
Currency swaps	2,831	2,831	-	2,831	-	
Forward contracts	13	13	-	13	-	
Credit default swaps	1	1	-	1	-	
Financial futures	56	56	56	-	-	
Cash, cash equivalents and short-term investments	11,134	11,134	782	10,352	-	
Separate account assets	52,593	52,593	35,002	15,677	1,914	
Financial liabilities:						
GICs	16,207	15,550	-	-	-	15,550
Group annuity contracts and other deposits	2,053	1,841	-	-	-	1,841
Individual annuity contracts	25,861	24,495	-	-	-	24,495
Supplementary contracts	942	943	-	-	-	943
Repurchase agreements	3,219	3,219	-	-	-	3,219
Commercial paper	50	50	-	-	-	50
Derivatives:						
Interest rate swaps	11,922	12,289	-	12,289	-	
Options	35	35	35	-	-	
Currency swaps	1,294	1,309	-	1,309	-	
Forward contracts	301	303	-	303	-	
Credit default swaps	153	152	-	152	-	
Financial futures	29	29	29	-	-	

Common stocks-subsidiaries and affiliates do not include unconsolidated subsidiaries, which had statutory carrying values of \$25,066 million.

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

	December 31, 2022					
	Carrying Value	Fair Value	Level 1	Level 2	Level 3	
	(In Millions)					
Financial assets:						
Bonds:						
U. S. government and agencies	\$ 4,764	\$ 4,428	\$ -	\$ 4,428	\$ -	-
All other governments	1,635	1,385	-	1,323	62	
States, territories and possessions	248	241	-	241	-	
Political subdivisions	405	388	-	388	-	
Special revenue	4,187	4,111	-	4,102	9	
Industrial and miscellaneous	117,023	105,791	-	45,812	59,979	
Parent, subsidiaries and affiliates	8,183	7,956	-	1,015	6,941	
Preferred stocks	451	446	45	-	401	
Common stocks - subsidiaries and affiliates	460	460	110	-	350	
Common stocks - unaffiliated	1,477	1,477	507	-	970	
Mortgage loans - commercial	20,756	19,152	-	-	19,152	
Mortgage loans - residential	4,216	3,892	-	-	3,892	
Derivatives:						
Interest rate swaps	18,287	18,456	-	18,456	-	
Options	639	639	31	608	-	
Currency swaps	3,071	3,071	-	3,071	-	
Forward contracts	14	14	-	14	-	
Financial futures	21	21	21	-	-	
Cash, cash equivalents and short-term investments	5,568	5,568	420	5,148	-	
Separate account assets	53,414	53,414	34,931	16,790	1,693	
Financial liabilities:						
GICs	14,701	13,803	-	-	13,803	
Group annuity contracts and other deposits	2,162	1,890	-	-	1,890	
Individual annuity contracts	17,000	16,214	-	-	16,214	
Supplementary contracts	1,139	1,140	-	-	1,140	
Repurchase agreements	3,042	3,042	-	3,042	-	
Commercial paper	250	250	-	250	-	
Derivatives:						
Interest rate swaps	13,036	18,165	-	18,165	-	
Options	6	6	6	-	-	
Currency swaps	709	362	-	362	-	
Forward contracts	236	236	-	236	-	
Interest rate caps and floors	13	13	-	13	-	
Credit default swaps	3	3	3	-	-	

Common stocks - subsidiaries and affiliates do not include unconsolidated subsidiaries, which had statutory carrying values of \$24,223 million.

Fair value is defined as the price that would be received from selling an asset or paid to transfer a liability in an orderly transaction between market participants at the measurement date. The authoritative guidance for fair value establishes a measurement framework that includes a hierarchy used to classify the inputs used in measuring fair value. The hierarchy prioritizes the inputs to valuation techniques into three levels. Each level reflects a unique description of the inputs that are significant to the fair value measurements. The levels of the fair value hierarchy are as follows:

Level 1 – Observable inputs in the form of quoted prices for identical instruments in active markets.

**MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued**

Level 2 – Observable inputs other than Level 1 prices, such as quoted prices for similar assets or liabilities, quoted prices in markets that are not active or other inputs that are observable or can be derived from observable market data for substantially the full term of the assets or liabilities.

Level 3 – One or more unobservable inputs that are supported by little or no market activity and are significant to the fair value of the assets or liabilities. Level 3 assets and liabilities include financial instruments whose value is determined using internal models, as well as instruments for which the determination of fair value requires significant management judgment or estimation.

When available, the Company generally uses unadjusted quoted market prices from independent sources to determine the fair value of investments, and classifies such items within Level 1 of the fair value hierarchy. If quoted prices are not available, prices are derived from observable market data for similar assets in an active market or obtained directly from brokers for identical assets traded in inactive markets. Investments that are priced using these inputs are classified within Level 2 of the fair value hierarchy. When some of the necessary observable inputs are unavailable, fair value is based upon internally developed models. These models use inputs not directly observable or correlated with observable market data. Typical inputs, which are integrated in the Company's internal discounted cash flow models and discounted earnings models include, but are not limited to, issuer spreads derived from internal credit ratings and benchmark yields such as SOFR, cash flow estimates and earnings before interest, taxes, depreciation and amortization estimates. Investments that are priced with such unobservable inputs are classified within Level 3 of the fair value hierarchy.

The Company reviews the fair value hierarchy classifications at each reporting period. Overall, reclassifications between levels occur when there are changes in the observability of inputs and market activity used in the valuation of a financial asset or liability. Such reclassifications are reported as transfers between levels at the beginning fair value for the reporting period in which the changes occur. Given the types of assets classified as Level 1 (primarily equity securities including mutual fund investments), transfers between Level 1 and Level 2 measurement categories are expected to be infrequent. Transfers into and out of Level 3 are summarized in the schedule of changes in Level 3 assets and liabilities.

The fair value of group annuity contracts and other deposits is determined by multiplying the book value of the contract by an average market value adjustment factor. The market value adjustment factor is directly related to the difference between the book value of client liabilities and the present value of installment payments discounted at current market value yields. The market value yield is measured by the Barclay's Aggregate Bond Index, subject to certain adjustments, and the installment period is equivalent to the duration of the Company's invested asset portfolio.

The fair value of individual annuity and supplementary contracts is determined using one of several methods based on the specific contract type. For short-term contracts, generally less than 30 days, the fair value is assumed to be the book value. For contracts with longer durations, GICs and investment-type contracts, the fair value is determined by calculating the present value of future cash flows discounted at current market interest rates, the risk-free rate or a current pricing yield curve based on pricing assumptions using assets of a comparable corporate bond quality. Annuities receiving dividends are accumulated at the average minimum guaranteed rate and discounted at the risk-free rate. All others are valued using cash flow projections from the Company's asset/liability management analysis.

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

The following presents the Company's fair value hierarchy for assets and liabilities that are carried at fair value:

	December 31, 2023			
	Level 1	Level 2	Level 3	Total
	(In Millions)			
Financial assets:				
Bonds				
Special revenue	-	2	-	2
Industrial and miscellaneous	66	107	172	345
Preferred Stock	24	-	63	87
Common stock - subsidiaries and affiliates	253	-	177	430
Common stock - unaffiliated	666	-	957	1,623
Derivatives				
Interest rate swaps	-	17,287	-	17,287
Options	68	479	-	547
Currency swaps	-	2,831	-	2,831
Forward contracts	-	13	-	13
Financial futures	56	-	-	56
Separate account assets	35,002	15,677	1,914	52,593
Total financial assets carried at fair value	<u>\$ 36,135</u>	<u>\$ 36,396</u>	<u>\$ 3,283</u>	<u>\$ 78,814</u>
Financial liabilities:				
Derivatives:				
Interest rate swaps	\$ -	\$ 11,922	\$ -	\$ 11,922
Options	35	-	-	35
Currency swaps	-	192	-	192
Forward Contracts	-	301	-	301
Credit default swaps	-	153	-	153
Financial futures	29	-	-	29
Total financial liabilities carried at fair value	<u>\$ 64</u>	<u>\$ 12,568</u>	<u>\$ -</u>	<u>\$ 12,632</u>

For the year ended December 31, 2023 and the year ended December 31, 2022, the Company did not have any financial instruments that were carried at net asset value as a practical expedient.

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

The following presents the Company's fair value hierarchy for assets and liabilities that are carried at fair value:

	December 31, 2022			
	Level 1	Level 2	Level 3	Total
	(In Millions)			
Financial assets:				
Bonds:				
All other governments	\$ -	6	- \$	6
Special revenue	- -	1	- -	1
Industrial and miscellaneous	- -	85	220	305
Preferred stocks	21	- -	47	68
Common stocks - subsidiaries and affiliates	110	- -	350	460
Common stocks - unaffiliated	507	- -	970	1,477
Derivatives:				
Interest rate swaps	- -	18,287	- -	18,287
Options	31	608	- -	639
Currency swaps	- -	3,071	- -	3,071
Forward contracts	- -	14	- -	14
Financial futures	21	- -	- -	21
Separate account assets	34,931	16,790	1,693	53,414
Total financial assets carried at fair value	<u>\$ 35,621</u>	<u>\$ 38,862</u>	<u>\$ 3,280</u>	<u>\$ 77,763</u>
Financial liabilities:				
Derivatives:				
Interest rate swaps	\$ - -	13,036	- - \$	13,036
Options	6	- -	- -	6
Currency swaps	- -	122	- -	122
Forward contracts	- -	236	- -	236
Credit default swaps	- -	13	- -	13
Financial futures	3	- -	- -	3
Total financial liabilities carried at fair value	<u>\$ 9</u>	<u>\$ 13,407</u>	<u>\$ - -</u>	<u>\$ 13,416</u>

The Company reviews the fair value hierarchy classifications each reporting period. Changes in the observability of the valuation attributes and the level of market activity may result in a reclassification of certain financial assets or liabilities between fair value hierarchy classifications. Such reclassifications are reported as transfers between levels in the beginning fair value for the reporting period in which the changes occur.

Valuation Techniques and Inputs

The Company determines the fair value of its investments using primarily the market approach or the income approach. The use of quoted prices for identical assets and matrix pricing or other similar techniques are examples of market approaches, while the use of discounted cash flow methodologies is an example of the income approach. The Company attempts to maximize the use of observable inputs and minimize the use of unobservable inputs in selecting whether the market or the income approach is used.

**MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued**

A description of the significant valuation techniques and inputs to the determination of estimated fair value for the more significant asset and liability classes measured at fair value on a recurring basis and categorized within Level 2 and Level 3 of the fair value hierarchy is as follows:

Separate account assets – These assets primarily include bonds (industrial and miscellaneous; U.S. government and agencies), and derivatives. Their fair values are determined as follows:

Bonds (Industrial and miscellaneous) – These securities are principally valued using the market or the income approaches. Level 2 valuations are based primarily on quoted prices in markets that are not active, broker quotes, matrix pricing or other similar techniques that use standard market observable inputs such as benchmark yields, spreads versus benchmark yields, new issuances, issuer ratings, duration, and trades of identical or comparable securities. Privately placed securities are valued using discounted cash flow models using standard market observable inputs, and inputs derived from, or corroborated by, market observable data including market yield curve, duration, call provisions, observable prices and spreads for similar publicly traded or privately traded issuances that incorporate the credit quality and industry sector of the issuer. This level also includes securities priced by independent pricing services that use observable inputs. Valuations based on matrix pricing or other similar techniques that utilize significant unobservable inputs or inputs that cannot be derived principally from, or corroborated by, observable market data, including adjustments for illiquidity, delta spread adjustments or spreads to reflect industry trends or specific credit-related issues are classified as Level 3. In addition, inputs including quoted prices for identical or similar securities that are less liquid and based on lower levels of trading activity than securities classified in Level 2 are classified as Level 3.

Bonds (U.S. government and agencies) – These securities are principally valued using the market approach. Level 2 valuations are based primarily on quoted prices in markets that are not active, or using matrix pricing or other similar techniques using standard market observable inputs such as the benchmark U.S. Treasury yield curve, the spreads versus the U.S. Treasury yield curve for the identical security and comparable securities that are actively traded.

Derivative assets and liabilities – These financial instruments are primarily valued using the market approach. The estimated fair value of derivatives is based primarily on quotations obtained from counterparties and independent sources, such as quoted market values received from brokers. These quotations are compared to internally derived prices and a price challenge is lodged with the counterparties and an independent source when a significant difference cannot be explained by appropriate adjustments to the internal model. When quoted market values are not reliable or available, the value is based upon an internal valuation process using market observable inputs that other market participants would use. Significant inputs to the valuation of derivative financial instruments include overnight index swaps (OIS) and SOFR basis curves, interest rate volatility, swap yield curve, currency spot rates, cross currency basis curves and dividend yields. Due to the observability of the significant inputs to these fair value measurements, they are classified as Level 2.

The use of different assumptions or valuation methodologies may have a material impact on the estimated fair value amounts. For the periods presented, there were no significant changes to the Company's valuation techniques.

**MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued**

The following presents changes in the Company's Level 3 assets carried at fair value:

	Gains		Losses		Transfers In	Transfers Out	Transfers Other	Balance as of 12/31/23
	Balance as of 1/1/23	(Losses) Income	(Gains) in Net Surplus	Purchases	Issuances	Sales	Settlements	
	(In Millions)							
Financial assets:								
Bonds:								
Industrial and miscellaneous	\$ 220	\$ (4)	\$ (10)	\$ 36	\$ 1	\$ (2)	\$ (13)	\$ (56)
Preferred stocks	47	-	11	3	-	-	-	2
Common stocks - subsidiaries and affiliates	350	7	(216)	21	20	(47)	-	48
Common stocks - unaffiliated	970	24	(53)	60	26	(29)	(38)	-
Separate account assets	1,693	271	-	134	-	(182)	(2)	-
Total financial assets	\$ 3,280	\$ 298	\$ (268)	\$ 254	\$ 47	\$ (260)	\$ (53)	\$ 48

	Gains		Losses		Transfers In	Transfers Out	Transfers Other	Balance as of 12/31/22
	Balance as of 1/1/22	(Losses) Income	(Gains) in Net Surplus	Purchases	Issuances	Sales	Settlements	
	(In Millions)							
Financial assets:								
Bonds:								
Industrial and miscellaneous	\$ 187	\$ 3	\$ (9)	\$ 19	\$ 9	\$ -	\$ (52)	\$ 63
Preferred stocks	18	-	(18)	-	-	-	-	47
Common stocks - subsidiaries and affiliates	253	(13)	110	(793)	980	(65)	(6)	(116)
Common stocks - unaffiliated	753	28	2	327	3	(27)	(112)	-
Separate account assets	1,894	(174)	-	282	-	(296)	-	(13)
Total financial assets	\$ 3,105	\$ (156)	\$ 85	\$ (165)	\$ 992	\$ (388)	\$ (170)	\$ (7)

Other transfers include assets that are either no longer carried at fair value or have just begun to be carried at fair value, such as assets with no level changes but a change in the lower of cost or market carrying basis. Industrial and miscellaneous bonds in other contain assets that are now carried at fair value due to ratings changes and assets are no longer carried at fair value where the fair value is now higher than the book value.

Level 3 transfers in are assets that are consistently carried at fair value but have had a level change. Common stocks unaffiliated assets were transferred from Level 2 to Level 3 due to a change in the observability of pricing inputs, at the beginning fair value for the reporting period.

**MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued**

5. Investments

The Company maintains a diversified investment portfolio. Investment policies limit concentration in any asset class, geographic region, industry group, economic characteristic, investment quality or individual investment.

a. Bonds

The carrying value and fair value of bonds were as follows:

	December 31, 2023					
	Carrying Value	Gross Unrealized Gains		Gross Unrealized Losses		Fair Value
		(In Millions)	(In Millions)	(In Millions)	(In Millions)	
U.S. government and agencies	\$ 5,060	\$ 70	\$ 385	\$ 4,744		
All other governments	1,242	13	163		1,092	
States, territories and possessions	231	4	6		229	
Political subdivisions	363	7	17		353	
Special revenue	4,986	113	125		4,975	
Industrial and miscellaneous	122,721	841	8,964		114,598	
Parent, subsidiaries and affiliates	9,830	20	439		9,410	
Total	\$ 144,433	\$ 1,068	\$ 10,099		\$ 135,401	

The December 31, 2023 gross unrealized losses exclude \$127 million of losses included in the carrying value. These losses include \$126 million from NAIC Class 6 bonds and \$1 million from RMBS and CMBS whose ratings were obtained from outside modelers. These losses were primarily included in industrial and miscellaneous or parent, subsidiaries and affiliates.

	December 31, 2022					
	Carrying Value	Gross Unrealized Gains		Gross Unrealized Losses		Fair Value
		(In Millions)	(In Millions)	(In Millions)	(In Millions)	
U.S. government and agencies	\$ 4,764	\$ 59	\$ 395	\$ 4,428		
All other governments	1,635	15	265		1,385	
States, territories and possessions	248	2	9		241	
Political subdivisions	405	6	23		388	
Special revenue	4,187	106	182		4,111	
Industrial and miscellaneous	117,023	391	11,623		105,791	
Parent, subsidiaries and affiliates	8,183	1	228		7,956	
Total	\$ 136,445	\$ 580	\$ 12,725		\$ 124,300	

The December 31, 2022 gross unrealized losses exclude \$102 million of losses included in the carrying value. These losses include \$104 million from NAIC Class 6 bonds and \$(2) million from RMBS and CMBS whose ratings were obtained from outside modelers. These losses were primarily included in industrial and miscellaneous or parent, subsidiaries and affiliates.

**MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued**

The quality of the bond portfolio is determined by the use of SVO ratings and the equivalent rating agency designations, except for RMBS and CMBS that use outside modelers. The following sets forth the NAIC class ratings for the bond portfolio including RMBS and CMBS:

NAIC Class	Equivalent Rating Agency Designation	2023		December 31, 2022	
		Carrying Value	% of Total	Carrying Value	% of Total
(\$ In Millions)					
1	Aaa/ Aa/ A	\$ 81,184	56%	\$ 73,290	54%
2	Baa	53,888	37	51,732	38
3	Ba	3,617	3	5,495	4
4	B	2,842	2	2,888	2
5	Caa and lower	2,512	2	2,603	2
6	In or near default	390	-	437	-
Total		\$ 144,433	100%	\$ 136,445	100%

The following summarizes NAIC ratings for RMBS and CMBS investments subject to NAIC modeling:

NAIC Class	2023		December 31,		2022			
	RMBS		CMBS		RMBS		CMBS	
	Carrying Value	% of Total						
(\$ In Millions)								
1	\$ 246	95%	\$ 2,020	75%	\$ 391	82%	\$ 1,693	75%
2	-	-	237	9	29	6	202	9
3	1	-	155	6	32	7	160	7
4	5	2	143	5	14	3	83	4
5	7	3	63	2	10	2	81	4
6	-	-	72	3	2	-	12	1
	\$ 259	100%	\$ 2,690	100%	\$ 478	100%	\$ 2,231	100%

The following is a summary of the carrying value and fair value of bonds as of December 31, 2023 by contractual maturity. Expected maturities may differ from contractual maturities because issuers may have the right to call or prepay obligations with or without prepayment penalties. Securities with more than one maturity date are included in the table using the final maturity date.

	Carrying Value	Fair Value	
		(In Millions)	
Due in one year or less		\$ 8,289	\$ 7,949
Due after one year through five years		32,923	32,288
Due after five years through ten years		38,086	36,551
Due after ten years		65,135	58,613
Total	\$ 144,433	\$ 135,401	

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

Sales proceeds and related gross realized capital gains (losses) from bonds were as follows:

	Years Ended December 31,		
	2023	2022	2021
	(In Millions)		
Proceeds from sales	\$ 11,489	\$ 16,097	\$ 21,687
Gross realized capital gains from sales	102	143	406
Gross realized capital losses from sales	(645)	(624)	(135)

The following is a summary of the fair values and gross unrealized losses aggregated by bond category and length of time that the securities were in a continuous unrealized loss position:

	December 31, 2023							
	Less Than 12 Months				12 Months or Longer			
	Fair Value	Unrealized Losses	Number of Issuers	Fair Value	Unrealized Losses	Number of Issuers	(\$ In Millions)	
U.S. government and agencies	\$ 576	\$ 5	6	\$ 2,067	\$ 380	13		
All other governments	26	-	5	882	163	32		
States, territories and possessions	10	-	3	98	6	8		
Political subdivisions	13	-	3	176	17	10		
Special revenue	331	8	27	1,260	118	163		
Industrial and miscellaneous	5,762	265	592	65,928	8,840	2,940		
Parent, subsidiaries and affiliates	5,042	316	10	2,429	123	21		
Total	\$ 11,760	\$ 594	646	\$ 72,840	\$ 9,647	3,187		

The December 31, 2023 gross unrealized losses include \$127 million of losses included in the carrying value. These losses include \$126 million from NAIC Class 6 bonds and \$1 million from RMBS and CMBS whose ratings were obtained from outside modelers. These losses were primarily included in industrial and miscellaneous or parent, subsidiaries and affiliates.

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

	December 31, 2022						
	Less Than 12 Months			Number of Issuers	12 Months or Longer		
	Fair Value	Unrealized Losses	Fair Value		Unrealized Losses	Number of Issuers	
(\$ In Millions)							
U.S. government and agencies	\$ 1,609	\$ 243	15	\$ 1,113	\$ 153	7	
All other governments	447	46	33	737	220	27	
States, territories and possessions	87	3	11	74	6	3	
Political subdivisions	155	13	17	62	10	4	
Special revenue	1,477	123	176	291	58	67	
Industrial and miscellaneous	51,038	5,265	2,735	27,854	6,471	1,807	
Parent, subsidiaries and affiliates	2,575	83	28	1,046	144	11	
Total	<u>\$ 57,388</u>	<u>\$ 5,776</u>	<u>3,015</u>	<u>\$ 31,177</u>	<u>\$ 7,062</u>	<u>1,926</u>	

The December 31, 2022 gross unrealized losses include \$102 million of losses included in the carrying value. These losses include \$104 million from NAIC Class 6 bonds and \$(2) million from RMBS and CMBS whose ratings were obtained from outside modelers. These losses were primarily included in industrial and miscellaneous or parent, subsidiaries and affiliates.

As of December 31, 2023 and 2022, management has not deemed these unrealized losses to be other than temporary because the investment's carrying value is expected to be realized and the Company has the ability and intent not to sell these investments until recovery, which may be at maturity.

As of December 31, 2023, investments in structured and loan-backed securities that had unrealized losses, which were not recognized in earnings, had a fair value of \$17,178 million. Securities in an unrealized loss position for less than 12 months had a fair value of \$2,151 million and unrealized losses of \$48 million. Securities in an unrealized loss position for greater than 12 months had a fair value of \$15,027 million and unrealized losses of \$1,261 million. These securities were primarily categorized as industrial and miscellaneous or parent, subsidiaries and affiliates.

As of December 31, 2022, investments in structured and loan-backed securities that had unrealized losses, which were not recognized in earnings, had a fair value of \$20,311 million. Securities in an unrealized loss position for less than 12 months had a fair value of \$14,684 million and unrealized losses of \$892 million. Securities in an unrealized loss position for greater than 12 months had a fair value of \$5,624 million and unrealized losses of \$894 million. These securities were primarily categorized as industrial and miscellaneous or parent, subsidiaries and affiliates.

In the course of the Company's investment management activities, securities may be sold and reacquired within 30 days to enhance the Company's yield on its investment portfolio. The Company did not sell any securities with the NAIC Designation 3 or below for the years ended December 31, 2023 or 2022, that were reacquired within 30 days of the sale date.

The Company had assets on deposit with government authorities or trustees, as required by law, in the amount of \$10 million as of December 31, 2023 and December 31, 2022.

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

Residential mortgage-backed exposure

RMBS are included in the U.S. government and agencies, special revenue, and industrial and miscellaneous bond categories. The Alt-A category includes option adjustable-rate mortgages and the subprime category includes 'scratch and dent' or reperforming pools, high loan-to-value pools, and pools where the borrowers have very impaired credit but the average loan-to-value is low, typically 70% or below. In identifying Alt-A and subprime exposure, management used a combination of qualitative and quantitative factors, including FICO scores and loan-to-value ratios.

As of December 31, 2023, RMBS had a total carrying value of \$3,775 million and a fair value of \$3,756 million, of which approximately 4%, based on carrying value, was classified as Alt-A. Alt-A and subprime RMBS had a total carrying value of \$1,326 million and a fair value of \$1,312 million. As of December 31, 2022, RMBS had a total carrying value of \$2,308 million and a fair value of \$2,266 million, of which approximately 8%, based on carrying value, was classified as Alt-A. Alt-A and subprime RMBS had a total carrying value of \$999 million and a fair value of \$993 million.

During the year ended December 31, 2023, there were no significant credit downgrades for the securities held by the Company that were backed by residential mortgage pools.

Leveraged loan exposure

Leveraged loans are loans extended to companies that already have considerable amounts of debt. The Company reports leveraged loans as bonds. These leveraged loans have interest rates higher than typical loans, reflecting the additional risk of default from issuers with high debt-to-equity ratios.

As of December 31, 2023, total leveraged loans and leveraged loan CDOs had a carrying value of \$27,844 million and a fair value of \$27,509 million, of which approximately 80%, based on carrying value, were domestic leveraged loans and CDOs. As of December 31, 2022, total leveraged loans and leveraged loan CDOs had a carrying value of \$26,332 million and a fair value of \$25,664 million, of which approximately 81%, based on carrying value, were domestic leveraged loans and CDOs.

Commercial mortgage-backed exposure

The Company holds bonds backed by pools of commercial mortgages. The mortgages in these pools have varying risk characteristics related to underlying collateral type, borrower's risk profile and ability to refinance and the return provided to the borrower from the underlying collateral. These investments had a carrying value of \$2,693 million and fair value of \$2,285 million as of December 31, 2023 and a carrying value of \$2,669 million and fair value of \$2,285 million as of December 31, 2022.

b. Preferred stocks

The carrying value and fair value of preferred stocks were as follows:

	December 31,	
	2023	2022
	(In Millions)	
Carrying value	\$ 446	\$ 451
Gross unrealized gains	29	9
Gross unrealized losses	(5)	(14)
Fair value	\$ 470	\$ 446

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

As of December 31, 2023, investments in preferred stocks in an unrealized loss position included holdings with a fair value of \$267 million in 19 issuers, \$265 million of which was in an unrealized loss position for more than 12 months. As of December 31, 2022, investments in preferred stocks in an unrealized loss position included holdings with a fair value of \$245 million in 17 issuers, \$55 million of which was in an unrealized loss position for more than 12 months. Based upon the Company's impairment review process discussed in *Note 2dd*. "*Net realized capital (losses) gains including other-than-temporary impairments and unrealized capital gains (losses)*" the decline in value of these securities was not considered to be other than temporary as of December 31, 2023 or 2022.

The Company held preferred stocks for which the transfer of ownership was restricted by contractual requirements with carrying values of \$201 million as of December 31, 2023 and \$323 million as of December 31, 2022.

c. Common stocks – subsidiaries and affiliates

The Company has two primary domestic life insurance subsidiaries, C.M. Life, which primarily provides fixed and variable annuities and universal life insurance business, and MML Bay State, a subsidiary of C.M. Life, which primarily issues variable life and bank-owned life insurance policies.

Summarized below is certain combined statutory financial information for the unconsolidated domestic life insurance subsidiaries:

	As of and for the Years Ended December 31,			(In Millions)
	2023	2022	2021	
	\$	\$	\$	
Total revenue	\$ 433	\$ 577	\$ 682	
Net income	48	155	106	
Assets	12,653	12,870	14,270	
Liabilities	10,515	11,090	12,636	
Shareholder's equity	2,138	1,780	1,634	

In 2023, C.M. Life did not pay any dividends to MassMutual and paid \$163 million in dividends to MassMutual in 2022.

In 2023, MassMutual did not make any contributions to C.M. Life and contributed capital of \$50 million to C.M. Life in 2022.

MMHLLC, a wholly-owned subsidiary of MassMutual, is the parent of subsidiaries that include Barings LLC (Barings) and deals in markets that include retail and institutional asset management entities and registered broker dealers.

The MMHLLC statutory carrying value was \$17.6 billion, which included \$106 million of nonadmitted asset adjustments as of December 31, 2023 and \$17.2 billion as of December 31, 2022, which included \$151 million nonadmitted asset adjustments.

**MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued**

Summarized below is certain U.S. GAAP financial information for MMHLLC:

	As of and for the Years Ended December 31,		
	2023	2022	2021
	(In Billions)		
Total revenue	\$ 3.4	\$ 3.6	\$ 4.9
Net income	0.7	0.6	1.7
Assets	27.2	27.2	25.5
Liabilities	9.1	8.2	7.6
Member's equity	18.1	18.9	17.9

MMHLLC paid \$730 million in dividends to MassMutual for the year ended December 31, 2023, \$450 million of which were declared in 2022, and paid \$604 million in dividends to MassMutual for the year ended December 31, 2022, \$344 million of which were declared in 2021.

MMHLLC declared an additional \$630 million in dividends to MassMutual for the year ended December 31, 2023, which will be paid in 2024.

MassMutual contributed capital of \$235 million to MMHLLC for the year ended December 31, 2023 and \$660 million for the year ended December 31, 2022.

Summarized below is certain U.S. GAAP financial information for Glidepath:

	As of and for the Years Ended December 31,		
	2023	2022	2021
	(In Billions)		
Total revenue	\$ 0.8	\$ 1.2	1.2
Net income (loss)	0.8	1.0	1.0
Assets	53.4	51.0	51.0
Liabilities	51.5	48.8	48.8
Member's equity	1.9	2.2	2.2

Summarized below is certain U.S. GAAP financial information for MMIH:

	As of and for the Years Ended December 31,		
	2023	2022	2021
	(In Billions)		
Total revenue	\$ 0.4	\$ 0.3	0.3
Net income	0.1	0.1	0.1
Assets	10.1	9.3	8.8
Liabilities	8.2	7.6	7.0
Member's Equity	1.9	1.7	1.8

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

Subsidiaries of MMHLLC are involved in litigation and investigations arising in the ordinary course of their business, which seek compensatory damages, punitive damages and equitable remedies. Although the Company is not aware of any actions or allegations that reasonably could give rise to a material adverse impact to the Company's financial position or liquidity, the outcome of litigation cannot be foreseen with certainty. It is the opinion of management that the ultimate resolution of these matters will not materially impact the Company's financial position or liquidity. However, the outcome of a particular proceeding may be material to the Company's Statutory Statements of Changes in Surplus for a particular period depending upon, among other factors, the size of the loss and the level of the Company's changes in surplus for the period.

The Company does not rely on dividends from its subsidiaries to meet its operating cash flow requirements. For the domestic life insurance subsidiaries, substantially all of their statutory shareholder's equity of \$1,905 million as of December 31, 2023 was subject to dividend restrictions imposed by the State of Connecticut.

For further information on related party transactions with subsidiaries and affiliates, see *Note 17. "Related party transactions"*.

d. Common stocks - unaffiliated

The adjusted cost basis and carrying value of unaffiliated common stocks were as follows:

	December 31,		2022
	2023	(In Millions)	
Adjusted cost basis	\$ 1,268	\$ 1,198	
Gross unrealized gains	407		317
Gross unrealized losses	(52)		(38)
Carrying value	<u>\$ 1,623</u>		<u>\$ 1,477</u>

As of December 31, 2023, investments in unaffiliated common stocks in an unrealized loss position included holdings with a fair value of \$308 million in 30 issuers, \$289 million of which were in an unrealized loss position for more than 12 months. As of December 31, 2022, investments in unaffiliated common stocks in an unrealized loss position included holdings with a fair value of \$268 million in 68 issuers, \$78 million of which were in an unrealized loss position for more than 12 months. Based upon the Company's impairment review process discussed in *Note 2dd. "Net realized capital (losses) gains including other-than-temporary impairments and unrealized capital gains (losses)"* the decline in value of these securities was not considered to be other than temporary as of December 31, 2023 or 2022.

The Company held common stocks, for which the transfer of ownership was restricted by contractual requirements, with carrying values of \$106 million as of December 31, 2023 and \$135 million as of December 31, 2022.

e. Mortgage loans

Mortgage loans are comprised of commercial mortgage loans and residential mortgage loans. The Company's commercial mortgage loans primarily finance various types of real estate properties throughout the U.S., the United Kingdom and Canada. The Company holds commercial mortgage loans for which it is the primary lender or a participant or co-lender in a mortgage loan agreement and mezzanine loans that are subordinate to senior secured first liens. The Company's loan agreements with the senior lender contain negotiated provisions that are designed to maximize the Company's influence with the objective of mitigating the Company's risks as the secondary lender for mezzanine loans. Commercial mortgage loans have varying risk characteristics including, among others, the borrower's liquidity, the underlying percentage of completion of a project, the returns generated by the collateral, the refinance risk associated with maturity of the loan and deteriorating collateral value.

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

Residential mortgage loans are primarily seasoned pools of homogeneous residential mortgage loans substantially backed by Federal Housing Administration (FHA) and Veterans Administration (VA) guarantees. As of December 31, 2023 and 2022, the Company did not have any direct subprime exposure through the purchases of unsecuritized whole-loan pools.

Geographical concentration is considered prior to the purchase of mortgage loans and residential mortgage loan pools. The mortgage loan portfolio is diverse with no significant collateral concentrations in any particular geographic region as of December 31, 2023 or 2022.

The carrying value and fair value of the Company's mortgage loans were as follows:

	December 31, 2023		December 31, 2022	
	Carrying Value	Fair Value	Carrying Value	Fair Value
	(In Millions)			
Commercial mortgage loans:				
Primary lender	\$ 19,162	\$ 17,766	\$ 20,662	\$ 19,065
Mezzanine loans	137	119	94	87
Total commercial mortgage loans	<u>19,299</u>	<u>17,885</u>	<u>20,756</u>	<u>19,152</u>
Residential mortgage loans:				
FHA insured and VA guaranteed	1,833	1,699	2,304	2,128
Other residential loans	2,889	2,750	1,912	1,764
Total residential mortgage loans	<u>4,722</u>	<u>4,449</u>	<u>4,216</u>	<u>3,892</u>
Total mortgage loans	<u><u>\$ 24,021</u></u>	<u><u>\$ 22,334</u></u>	<u><u>\$ 24,972</u></u>	<u><u>\$ 23,044</u></u>

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

The loan-to-value ratios by property type of the Company's commercial mortgage loans were as follows:

	December 31, 2023					% of Total
	Less Than 81%	81% to 95%	Above 95%	Total		
	(\$ In Millions)					
Office	\$ 4,957	\$ 508	\$ 1,042	\$ 6,507		34%
Apartments	5,064	417	235	5,716		30
Industrial and other	2,765	25	24	2,814		15
Hotels	1,742	82	92	1,916		10
Retail	2,276	-	70	2,346		12
Total	\$ 16,804	\$ 1,032	\$ 1,463	\$ 19,299		100%

	December 31, 2022					% of Total
	Less Than 81%	81% to 95%	Above 95%	Total		
	(\$ In Millions)					
Office	\$ 6,843	\$ -	\$ 34	\$ 6,877		33%
Apartments	5,437	447	-	5,884		28
Industrial and other	3,447	26	-	3,473		17
Retail	2,449	-	-	2,449		12
Hotels	1,982	91	-	2,073		10
Total	\$ 20,158	\$ 564	\$ 34	\$ 20,756		100%

More than 87% of the Company's commercial mortgage loans' loan-to-value ratios are below 81% for the year ended December 31, 2023. As of December 31, 2022, more than 97% of the Company's commercial mortgage loans' loan-to-value ratios are below 81%.

The Company uses an internal rating system as its primary method of monitoring credit quality. The following illustrates the Company's mortgage loan portfolio rating, translated into the equivalent rating agency designation:

	December 31, 2023						Total
	AAA/AA/A	BBB	BB	B	CCC and Lower		
	(In Millions)						
Commercial mortgage loans:							
Primary lender	\$ 6,014	\$ 9,680	\$ 2,156	\$ 875	\$ 437	\$ 19,162	
Mezzanine loans	-	80	57	-	-	137	
Total commercial mortgage loans	6,014	9,760	2,213	875	437	19,299	
Residential mortgage loans:							
FHA insured and VA guaranteed	1,832	-	-	-	-	1,832	
Other residential loans	-	2,759	23	108	-	2,889	
Total residential mortgage loans	1,832	2,759	23	108	-	4,722	
Total mortgage loans	\$ 7,846	\$ 12,519	\$ 2,236	\$ 983	\$ 437	\$ 24,021	

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

	December 31, 2022						(In Millions)
	AAA/AA/A	BBB	BB	B	CCC and Lower	Total	
Commercial mortgage loans:							
Primary lender	\$ 7,632	\$ 10,300	\$ 2,306	\$ 354	\$ 70	\$ 20,662	
Mezzanine loans	-	37	57	-	-	94	
Total commercial mortgage loans	7,632	10,337	2,363	354	70	20,756	
Residential mortgage loans:							
FHA insured and VA guaranteed	2,299	5	-	-	-	-	2,304
Other residential loans	61	1,832	19	-	-	-	1,912
Total residential mortgage loans	2,360	1,837	19	-	-	-	4,216
Total mortgage loans	\$ 9,992	\$ 12,174	\$ 2,382	\$ 354	\$ 70	\$ 24,972	

The maximum percentage of any one commercial mortgage loan to the estimated value of secured collateral at the time the loan was originated, exclusive of mezzanine, insured, guaranteed or purchase money mortgages, was 80% as of December 31, 2023 and 100% as of December 31, 2022.

The geographic distribution of commercial mortgage loans was as follows:

	December 31, 2023		(\$ In Millions)
	Carrying Value	Average Loan-to-Value Ratio	
California	\$ 3,904	66%	
United Kingdom	2,110	51%	
New York	1,894	66%	
Texas	1,812	56%	
Illinois	1,444	56%	
Washington	1,018	70%	
District of Columbia	929	82%	
All other	6,190	72%	
Total commercial mortgage loans	\$ 19,301	66%	

All other consists of 30 jurisdictions, with no individual exposure exceeding \$878 million.

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

	December 31, 2022	Average Carrying Value (\$ In Millions)	Loan-to-Value Ratio
California	\$ 4,632	50%	
New York	2,157	54%	
United Kingdom	2,008	48%	
Texas	1,867	54%	
Illinois	1,472	51%	
Washington	1,114	53%	
District of Columbia	1,041	58%	
All other	6,465	55%	
Total commercial mortgage loans	\$ 20,756		53%

All other consists of 31 jurisdictions, with no individual exposure exceeding \$897 million.

Interest rates, including fixed and variable, on the Company's portfolio of mortgage loans were:

	Years Ended December 31,			
	2023	2022	Low	High
Commercial mortgage loans			1.8%	12.9%
Residential mortgage loans			2.2%	11.8%
Mezzanine mortgage loans			5.3%	14.4%
			1.7%	11.7%
			2.2%	11.7%
			5.3%	13.3%

Interest rates, including fixed and variable, on new mortgage loans were:

	Years Ended December 31,			
	2023	2022	Low	High
Commercial mortgage loans			4.3%	11.0%
Residential mortgage loans			4.2%	11.8%
Mezzanine mortgage loans			5.5%	8.0%
			2.6%	11.7%
			2.6%	11.7%
			12.2%	13.3%

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

As of December 31, 2023, the Company had impaired mortgage loans with or without a valuation allowance or mortgage loans derecognized as a result of foreclosure, including mortgage loans subject to a participant or co-lender mortgage loan agreement with a unilateral mortgage loan foreclosure restriction or mortgage loan derecognized as a result of a foreclosure.

The following presents a summary of the Company's impaired mortgage loans as of December 31, 2023 and as of December 31, 2022:

	December 31, 2023				
	Carrying Value	Average Carrying Value	Unpaid Principal Balance	Valuation Allowance	Interest Income
(In Millions)					

With allowance recorded:

Commercial mortgage loans:

Primary lender	\$ 465	\$ 537	\$ 624	\$ (157)	\$ 24
Total	465	537	624	(157)	24
Total impaired commercial mortgage loans	\$ 465	\$ 537	\$ 624	\$ (157)	\$ 24

	December 31, 2022				
	Carrying Value	Average Carrying Value	Unpaid Principal Balance	Valuation Allowance	Interest Income
(In Millions)					

With no allowance recorded:

Commercial mortgage loans:

Primary lender	\$ 14	\$ 15	\$ 17	\$ -	\$ 1
Total	14	15	17	-	1
Total impaired commercial mortgage loans	\$ 14	\$ 15	\$ 17	\$ -	\$ 1

The Company did not hold any restructured mortgage loans, mortgage loans with principal or interest past due, or mortgage loans with suspended interest accruals as of December 31, 2023 or 2022. The carrying value of commercial mortgage loans subject to a participant or co-lender mortgage loan agreement was \$855 million as of December 31, 2023 and \$1,264 million as of December 31, 2022.

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

f. Real estate

The carrying value of real estate was as follows:

	December 31, 2023	December 31, 2022
	(In Millions)	
Held for the production of income	\$ 355	\$ 351
Accumulated depreciation	(94)	(78)
Encumbrances	<u>(285)</u>	<u>(285)</u>
Held for the production of income, net	<u>(24)</u>	<u>(12)</u>
Held for sale	76	76
Accumulated depreciation	(74)	(74)
Held for sale, net	<u>2</u>	<u>2</u>
Occupied by the Company	566	574
Accumulated depreciation	(215)	(209)
Occupied by the Company, net	<u>351</u>	<u>365</u>
Total real estate	\$ 329	\$ 355

Depreciation expense on real estate was \$31 million for the year ended December 31, 2023, \$36 million for the year ended December 31, 2022 and \$91 million for the year ended December 31, 2021.

g. Partnerships and limited liability companies

The carrying value of partnership and LLC holdings by annual statement category were:

	December 31, 2023	December 31, 2022
	(In Millions)	
Joint venture interests:		
Common stocks - subsidiaries and affiliates	\$ 2,001	\$ 2,090
Common stocks - unaffiliated	3,462	3,353
Real estate	2,382	2,212
Bonds/preferred stock	735	1,058
Other	1,718	1,144
Mortgage loans	2,096	1,930
Surplus notes	385	389
LIHTCs	128	120
Total	\$ 12,907	\$ 12,296

The Company held 13 affiliated partnerships and limited liability companies in a loss position with accumulated losses of \$63 million as of December 31, 2023, and eight affiliated partnerships and limited liability companies in a loss position with accumulated losses of \$75 million as of December 31, 2022.

The Company's unexpired tax credits expire within a range of less than 1 year to 12 years.

**MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued**

The Company recorded tax credits on these investments of \$55 million for the year ended December 31, 2023 and \$52 million for the year ended December 31, 2022. The minimum holding period required for the Company's LIHTC investments extends from 1 year to 15 years.

For determining impairments for LIHTC investments, the Company uses the present value of all future benefits, the majority of which are tax credits, discounted at a risk-free rate ranging from 4.4% for future benefits of two years to 3.9% for future benefits of ten or more years, and compares the result to its current carry value. The Company recorded \$14 million of impairments for the year ended December 31, 2023.

h. Derivatives

The Company uses derivative financial instruments in the normal course of business to manage risks, primarily to reduce currency, interest rate and duration imbalances determined in asset/liability analyses. The Company also uses a combination of derivatives and fixed income investments to create replicated synthetic investments. These replicated synthetic investments are created when they are economically more attractive than the actual instrument or when similar instruments are unavailable. Replicated synthetic investments are created either to hedge and reduce the Company's credit exposure or to create an investment in a particular asset. The Company held replicated synthetic investments with a notional amount of \$31,687 million as of December 31, 2023 and \$31,264 million as of December 31, 2022, as defined under statutory accounting practices as the result of pairing of a long derivative contract with cash instruments.

The Company's derivative strategy employs a variety of derivative financial instruments: including interest rate, currency, equity, bond, and credit default swaps; options; forward contracts and financial futures. Investment risk is assessed on a portfolio basis and individual derivative financial instruments are not generally designated in hedging relationships; therefore, as allowed by statutory accounting practices, the Company intentionally has not applied hedge accounting.

Interest rate swaps are primarily used to more closely match the cash flows of assets and liabilities. Interest rate swaps are also used to mitigate changes in the value of assets anticipated to be purchased and other anticipated transactions and commitments. The Company uses currency swaps for the purpose of managing currency exchange risks in its assets and liabilities.

The Company does not sell credit default swaps as a participant in the credit insurance market. The Company does, however, use credit default swaps as part of its investment management process. The Company buys credit default swaps as an efficient means to reduce credit exposure to particular issuers or sectors in the Company's investment portfolio. The Company sells credit default swaps in order to create synthetic investment positions that enhance the return on its investment portfolio by providing comparable exposure to fixed income securities that might not be available in the primary market.

Options grant the purchaser the right to buy or sell a security or enter a derivative transaction at a stated price within a stated period. The Company's option contracts have terms of up to 45 years. A swaption is an option to enter an interest rate swap to either receive or pay a fixed rate at a future date. The Company purchases these options for the purpose of managing interest rate risks in its assets and liabilities.

The Company adopted a clearly defined hedging strategy (CDHS) to enable the Company to incorporate currently held hedges in risk-based capital (RBC) calculations. The CDHS is used to significantly mitigate the impact that movements in capital markets have on the liabilities associated with annuity guarantees. The hedge portfolio consists mainly of interest rate swaps, equity swaps, interest rate swaptions and equity futures, and provides protection in the stress scenarios under which RBC is calculated. The hedge portfolio has offsetting impacts relative to the total asset requirement for RBC and surplus for GMDB and VAGLB.

The Company utilizes certain other agreements including forward contracts and financial futures. In addition, the Company also uses "to be announced" forward contracts (TBAs) to hedge interest rate risk and participate in the mortgage-backed securities market in an efficient and cost-effective way. Typically, the price is agreed upon at contract inception and payment is made at a specified future date. The Company usually does not purchase TBAs with settlement by the first possible delivery date and thus, accounts for these TBAs as derivatives. TBAs that settle on the

**MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued**

first possible delivery date are accounted for as bonds. The Company's futures contracts are exchange traded and have credit risk. Margin requirements are met with the deposit of securities. Futures contracts are generally settled with offsetting transactions. Forward contracts and financial futures are used by the Company to reduce exposures to various risks including interest rates and currency rates.

The Company's principal derivative exposures to market risk are interest rate risk, which includes inflation and credit risk. Interest rate risk pertains to the change in fair value of the derivative instruments as a result of changes in market interest rates. The Company is exposed to credit-related losses in the event of nonperformance by counterparties to derivative financial instruments. The Company regularly monitors counterparty credit ratings, derivative positions, valuations and the value of collateral posted to ensure counterparties are credit-worthy and the concentration of exposure is minimized and monitors its derivative credit exposure as part of its overall risk management program.

The Company enters derivative transactions through bilateral derivative agreements with counterparties, or through over the counter cleared derivatives with a counterparty and the use of a clearinghouse. To minimize credit risk for bilateral transactions, the Company and its counterparties generally enter into master netting agreements based on agreed upon requirements that outline the framework for how collateral is to be posted in the amount owed under each transaction, subject to certain minimums. For over the counter cleared derivative transactions between the Company and a counterparty, the parties enter into a series of master netting and other agreements that govern, among other things, clearing and collateral requirements. These transactions are cleared through a clearinghouse and each derivative counterparty is only exposed to the default risk of the clearinghouse. Certain interest rate swaps and credit default swaps are considered cleared transactions. These cleared transactions require initial and daily variation margin collateral postings. These agreements allow for contracts in a positive position, in which amounts are due to the Company, to be offset by contracts in a negative position. This right of offset, combined with collateral obtained from counterparties, reduces the Company's credit exposure.

Net collateral pledged by the counterparties was \$421 million as of December 31, 2023 and \$2,427 million as of December 31, 2022. In the event of default, the full market value exposure at risk in a net gain position, net of offsets and collateral, was \$309 million as of December 31, 2023 and \$634 million as of December 31, 2022. The statutory net amount at risk, defined as net collateral pledged and statement values excluding accrued interest, was \$5,003 million as of December 31, 2023 and \$5,518 million as of December 31, 2022.

The Company had the right to rehypothecate or repledge securities totaling \$1,444 million of the \$421 million as of December 31, 2023 and \$770 million of the \$2,417 million as of December 31, 2022 of net collateral pledged by counterparties. There were no securities rehypothecated to other counterparties as of December 31, 2023 or December 31, 2022.

The following summarizes the carrying values and notional amounts of the Company's derivative financial instruments:

	December 31, 2023					
	Assets				Liabilities	
	Carrying Value	Notional Amount	Carrying Value	Notional Amount		
(In Millions)						
Interest rate swaps	\$ 17,292	\$ 177,596	\$ 11,922	\$ 128,949		
Options	547	11,727	35	248		
Currency swaps	2,831	28,593	1,294	14,672		
Forward contracts	13	993	301	9,162		
Credit default swaps	1	81	153	7,902		
Financial futures	56	674	29	257		
Total	\$ 20,740	\$ 219,664	\$ 13,734	\$ 161,190		

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

	December 31, 2022			
	Assets		Liabilities	
	Carrying Value	Notional Amount	Carrying Value	Notional Amount
(In Millions)				
Interest rate swaps	\$ 18,287	\$ 134,714	\$ 13,036	\$ 136,705
Options	639	14,529	6	-
Currency swaps	3,071	27,615	709	14,814
Forward contracts	14	1,250	236	7,287
Credit default swaps	-	-	13	1,580
Financial futures	21	2,334	3	369
Total	\$ 22,032	\$ 180,442	\$ 14,003	\$ 160,775

The average fair value of outstanding derivative assets was \$22,228 million for the years ended December 31, 2023 and \$18,766 million for the years ended December 31, 2022. The average fair value of outstanding derivative liabilities was \$14,607 million for the years ended December 31, 2023 and \$10,938 million for the years ended December 31, 2022.

The following summarizes the notional amounts of the Company's credit default swaps by contractual maturity:

	December 31, 2023	December 31, 2022
	(In Millions)	
	\$ 7,983	\$ 1,580
Due after one year through five years		
Total	\$ 7,983	\$ 1,580

The following presents the Company's gross notional interest rate swap positions:

	December 31, 2023	December 31, 2022
	(In Millions)	
	\$ 130,853	\$ 128,337
Open interest rate swaps in a fixed pay position		
Open interest rate swaps in a fixed receive position	170,817	137,686
Other interest related swaps	4,875	5,396
Total interest rate swaps	\$ 306,545	\$ 271,418

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

The following summarizes the Company's net realized gains (losses) on closed contracts and change in net unrealized gains (losses) related to market fluctuations on open contracts by derivative type:

	Year Ended December 31, 2023	
	Net Realized Gains (Losses) on Closed Contracts	Change In Net Unrealized Gains (Losses) on Open Contracts
	(In Millions)	
Interest rate swaps	\$ (267)	\$ 118
Currency swaps	101	(309)
Options	31	(96)
Credit default swaps	(39)	(24)
Forward contracts	(62)	(66)
Financial futures	(107)	9
Total	\$ (343)	\$ (368)

	Year Ended December 31, 2022	
	Net Realized Gains (Losses) on Closed Contracts	Change In Net Unrealized Gains (Losses) on Open Contracts
	(In Millions)	
Interest rate swaps	(717)	846
Currency swaps	69	2,204
Options	(6)	385
Credit default swaps	2	(17)
Forward contracts	853	(222)
Financial futures	(902)	(15)
Total	\$ (702)	\$ 3,181

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

	Year Ended December 31, 2021	
	Net Realized Gains (Losses) on Closed Contracts	Change In Net Unrealized Gains (Losses) on Open Contracts
	(In Millions)	
Interest rate swaps	\$ (451)	\$ 458
Currency swaps	(25)	1,094
Options	(126)	74
Credit default swaps	2	-
Forward contracts	109	216
Financial futures	(315)	92
Total	\$ (806)	\$ 1,934

The following summarizes gross and net information of derivative assets and liabilities, along with collateral posted in connection with master netting agreements:

	December 31, 2023			December 31, 2022		
	Derivative Assets	Derivative Liabilities	Net	Derivative Assets	Derivative Liabilities	Net
	(In Millions)					
Gross	\$ 20,740	\$ 13,734	\$ 7,006	\$ 22,032	\$ 14,003	\$ 8,029
Due and accrued	1,371	2,387	(1,016)	733	1,689	(956)
Gross amounts offset	(19,063)	(19,063)	-	(15,378)	(15,378)	-
Net asset	3,048	(2,943)	5,990	7,387	314	7,073
Collateral Posted	(3,438)	(3,017)	(421)	(4,821)	(2,394)	(2,427)
Net	\$ (390)	\$ (5,959)	\$ 5,569	\$ 2,566	\$ (2,080)	\$ 4,646

i. Repurchase agreements

The Company had repurchase agreements with carrying values of \$3,221 million as of December 31, 2023 and \$3,042 million as of December 31, 2022. As of December 31, 2023, the maturities of these agreements ranged from January 8, 2024 through March 14, 2024 and the interest rates ranged from 5.52% to 5.6%. The outstanding amounts were collateralized by cash and bonds with a carrying value of \$3,230 million as of December 31, 2023 and \$3,049 million as of December 31, 2022.

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

The following presents the Company's maximum amount and ending balance for repurchase agreements accounted for as secured borrowing for the years ended:

	December 31,			
	2023		2022	
	Maximum balance	Ending balance	Maximum balance	Ending balance
(In Millions)				
From 1 week to 1 month	\$ 596	\$ -	\$ 773	\$ 398
Greater than 1 month to 3 months	3,247	2,136	3,227	2,644
Greater than 3 months to 1 year	1,088	1,085	1,937	-
Total	\$ 4,931	\$ 3,221	\$ 5,937	\$ 3,042

The following presents the Company's cash collateral and the fair value of security collateral received for the years ended:

	December 31,			
	2023		2022	
	Cash	Securities	Cash	Securities
(In Millions)				
Total	\$ 69	\$ 16	\$ -	\$ -

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

j. Net investment income

Net investment income, including IMR amortization, comprised the following:

	Years Ended December 31,		
	2023	2022	2021
	(In Millions)		
Bonds	\$ 7,275	\$ 5,215	\$ 4,437
Preferred stocks	27	22	17
Common stocks - subsidiaries and affiliates	1,115	878	717
Common stocks - unaffiliated	111	102	55
Mortgage loans	1,102	1,118	1,145
Policy loans	1,058	1,141	1,103
Real estate	70	79	162
Partnerships and LLCs	957	1,014	1,171
Derivatives	(84)	464	539
Cash, cash equivalents and short-term investments	363	80	61
Other	184	35	18
Subtotal investment income	<u>12,178</u>	<u>10,148</u>	<u>9,425</u>
Amortization of the IMR	(51)	(50)	150
Net gains from separate accounts	3	-	-
Investment expenses	(1,087)	(796)	(730)
Net investment income	<u><u>\$ 11,043</u></u>	<u><u>\$ 9,302</u></u>	<u><u>\$ 8,845</u></u>

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

k. Net realized capital (losses) gains

Net realized capital (losses) gains, which include OTTI and are net of deferral to the IMR, comprised the following:

	Years Ended December 31,		
	2023	2022	2021
	(In Millions)		
Bonds	\$ (720)	\$ (889)	\$ 199
Preferred stocks	-	(6)	9
Common stocks - subsidiaries and affiliates	24	(13)	10
Common stocks - unaffiliated	15	64	147
Mortgage loans	(73)	(41)	(7)
Real estate	3	127	24
Partnerships and limited liability companies	(314)	(355)	(413)
Derivatives	(344)	(701)	(806)
Other	(7)	(74)	7
Net realized capital losses (gains) before federal and state taxes and deferral to the IMR	(1,416)	(1,888)	(830)
Net federal and state tax benefit (expense)	281	94	(86)
Net realized capital losses before deferral to the IMR	(1,135)	(1,794)	(916)
Net after tax deferred to the IMR	645	2,120	382
Net realized capital (losses) gains	<u><u>\$ (490)</u></u>	<u><u>\$ 326</u></u>	<u><u>\$ (534)</u></u>

OTTI, included in the realized capital losses, consisted of the following:

	Years Ended December 31,		
	2023	2022	2021
	(In Millions)		
Bonds	\$ (178)	\$ (416)	\$ (80)
Preferred stock	-	(6)	-
Common stocks- subsidiaries and affiliates	(1)	-	-
Common stocks - unaffiliated	-	(2)	(11)
Mortgage loans	(13)	(4)	(17)
Partnerships and LLCs	(353)	(183)	(483)
Total OTTI	<u><u>\$ (545)</u></u>	<u><u>(611)</u></u>	<u><u>(591)</u></u>

The Company recognized OTTI of \$15 million for the year ended December 31, 2023 and \$14 million for the year ended December 31, 2022 on structured and loan-backed securities, which are included in bonds, primarily due to the present value of expected cash flows being less than the amortized cost.

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

The Company utilized internally-developed models to determine less than 1% of the \$178 million of bond OTTI for the year ended December 31, 2023, less than 1% of the \$416 million of bond OTTI for the year ended December 31, 2022 and less than 1% of the \$80 million of bond OTTI for the year ended December 31, 2021. The remaining OTTI amounts were determined using external inputs such as publicly observable fair values and credit ratings. Refer to *Note 2dd. “Net realized capital (losses) gains including other-than-temporary impairments and unrealized capital gains (losses)”* for more information on assumptions and inputs used in the Company’s OTTI models.

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

6. Federal income taxes

On August 16th, 2022, the Inflation Reduction Act (“IRA”) was signed into law and includes certain corporate income tax provisions. Impacts to the Company could include the imposition of a corporate alternative minimum tax (“CAMT”) applicable to tax years beginning after December 31, 2022. The CAMT imposes a 15% minimum tax on adjusted financial statement income on applicable corporations that have an average group wide adjusted financial statement income over \$1 billion in the prior three-year period (2020-2022). As of the reporting date, the Company has determined that it is not an applicable corporation and therefore not liable for CAMT in 2023. The United States Treasury Secretary and the IRS have been authorized to issue further guidance and intend to publish proposed regulations in 2024.

The Company provides for DTAs in accordance with statutory accounting practices, and has met the required threshold to utilize the three-year reversal period and 15% of surplus limitation.

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

The net DTA or deferred tax liability (DTL) recognized in the Company's assets, liabilities and surplus is as follows:

	December 31, 2023		
	Ordinary	Capital (In Millions)	Total
Gross DTAs	\$ 3,943	\$ 740	\$ 4,683
Statutory valuation allowance adjustment	-	-	-
Adjusted gross DTAs	3,943	740	4,683
DTAs nonadmitted	(82)	-	(82)
Subtotal net admitted DTA	3,861	740	4,601
Total gross DTLs	(2,009)	(932)	(2,941)
Net admitted DTA(L)	\$ 1,852	\$ (192)	\$ 1,660

	December 31, 2022		
	Ordinary	Capital (In Millions)	Total
Gross DTAs	\$ 3,444	\$ 742	\$ 4,186
Statutory valuation allowance adjustment	-	-	-
Adjusted gross DTAs	3,444	742	4,186
DTAs nonadmitted	-	-	-
Subtotal net admitted DTA	3,444	742	4,186
Total gross DTLs	(2,045)	(912)	(2,957)
Net admitted DTA(L)	\$ 1,399	\$ (170)	\$ 1,229

	Change		
	Ordinary	Capital	Total
Gross DTAs	\$ 499	\$ (2)	\$ 497
Statutory valuation allowance adjustment	-	-	-
Adjusted gross DTAs	499	(2)	497
DTAs nonadmitted	(82)	-	(82)
Subtotal net admitted DTA	417	(2)	415
Total gross DTLs	36	(20)	16
Net admitted DTA(L)	\$ 453	\$ (22)	\$ 431

**MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued**

The amount of adjusted gross DTA admitted under each component of the guidance and the resulting change by tax character are as follows:

	December 31, 2023		
	Ordinary	Capital	Total
	(In Millions)		
Admitted DTA 3 years:			
Federal income taxes that can be recovered	\$ -	\$ 90	\$ 90
 Remaining adjusted gross DTAs expected to be realized within 3 years:			
1. Adjusted gross DTA to be realized	1,570	-	1,570
2. Adjusted gross DTA allowed per limitation threshold	4,081	-	4,081
Lesser of lines 1 or 2	1,570	-	1,570
 Adjusted gross DTAs offset by existing DTLs	2,291	650	2,941
 Total admitted DTA realized within 3 years	\$ 3,861	\$ 740	\$ 4,601
	December 31, 2022		
	Ordinary	Capital	Total
	(In Millions)		
Admitted DTA 3 years:			
Federal income taxes that can be recovered	\$ -	\$ 63	\$ 63
 Remaining adjusted gross DTAs expected to be realized within 3 years			
1. Adjusted gross DTA to be realized	1,287	-	1,287
2. Adjusted gross DTA allowed per limitation threshold	4,005	-	4,005
Lesser of lines 1 or 2	1,287	-	1,287
 Adjusted gross DTAs offset by existing DTLs	2,158	678	2,836
 Total admitted DTA realized within 3 years	\$ 3,445	\$ 741	\$ 4,186
	Change		
	Ordinary	Capital	Total
	(In Millions)		
Admitted DTA 3 years:			
Federal income taxes that can be recovered	\$ -	\$ 27	\$ 27
 Remaining adjusted gross DTAs expected to be realized within 3 years			
1. Adjusted gross DTA to be realized	283	-	283
2. Adjusted gross DTA allowed per limitation threshold	76	-	76
Lesser of lines 1 or 2	283	-	283
 Adjusted gross DTAs offset by existing DTLs	133	(28)	105
 Total admitted DTA realized within 3 years	\$ 416	\$ (1)	\$ 415

**MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued**

The Company's total realization threshold limitations are as follows:

	December 31, 2023	2022
	(\$ In Millions)	
Ratio percentage used to determine recovery period and threshold limitation	850%	860%
Amount of adjusted capital and surplus used to determine recovery period and threshold limitation above	\$ 27,207	\$ 26,703

The ultimate realization of DTAs depends on the generation of future taxable income during the periods in which the temporary differences are deductible. Management considers the scheduled reversal of DTLs, including the impact of available carryback and carryforward periods, projected taxable income and tax-planning strategies in making this assessment. The impact of tax-planning strategies is as follows:

	December 31, 2023		
	Ordinary	Capital	Total
	(Percent)		
Impact of tax-planning strategies:			
Adjusted gross DTAs (% of total adjusted gross DTAs)	-%	-%	-%
Net admitted adjusted gross DTAs (% of total net admitted adjusted gross DTAs)	79%	-%	79%
December 31, 2022			
	Ordinary	Capital	Total
	(Percent)		
Impact of tax-planning strategies:			
Adjusted gross DTAs (% of total adjusted gross DTAs)	-%	-%	-%
Net admitted adjusted gross DTAs (% of total net admitted adjusted gross DTAs)	69%	-%	69%
Change			
	Ordinary	Capital	Total
	(Percent)		
Impact of tax-planning strategies:			
Adjusted gross DTAs (% of total adjusted gross DTAs)	-%	-%	-%
Net admitted adjusted gross DTAs (% of total net admitted adjusted gross DTAs)	10%	-%	10%

There are no reinsurance strategies included in the Company's tax-planning strategies.

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

The provision for current tax expense on earnings is as follows:

	Years Ended December 31,		
	2023	2022	2021
	(In Millions)		
Federal income tax expense (benefit) on operating earnings	\$ 111	\$ (92)	\$ 69
Foreign income tax expense on operating earnings	5	28	3
Total federal and foreign income tax expense (benefit) on operating earnings	116	(64)	72
Federal income tax expense (benefit) on net realized capital gains (losses)	(268)	(106)	43
Total federal and foreign income tax expense (benefit)	\$ (152)	\$ (170)	\$ 115

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

The tax effects of temporary differences that give rise to significant portions of the DTAs and DTLs are as follows:

	December 31,		Change	
	2023	2022		
	(In Millions)			
DTAs:				
Ordinary				
Reserve items	\$ 1,779	\$ 1,522	\$ 257	
Policy acquisition costs	931	856	75	
Nonadmitted assets	320	305	15	
Pension and compensation related items	73	49	24	
Policyholders' dividends	234	218	16	
Investment items	207	224	(17)	
Expense items	66	59	7	
Other	333	211	122	
Total ordinary DTAs	3,943	3,444	499	
Nonadmitted DTAs	82	-	82	
Admitted ordinary DTAs	3,861	3,444	417	
Capital				
Unrealized investment losses	434	397	37	
Expense items	18	18	-	
Investment items	288	327	(39)	
Total capital DTAs	740	742	(2)	
Admitted capital DTAs	740	742	(2)	
Admitted DTAs	4,601	4,186	415	
DTLs:				
Ordinary				
Reserve items	143	212	(69)	
Unrealized investment gains	1,128	1,104	24	
Deferred and uncollected premium	309	295	14	
Pension items	64	68	(4)	
Investment items	-	5	(5)	
Other	365	361	4	
Total ordinary DTLs	2,009	2,045	(36)	
Capital				
Unrealized investment gains	808	821	(13)	
Investment items	124	91	33	
Total capital DTLs	932	912	20	
Total DTLs	2,941	2,957	(16)	
Net admitted DTA	\$ 1,660	\$ 1,229	\$ 431	

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

The change in net deferred income taxes comprised the following:

	Years Ended December 31,		
	2023	2022	2021
	(In Millions)		
Net DTA(L)	\$ 512	\$ 520	\$ 201
Less: Items not recorded in the change in net deferred income taxes:			
Tax-effect of unrealized gains/(losses)	(38)	105	343
Tax-effect of changes from investment transfers	(12)	37	-
Change in net deferred income taxes	<u><u>\$ 462</u></u>	<u><u>\$ 662</u></u>	<u><u>\$ 544</u></u>

As of December 31, 2023, the Company had no net operating or capital loss carryforwards to include in deferred income taxes. The Company has \$241 million in tax credit carryforwards included in deferred taxes.

The components of federal and foreign income tax are recorded in the Statutory Statements of Operations and the Statutory Statements of Changes in Surplus and are different from those which would be obtained by applying the prevailing federal income tax rate to net gain from operations before federal income taxes. The significant items causing this difference are as follows:

	Years Ended December 31,		
	2023	2022	2021
	(In Millions)		
Provision computed at federal statutory rate	\$ (175)	\$ (325)	\$ (92)
Expense items	(4)	19	(38)
Foreign governmental income taxes	5	28	3
Investment items	(248)	(188)	(135)
Nonadmitted assets	(15)	(10)	4
Tax credits	(222)	(293)	(95)
Other	<u><u>45</u></u>	<u><u>(63)</u></u>	<u><u>(76)</u></u>
Total statutory income tax benefit	<u><u>\$ (614)</u></u>	<u><u>\$ (832)</u></u>	<u><u>\$ (429)</u></u>
Federal and foreign income tax expense (benefit)	\$ (152)	\$ (170)	\$ 115
Change in net deferred income taxes	(462)	(662)	(544)
Total statutory income tax benefit	<u><u>\$ (614)</u></u>	<u><u>\$ (832)</u></u>	<u><u>\$ (429)</u></u>

The Company received refunds of federal income taxes in the amounts of \$58 million in 2023 and \$5 million in 2022 and paid \$849 million in 2021.

The total income taxes incurred in the current and prior years that will be available for recoupment in the event of future net capital losses totaled \$0 million related to 2023, \$29 million related to 2022, and \$124 million related to 2021.

**MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued**

MassMutual and its eligible U.S. subsidiaries are included in a consolidated U.S. federal income tax return. MassMutual and its eligible U.S. subsidiaries also file income tax returns in various states and foreign jurisdictions. MassMutual and its eligible U.S. subsidiaries and certain affiliates (the Parties) have executed and are subject to a written tax allocation agreement (the Tax Agreement). The Tax Agreement sets forth the manner in which the total combined federal income tax is allocated among the Parties. The Tax Agreement provides MassMutual with the enforceable right to recoup federal income taxes paid in prior years in the event of future net capital losses, which it may incur. Further, the Tax Agreement provides MassMutual with the enforceable right to utilize its net losses carried forward as an offset to future net income subject to federal income taxes. In accordance with the Tax Agreement, future corporate alternative minimum tax (CAMT) is outside of the scope to the general tax allocation method and, consequently any future CAMT liability shall be allocated solely to MassMutual.

Companies are generally required to disclose unrecognized tax benefits, which are the tax effect of positions taken on their tax returns that may be challenged by various taxing authorities, in order to provide users of financial statements more information regarding potential liabilities. The Company recognizes tax benefits and related reserves in accordance with existing statutory accounting practices for liabilities, contingencies and impairments of assets.

The following is a reconciliation of the beginning and ending liability for unrecognized tax benefits (in millions):

Balance, January 1, 2023	\$ 214
Gross change related to positions taken in prior years	-
Gross change related to settlements	-
Gross change related to positions taken in current year	14
Gross change related to lapse of statutes of limitations	-
Balance, December 31, 2023	<u>\$ 229</u>

Included in the liability for unrecognized tax benefits as of December 31, 2023, are \$215 million of tax positions for which the ultimate deductibility is highly certain but for which there is uncertainty about the timing of such deductibility. The liability for the unrecognized tax benefits as of December 31, 2023 includes \$9 million of unrecognized tax benefits that, if recognized, would impact the Company's effective tax rate.

The Company recognized an increase of \$8 million in accrued interest related to the liability for unrecognized tax benefits as a component of the provision for income taxes. The amount of net interest recognized was \$32 million as of December 31, 2023 and \$24 million as of December 31, 2022. The Company has no accrued penalties related to the liability for unrecognized tax benefits. In the next year, the Company does not anticipate the total amount of uncertain tax positions to significantly increase or decrease.

The Internal Revenue Service (IRS) has completed its examination of MassMutual and its subsidiaries for the year 2013 and prior. The 2014-2016 tax years are in the process of going to Appeals for 3 carryforward issues. The IRS completed its examination of 2017-2018 tax years and is being transferred to Appeals. The adjustments resulting from these examinations are not expected to materially affect the position or liquidity of the Company.

As of December 31, 2023 and 2022, the Company did not recognize any protective deposits as admitted assets.

7. *Other than invested assets*

a. *Admitted negative (disallowed) IMR*

As of December 31, 2023, the Company had \$1,112 million of negative (disallowed) IMR in aggregate and in the general account.

As of December 31, 2023, the Company had \$1,112 million of negative (disallowed) IMR admitted in the general account.

As of December 31, 2023, the calculated adjusted general capital and surplus was \$26,015 million.

**MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued**

As of December 31, 2023, the percentage of adjusted general capital and surplus for which the admitted disallowed IMR represents was 4%.

The following represents allocated gains (losses) previously deferred to the IMR from derivatives:

	December 31, 2023 (In Millions)
Realized capital gains	2,940
Realized capital losses	(3,935)
Total allocated gains (losses) to IMR from derivatives	<u>\$ (995)</u>

When the Company sells bonds and recognizes losses due to interest-rate related factors, and the realized losses are transferred to the IMR, the sales proceeds are generally used for reinvestment as governed by prudent asset liability management (ALM) policies and procedures. Such sales of bonds are intermittently used to meet liquidity needs and managed within the ALM framework.

IMR losses for fixed income related derivatives were in accordance with documented risk management procedures, as well as the Company's derivative use plans, and reflect the same historical treatment of derivative gains reversed to IMR and amortized rather than immediately recognized as realized gain upon termination.

b. Corporate-owned life insurance

The Company holds corporate-owned life insurance issued by unaffiliated third-party insurers to cover the lives of certain qualified senior employees. The primary purpose of the program is to offset future employee benefit expenses. The Company pays all premiums and is the owner and beneficiary of these policies. The Company had recorded cash surrender values of these policies of \$2,825 million as of December 31, 2023 and \$2,619 million as of December 31, 2022.

The cash surrender value is allocated by the following investment categories:

	December 31,	
	2023	2022
Other invested assets	45%	39%
Bonds	28	32
Stocks	17	16
Cash and short-term investments	7	10
Real estate	3	3
	<u>100%</u>	<u>100%</u>

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

c. Deferred and uncollected life insurance premium

Deferred and uncollected life insurance premium, net of loading and reinsurance, are included in other than invested assets in the Company's Statutory Statements of Financial Position. The following summarizes the deferred and uncollected life insurance premium on a gross basis, as well as, net of loading and reinsurance:

	2023		December 31,		2022		
	Gross	Net	Gross	Net			
	(In Millions)						
Ordinary new business	\$ 154	\$ 88	\$ 163	\$ 103			
Ordinary renewal	1,258	1,220	1,159	1,145			
Group life	10	10	10	10			
Total	\$ 1,422	\$ 1,318	\$ 1,332	\$ 1,258			

Deferred premium is the portion of the annual premium not earned at the reporting date. Loading on deferred premium is an amount obtained by subtracting the valuation net deferred premium from the gross deferred premium and generally includes allowances for acquisition costs and other expenses.

Uncollected premium is gross premium net of reinsurance that is due and unpaid as of the reporting date, net of loading. Net premium is the amount used in the calculation of reserves. The change in deferred and uncollected life insurance premium is included in premium income. The change in loading is included as an expense and is not shown as a reduction to premium income.

Ordinary new business and ordinary renewal business consist of the basic amount of premium required on the underlying life insurance policies.

In certain instances, gross premium is less than net premium according to the standard valuation set by the Division and the Department. The gross premium is less than the net premium needed to establish the reserves because the statutory reserves must use standard conservative valuation mortality tables, while the gross premium calculated in pricing uses mortality tables that reflect both the Company's experience and the transfer of mortality risk to reinsurers. The Company had life insurance in force of \$57,978 million as of December 31, 2023 and \$59,911 million as of December 31, 2022 for which gross premium was less than net premium.

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

8. Policyholders' liabilities

a. Policyholders' reserves

The Company had life insurance in force of \$953,410 million as of December 31, 2023 and \$907,462 million as of December 31, 2022.

The following summarizes policyholders' reserves, net of reinsurance, and the range of interest rates by type of product:

	2023					December 31,			2022		
	Amount	Interest Rates				Amount	Interest Rates				
		(\$ In Millions)									
Individual life	\$ 80,071	2.5%	-	6.0%		\$ 74,960	2.5%	-	6.0%		
Group annuities	19,737	1.0%	-	11.8%		18,692	1.0%	-	11.8%		
Individual universal and variable life	25,346	3.5%	-	6.0%		25,180	3.5%	-	6.0%		
Individual annuities	34,055	1.0%	-	11.8%		23,575	1.0%	-	11.8%		
Group life	4,178	3.0%	-	4.0%		6,382	3.0%	-	4.0%		
Disabled life claim reserves	1,856	3.0%	-	6.0%		1,831	3.0%	-	6.0%		
Disability active life reserves	1,504	3.0%	-	6.0%		2,118	3.0%	-	6.0%		
Other	503	2.5%	-	6.0%		478	2.5%	-	6.0%		
Total	\$ 167,250					\$ 153,216					

Individual life includes whole life and term insurance. Group life includes corporate-owned life insurance, bank-owned life insurance, group universal life and group variable universal life products. Individual annuities include individual annuity contracts, supplementary contracts involving life contingencies and structured settlements. Group annuities include deferred annuities and single premium annuity contracts. Disabled life claim reserves include disability income and LTC contracts and cover the future payments of known claims. Disability active life reserves include disability income and LTC contracts issued. Other is comprised of disability life and accidental death insurance.

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

b. Liabilities for deposit-type contracts

The following summarizes liabilities for deposit-type contracts and the range of interest rates by type of product:

	December 31,									
	2023		Interest Rates			2022		Interest Rates		
	Amount	(In Millions)	Amount	Interest Rates	Amount	(In Millions)	Interest Rates	Amount	Interest Rates	Amount
GICs:										
Note programs	\$ 12,376	0.6%	- 5.6%	\$ 10,813	0.5%	- 5.6%				
Federal Home Loan Bank of Boston	2,111	0.8%	- 3.4%	2,111	0.8%	- 3.4%				
Municipal contracts	1,720	0.0%	- 7.2%	1,777	0.2%	- 7.3%				
Supplementary contracts	2,978	1.0%	- 6.0%	2,909	1.0%	- 6.0%				
Dividend accumulations	439	3.0%	- 3.5%	455	3.0%	- 3.0%				
Other deposits	21	4.0%	- 8.0%	24	4.0%	- 8.0%				
Total	\$ 19,645				\$ 18,089					

Note program

Funding agreements are investment contracts sold to domestic and international institutional investors. Funding agreement liabilities are equal to the account value and are established by contract deposits, increased by interest credited and decreased by contract coupon payments and maturities. Contract holders do not have the right to terminate the contract prior to the contractually stated maturity date. The Company may retire funding agreements prior to the contractually-stated maturity date by repurchasing the agreement in the market or, in some cases, by calling the agreement. If this occurs, the difference in value is an adjustment to interest credited to liabilities for deposit-type contracts in the Statutory Statements of Operations. Credited interest rates vary by contract and can be fixed or floating. Agreements do not have put provisions or ratings-based triggers. The liability of non-U.S. dollar denominated funding agreements may increase or decrease due to changes in foreign exchange rates. Currency swaps are employed to eliminate foreign exchange risk from all funding agreements issued to back non-U.S. dollar denominated notes.

Under the note program, the Company creates special purpose entities (SPEs), which are investment vehicles or trusts, for the purpose of issuing medium-term notes to investors. Proceeds from the sale of the medium-term notes issued by these SPEs are used to purchase funding agreements from the Company. The payment terms of any particular series of notes are matched by the payment terms of the funding agreement securing the series. Notes are currently issued from the Company's \$16.0 billion Global Medium-Term Note Program.

Federal Home Loan Bank of Boston

MassMutual has funding agreements with Federal Home Loan Bank of Boston (FHLB Boston) in an investment spread strategy, consistent with its other funding agreements. These funding agreements are collateralized by securities with estimated fair values of \$1,955 million as of December 31, 2023. MassMutual's borrowing capacity with FHLB Boston is subject to the lower of the limitation on the pledge of collateral for a loan set forth by law or by MassMutual's internal limit. MassMutual's unused capacity was \$3,889 million as of December 31, 2023. As a member of FHLB Boston, MassMutual held common stock of FHLB Boston with a statement value of \$92 million as of December 31, 2023 and \$92 million as of December 31, 2022.

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued*Municipal contracts*

Municipal guaranteed investment contracts (municipal contracts) include contracts that contain terms with above market crediting rates. Liabilities for these contracts includes the municipal contracts' account values, which are established by contract deposits, increased by interest credited (fixed or floating) and decreased by contract coupon payments, additional withdrawals, maturities and amortization of premium. Certain municipal contracts allow additional deposits, subject to restrictions, which are credited based on the rates in the contracts. Contracts have scheduled payment dates and amounts and interest is paid periodically. In addition, certain contracts allow additional withdrawals above and beyond the scheduled payments. These additional withdrawals have certain restrictions on the number per year, minimum dollar amount and are limited to the maximum contract balance. The majority of the municipal contracts allow early contract termination under certain conditions.

Certain municipal contracts contain make-whole provisions, which document the formula for full contract payout. Certain municipal contracts have ratings-based triggers that allow the trustee to declare the entire balance due and payable. Municipal contracts may also have terms that require the Company to post collateral to a third party based on the contract balance in the event of a downgrade in ratings below certain levels under certain circumstances. When the collateral is other than cash, the collateral value is required to be greater than the account balance. The collateral was \$216 million as of December 31, 2023 and \$339 million as of December 31, 2022. The Company employs a rigorous asset/liability management process to help mitigate the economic impacts of various liability risks. By performing asset liability management and performing other risk management activities, the Company believes that these contract provisions do not create an undue level of operating risk to the Company.

Other deposits

Other deposits primarily consist of investment contracts assumed as part of the indemnity reinsurance agreement discussed in *Note 9. "Reinsurance"*. These contracts are used to fund retirement plans. Contract payments are not contingent upon the life of the retirement plan participant.

As of December 31, 2023, the Company's GICs by expected maturity year were as follows (in millions):

2024	\$ 2,584
2025	2,790
2026	3,386
2027	1,887
2028	1,689
Thereafter	3,871
Total	\$ 16,207

Most GICs only mature on their contractual maturity date. Actual maturities for municipal contracts may differ from their contractual maturity dates, as these contracts permit early contract termination under certain conditions.

c. Unpaid claims and claim expense reserves

The Company establishes unpaid claims and claim expense reserves to provide for the estimated costs of claims for individual disability and LTC policies. These reserves include estimates for both claims that have been reported and those that have been incurred but not reported, and include estimates of all future expenses associated with the processing and settling of these claims. This estimation process is primarily based on the assumption that experience is an appropriate indicator of future events and involves a variety of actuarial techniques that analyze experience, trends and other relevant factors. The amounts recorded for unpaid claims and claim expense reserves represent the Company's best estimate based upon facts and actuarial guidelines. Accordingly, actual claim payouts may vary from these estimates.

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

The following summarizes the changes in disabled life and LTC unpaid claims and claim expense reserves:

	December 31, 2023	2022
	(In Millions)	
Claim reserves, beginning of year	\$ 2,232	\$ 2,175
Less: Reinsurance recoverables	367	308
Net claim reserves, beginning of year	1,865	1,867
Claims paid related to:		
Current year	(14)	(14)
Prior years	(333)	(335)
Total claims paid	(347)	(349)
Incurred related to:		
Current year's incurred	375	324
Current year's interest	9	8
Prior year's incurred	(79)	(54)
Prior year's interest	68	69
Total incurred	373	347
Net claim reserves, end of year	1,891	1,865
Reinsurance recoverables	651	367
Claim reserves, end of year	\$ 2,542	\$ 2,232

The changes in reserves for incurred claims related to prior years are generally the result of recent loss development trends. The \$79 million decrease in the prior years' incurred claims for 2023 and the \$54 million decrease in the prior years' incurred claims for 2022 were generally the result of differences between actual termination experience and statutorily prescribed termination tables. In 2023, claim experience included normal claim volume with higher terminations, resulting in a reduction to the incurred reserve from favorable experience, while 2022 claims incurred was due to maturing LTC business partially offset by a corresponding increase in reinsurance recoverable.

The following reconciles disabled life claim reserves to the net claim reserves at the end of the years presented in the previous table. Disabled life claim reserves are recorded in policyholders' reserves. Accrued claim liabilities are recorded in other liabilities.

	December 31, 2023	2022
	(In Millions)	
Disabled life claim reserves	\$ 1,856	\$ 1,831
Accrued claim liabilities	33	33
Net claim reserves, end of year	\$ 1,889	\$ 1,864

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

d. Additional liability for annuity contracts

Certain individual variable annuity and fixed index annuity products have additional death or other insurance benefit features, such as GMDBs, GMIBs, GMABs and GLWBs. In general, living benefit guarantees require the contract holder or policyholder to adhere to a company approved asset-allocation strategy. Election of these benefit guarantees is generally only available at contract issue.

The following shows the changes in the liabilities for GMDB, GMIB, GMAB and GLWB (in millions):

Liability as of January 1, 2022		\$ 42
Incurred guarantee benefits		18
Paid guarantee benefits		(5)
Liability as of December 31, 2022		55
Incurred guarantee benefits		2
Paid guarantee benefits		(8)
Liability as of December 31, 2023		\$ 49

The following summarizes the account values, net amount at risk and weighted average attained age for variable annuity contracts with GMDB, GMIB, GMAB and GLWB classified as policyholders' reserves and separate account liabilities. The net amount at risk is defined as the minimum guarantee less the account value calculated on a policy-by-policy basis, but not less than zero.

	December 31, 2023			December 31, 2022		
	Account Value	Net Amount at Risk	Weighted Average Attained	Account Value	Net Amount at Risk	Weighted Average Attained
		(\$ In Millions)				
GMDB	\$ 8,572	\$ 25	66	\$ 8,685	\$ 199	66
GMIB Basic	449	7	73	466	21	72
GMIB Plus	1,240	448	69	1,198	505	68
GMAB	1,400	20	63	1,552	84	62
GLWB	94	15	75	97	22	74

As of December 31, 2023, the GMDB account value above consists of \$3,712 million of Modco assumed within the separate accounts. As of December 31, 2022, the GMDB account value above consists of \$3,600 million of Modco assumed within the separate accounts.

Account values of variable annuity contracts with GMDB, GMIB, GMAB and GLWB are summarized below:

	2023			December 31,			2022		
	Separate Account	General Account	Total		Separate Account	General Account	Total		
							(In Millions)		
GMDB	\$ 7,437	\$ 1,135	\$ 8,572	\$ 7,426	\$ 1,259	\$ 8,685			
GMIB Basic	434	15	449	445	21	466			
GMIB Plus	1,240	-	1,240	1,198	-	1,198			
GMAB	1,368	32	1,400	1,516	37	1,553			
GLWB	94	-	94	97	-	97			

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

e. Additional liability for individual life contracts

Certain universal life and variable universal life contracts include features such as GMDBs or other guarantees that ensure continued death benefit coverage when the policy would otherwise lapse. The value of the guarantee is only available to the beneficiary in the form of a death benefit.

The following presents the changes in the liability, net of reinsurance, for guarantees on universal life and variable universal life type contracts:

	December 31, 2023	2022
	(In Millions)	
Beginning balance	\$ 5,154	\$ 4,601
Net liability increase	332	553
Ending balance	<u>\$ 5,486</u>	<u>\$ 5,154</u>

9. Reinsurance

The Company enters into reinsurance agreements with affiliated and unaffiliated insurers in the normal course of business in order to mitigate the impact of underwriting mortality and morbidity risks or to assume business. Such transfers do not relieve the Company of its primary liability to its customers and, as such, failure of reinsurers to honor their obligations could result in credit losses that could arise if a reinsurer defaults. The Company reduces reinsurance default risk by evaluating the financial condition of reinsurers and monitoring for possible concentrations within the Company's reinsurers and using trust structures, when appropriate. The Company reinsurance a portion of its mortality risk in its life business under either a first dollar quota-share arrangement or an in excess of the retention limit arrangement with reinsurers. The Company also reinsurance a portion of its morbidity risk in its disability and LTC business. The amounts reinsurance are on a yearly renewable term, coinsurance funds withheld, coinsurance or Modco basis. The Company's highest retention limit for new issues of life policies ranges from \$15 million to \$35 million.

Refer to Note 17. "Related party transactions" for information about the Company's affiliated assumed reinsurance transactions.

There are no reinsurance agreements in effect under which the reinsurer may unilaterally cancel any reinsurance for reasons other than for nonpayment of premium or other similar credits. The Company has no reinsurance agreements in effect such that the amount of losses paid or accrued through the statement date may result in a payment to the reinsurer of amounts which, in aggregate and allowing for offset of mutual credits from other reinsurance agreements with the same reinsurer, exceed the total direct premium collected under the reinsured policies.

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

Reinsurance amounts included in the Statutory Statements of Operations were as follows:

	Years Ended December 31,		
	2023	2022	2021
	(In Millions)		
Direct premium	\$ 34,223	\$ 35,530	\$ 30,907
Premium assumed	977	1,013	1,112
Premium ceded	(9,711)	(13,019)	(12,128)
Total net premium	<u>\$ 25,490</u>	<u>\$ 23,524</u>	<u>\$ 19,891</u>
Ceded reinsurance recoveries	\$ 1,842	\$ 1,540	\$ 1,699
Assumed losses	\$ 425	\$ 330	\$ 356

Reinsurance amounts included in the Statutory Statements of Financial Position were as follows:

	December 31,	
	2023	2022
	(In Millions)	
Reinsurance reserves:		
Assumed	\$ 6,476	\$ 551
Ceded	(47,326)	(47,416)
Ceded amounts recoverable	\$ 324	\$ 329
Benefits payable on assumed business	\$ 65	\$ 40
Funds held under coinsurance		
Ceded	\$ 22,520	\$ 21,916

Reinsurance reserves ceded to unaffiliated reinsurers as of December 31, 2023 include \$9,219 million associated with life insurance policies, \$6,497 million for LTC, \$22,659 million for annuity, \$14 million for disability and \$6 million for group life and health. Reinsurance reserves ceded to unaffiliated reinsurers as of December 31, 2022 include \$9,016 million associated with life insurance policies \$5,998 million for LTC, \$32,381 million for annuity, \$15 million for disability and \$6 million for group life and health.

For the year ended December 31, 2023, the Company decreased its gross LTC policyholders' premium deficiency reserve by \$590 million primarily through a combination of various assumption changes to reflect the risk inherent in the cash flows of this business. The majority of the risk is ceded to unaffiliated reinsurers resulting in the ceded policyholders' premium deficiency reserves decreasing by \$295 million. The total net impact of the change is \$295 million, which was recorded as a decrease to policyholders' liabilities on the Statutory Statements of Financial Position and a decrease to change in policyholders' reserves on the Statutory Statements of Operations.

For the year ended December 31, 2022, the Company decreased its gross LTC policyholders' premium deficiency reserve by \$165 million primarily through a combination of various assumption changes to reflect the risk inherent in the cash flows of this business. The majority of the risk is ceded to unaffiliated reinsurers resulting in the ceded policyholders' premium deficiency reserves decreasing by \$345 million. The total net impact of the change is \$180 million, which was recorded as an increase to policyholders' liabilities on the Statutory Statements of Financial Position and an increase to change in policyholders' reserves on the Statutory Statements of Operations.

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

	December 31, 2023		
	(In Millions)		
	Direct	Ceded	Net
LTC premium deficiency reserves, beginning of year	\$ 4,390	\$ (3,910)	\$ 480
Assumption changes	(590)	295	(295)
LTC premium deficiency reserves, end of year	<u>\$ 3,800</u>	<u>\$ (3,615)</u>	<u>\$ 185</u>

As of December 31, 2023, one reinsurer accounted for 29% of the outstanding balance of the reinsurance recoverable and the next largest reinsurer had 21%. The Company continues to monitor its morbidity risk ceded to one reinsurer for its LTC business, in which 72% of the reserves are held in trust.

On July 5, 2023, the Company recaptured approximately \$16 million of statutory reserves reinsured on a yearly renewable term (YRT) basis for certain closed blocks of LTC business and reinsured on a coinsurance basis a portion of this product resulting in ceding \$692 million statutory reserves to a different reinsurer. The recapture settlement of \$17 million relieved the reinsurer of all obligations under the YRT agreement and resulted in an offset to premiums and disability benefits. As part of the coinsurance transaction, the Company transferred \$657 million of premium to the reinsurer.

The Company holds invested assets associated with funds withheld that are managed externally, as of December 31, 2023 and 2022, these assets, at carry value, included:

	December 31,	
	2023	2022
	(In Millions)	
Bonds	\$ 15,215	\$ 14,955
Preferred stocks	79	70
Mortgage loans	1,043	1,473
Partnerships and LLCs	51	126
Cash, cash equivalents and short-term investments	946	361
Total	<u>\$ 17,334</u>	<u>\$ 16,985</u>

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

10. Withdrawal characteristics

a. Annuity actuarial reserves and liabilities for deposit-type contracts

The withdrawal characteristics of the Company's annuity actuarial reserves and deposit-type contracts as of December 31, 2023 are illustrated below:

Individual annuities

	General Account	Separate Account with Guarantees	Separate Account Non- Guaranteed	Total	% of Total
	(In Millions)				
Subject to discretionary withdrawal:					
With market value adjustment	\$ 570	\$ -	\$ -	\$ 570	1%
At book value less current surrender charge of 5% or more	32,552	-	-	32,552	61
At fair value	-	-	8,058	8,058	15
Total with market value adjustment or at fair value	33,122	-	8,058	41,180	77
At book value without adjustment (minimal or no charge or adjustment)	3,905	-	-	3,905	7
Not subject to discretionary withdrawal	8,302	-	-	8,302	16
Total	\$ 45,329	\$ -	\$ 8,058	\$ 53,387	100%
Reinsurance ceded	11,323	-	-	11,323	
Total, net of reinsurance	\$ 34,006	\$ -	\$ 8,058	\$ 42,064	
Amount included in book value moving to at book value without adjustment after statement date	1,304	-	-	1,304	

Group annuities

	General Account	Separate Account with Guarantees	Separate Account Non- Guaranteed	Total	% of Total
	(In Millions)				
Subject to discretionary withdrawal:					
With market value adjustment	\$ 13,547	\$ -	\$ -	\$ 13,547	20%
At fair value	-	10,694	20,623	31,317	45
Total with market value adjustment or at fair value	13,547	10,694	20,623	44,864	65
At book value without adjustment (minimal or no charge or adjustment)	311	376	-	687	1
Not subject to discretionary withdrawal	23,544	-	-	23,544	34
Total	\$ 37,402	\$ 11,070	\$ 20,623	\$ 69,095	100%
Reinsurance ceded	17,690	-	-	17,690	
Total, net of reinsurance	\$ 19,712	\$ 11,070	\$ 20,623	\$ 51,405	

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

Deposit-type contracts

	General Account	Separate Account with Guarantees	Separate Account Non- Guaranteed	Total	% of Total
	(In Millions)				
Subject to discretionary withdrawal:					
With market value adjustment	\$ 2,479	\$ -	\$ -	\$ 2,479	8%
At fair value	-	-	9,332	9,332	30
Total with market value adjustment or at fair value	<u>2,479</u>	<u>-</u>	<u>9,332</u>	<u>11,811</u>	38
At book value without adjustment (minimal or no charge or adjustment)	2,704	-	-	2,704	8
Not subject to discretionary withdrawal	17,038	-	-	17,038	54
Total	<u>\$ 22,221</u>	<u>\$ -</u>	<u>\$ 9,332</u>	<u>\$ 31,553</u>	100%
Reinsurance ceded	2,576	-	-	2,576	
Total, net of reinsurance	<u>\$ 19,645</u>	<u>\$ -</u>	<u>\$ 9,332</u>	<u>\$ 28,977</u>	

The following is a summary of total annuity actuarial reserves and liabilities for deposit-type contracts as of December 31, 2023 (in millions):

Statutory Statements of Financial Position:

Policyholders' reserves – group annuities	\$ 19,712
Policyholders' reserves – individual annuities	34,005
Liabilities for deposit-type contracts	19,645
Subtotal	73,362

Separate Account Annual Statement:

Annuites	39,751
Other annuity contract deposit-funds and GICs	9,332
Subtotal	49,083
Total	\$ 122,445

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

b. Analysis of life actuarial reserves by withdrawal characteristics

The withdrawal characteristics of the Company's life actuarial reserves as of December 31, 2023 are illustrated below:

General Account

	Account Value	Cash Value	Reserve
	(In Millions)		
Subject to discretionary withdrawal, surrender values, or policy loans:			
Universal life	\$ 22,384	\$ 22,381	22,439
Universal life with secondary guarantees	1,710	1,520	7,088
Other permanent cash value life insurance	-	79,893	84,398
Variable life	1	1	1
Variable universal life	888	886	938
Not subject to discretionary withdrawal or no cash values:			
Term policies without cash value	-	-	2,971
Accidental death benefits	-	-	3
Disability - active lives	-	-	192
Disability - disabled lives	-	-	311
Miscellaneous reserves	-	-	975
Total (gross: direct + assumed)	\$ 24,983	\$ 104,681	119,316
Reinsurance Ceded	4,479	5,166	9,219
Total (net)	\$ 20,504	\$ 99,515	110,097

Separate Account with Guarantees

	Account Value	Cash Value	Reserve
	(In Millions)		
Subject to discretionary withdrawal, surrender values, or policy loans:			
Variable universal life	\$ 1,549	\$ 1,549	1,549
Not subject to discretionary withdrawal or no cash values:			
Total (gross: direct + assumed)	1,549	1,549	1,549
Total (net)	\$ 1,549	\$ 1,549	1,549

Separate Account Nonguaranteed

	Account Value	Cash Value	Reserve
	(In Millions)		
Subject to discretionary withdrawal, surrender values, or policy loans:			
Variable life	\$ 1	\$ 1	2
Variable universal life	1,657	1,629	1,645
Not subject to discretionary withdrawal or no cash values:			
Total (gross: direct + assumed)	1,658	1,630	1,647
Total (net)	\$ 1,658	\$ 1,630	1,647

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

c. Separate accounts

The Company has guaranteed separate accounts classified as the following: nonindexed, which have multiple concurrent guarantees, including a guarantee that applies for as long as the contract is in effect and does not exceed a 4% rate of return. The Company has nonguaranteed separate accounts which are variable accounts where the benefit is determined by the performance and/or market value of the investments held in the separate account with incidental risk, notional expense and minimum death benefit guarantees.

Information regarding the separate accounts of the Company as of and for the year ended December 31, 2023 is as follows:

	Guaranteed					(In Millions)	
	Indexed	Nonindexed					
		Less Than/ Equal to	Non Guarantee	Total			
Net premium, considerations or deposits for the year ended December 31, 2023	\$ -	\$ -	\$ 4,769	\$ 4,769			
Reserves at December 31, 2023:							
For accounts with assets at:							
Fair value	\$ -	\$ 11,447	\$ 39,284	\$ 50,731			
Amortized cost/book value	-	1,549	-	1,549			
Subtotal SIA Reserves	-	12,996	39,284	52,280			
Nonpolicy liabilities	-	-	175	175			
Total Separate Account Liabilities	\$ -	\$ 12,996	\$ 39,459	\$ 52,455			
Reserves by withdrawal characteristics:							
Subject to discretionary withdrawal:							
At fair value	\$ -	\$ 11,447	\$ 39,284	\$ 50,731			
At book value without market value adjustment and current surrender charge of less than 5%	-	1,549	-	1,549			
Subtotal	-	12,996	39,284	52,280			
Nonpolicy liabilities	-	-	175	175			
Total Separate Account Liabilities	\$ -	\$ 12,996	\$ 39,459	\$ 52,455			

The Company does not have any reserves in separate accounts for asset default risk in lieu of AVR.

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

The following is a reconciliation of amounts reported as transfers (from) to separate accounts in the Summary of Operations of the Company's NAIC Separate Account Annual Statement to the amounts reported as net transfers (from) to separate accounts in change in policyholders' reserves in the accompanying Statutory Statements of Operations:

	Years Ended December 31,		
	2023	2022	2021
	(In Millions)		
From the Separate Account Annual Statement:			
Transfers to separate accounts	\$ 1,935	\$ 4,205	\$ 3,971
Transfers from separate accounts	<u>(9,387)</u>	<u>(14,220)</u>	<u>(11,152)</u>
Subtotal	<u>(7,452)</u>	<u>(10,015)</u>	<u>(7,181)</u>
Reconciling adjustments:			
Miscellaneous	4,278	3,481	4,537
Net deposits on deposit-type liabilities	<u>1,573</u>	<u>1,939</u>	<u>1,202</u>
Net transfers from separate accounts	<u><u>\$ (1,601)</u></u>	<u><u>\$ (4,595)</u></u>	<u><u>\$ (1,442)</u></u>

Net deposits on deposit-type liabilities are not considered premium and therefore are excluded from the Statutory Statements of Operations.

11. Debt

MassMutual issues commercial paper in the form of Notes in minimum denominations of \$250 thousand up to a total aggregation of \$1,000 million with maturity dates up to a maximum of 270 days from the date of issuance. Noninterest bearing Notes are sold at par less a discount representing an interest factor. Interest bearing Notes are sold at par. The Notes are not redeemable or subject to voluntary prepayments by MassMutual. The Notes have a carrying value and face amount of \$50 million as of December 31, 2023 and \$250 million as of December 31, 2022. Notes issued in 2023 had interest rates ranging from 4.36% to 5.40% with maturity dates ranging from 1-36 days. Interest expense for commercial paper was \$7 million for the year ended December 31, 2023 and \$5 million for the year ended December 31, 2022.

MassMutual has a \$1,500 million, five-year credit facility, with a syndicate of lenders that can be used for general corporate purposes and to support commercial paper borrowings. During December 2022, the facility was renewed and the scheduled maturity is December 16, 2027. The facility includes two one-year extension options that may be exercised with proper notification as set forth in the agreement. The facility has an upsize option for an additional \$500 million. The terms of the credit facility additionally provide for, among other provisions, covenants pertaining to liens, fundamental changes, transactions with affiliates and adjusted statutory surplus. As of and for the years ended December 31, 2023 and 2022, MassMutual was in compliance with all covenants under the credit facility. For the years ended December 31, 2023 and 2022, there were no draws on the credit facilities. Credit facility fees were less than \$1 million for the years ended December 31, 2023 and December 31, 2022.

12. Employee benefit plans

The Company sponsors multiple employee benefit plans, providing retirement, life, health and other benefits to employees, certain employees of unconsolidated subsidiaries, agents, general agents and retirees who meet plan eligibility requirements.

a. Pension plans

The Company sponsors funded and unfunded noncontributory defined benefit pension plans for its eligible employees, agents and retirees.

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

The funded qualified defined benefit plan generally provides benefits under a cash balance formula based on age, service and salary during the participants' careers. Certain eligible participants may be entitled to benefits under a legacy defined benefit formula. The Company's policy is to fund the qualified pension plan in accordance with the Employee Retirement Income Security Act of 1974. There were no contributions in 2023 and 2022.

b. Defined contribution plans

The Company sponsors funded qualified defined contribution plans and unfunded nonqualified deferred compensation thrift savings plans for its employees, agents and retirees. Defined contribution plan expense for 2023 and 2022 was \$56 million and \$52 million, respectively.

c. Other postretirement benefits

The Company provides certain life insurance and health care benefits (other postretirement benefits) for its retired employees and agents, their beneficiaries and covered dependents. MMHLLC has the obligation to pay the Company's other postretirement benefits. The transfer of this obligation to MMHLLC does not relieve the Company of its primary liability. MMHLLC is allocated other postretirement expenses related to interest cost, amortization of actuarial gains (losses) and expected return on plan assets, whereas service cost and prior service cost are recorded by the Company.

Substantially all of the Company's U.S. employees and agents may become eligible to receive other postretirement benefits. These benefits are funded as the benefits are provided to the participants. For eligible employees who retire after 2009, except certain employees who were close to retirement in 2010, the Company's cost is limited to a retiree health reimbursement account (RHRA), which accumulates during an employee's career and can be drawn down by the retiree to purchase coverage outside of the Company or for other health care costs. Retired employees with a RHRA also may choose to purchase coverage through the private retiree exchange.

For other eligible current and future retired employees, and current and future retired agents, the Company provides access to postretirement health care plans through a private retiree exchange. The Company's cost is limited to the fixed annual subsidy provided to retirees through a Health Reimbursement Account each year that the retiree can use to purchase coverage on the exchange or for other health care costs.

Company-paid basic life insurance is provided to retirees who retired before 2010 and certain employees who retire after 2009 but were close to retirement in 2010. Supplemental life insurance is available to certain retirees on a retiree-pay-all basis.

The Company provides retiree life insurance coverage for home office employees who, as of January 1, 2010, were age 50 with at least 10 years of service or had attained 75 points, generally age plus service, with a minimum 10 years of service.

d. Benefit obligations

Accumulated and projected benefit obligations are the present value of pension benefits earned as of a December 31 measurement date (the Measurement Date) based on service and compensation as of that date.

Refer to *Note 12f, "Amounts recognized in the Statutory Statements of Financial Position,"* for details on the funded status of the plans. Accumulated and projected postretirement benefit obligations for other postretirement benefits are the present value of postretirement medical and life insurance benefits earned as of the Measurement Date projected for estimated salary increases to an assumed date with respect to retirement, disability or death.

Actuarial (gains) losses represent the difference between the expected results and the actual results used to determine the projected benefit obligation, accumulated benefit obligation and current year expense. Select assumptions used in this calculation include expected future compensation levels, mortality and expected retirement age.

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

The following presents the total pension and other postretirement accumulated benefit obligation:

	December 31,			
	2023	2022	2023	2022
	Pension Benefits	Other Postretirement Benefits		
(In Millions)				
Accumulated benefit obligation	\$ 2,634	\$ 2,590	\$ 313	\$ 315

The following sets forth the change in projected benefit obligation of the defined benefit pension and other postretirement plans:

	December 31,			
	2023	2022	2023	2022
	Pension Benefits	Other Postretirement Benefits		
(In Millions)				
Projected benefit obligation, beginning of year	\$ 2,590	\$ 3,099	\$ 315	\$ 374
Service cost	86	97	7	10
Interest cost	125	86	15	11
Actuarial (gains) losses	21	44	(14)	(10)
Benefits paid	(222)	(180)	(14)	(14)
Change in discount rate	34	(565)	4	(56)
Change in actuarial assumptions	-	9	-	-
Projected benefit obligation, end of year	<u><u>\$ 2,634</u></u>	<u><u>\$ 2,590</u></u>	<u><u>\$ 313</u></u>	<u><u>\$ 315</u></u>

The determination of the discount rate is based upon rates commensurate with current yields on high quality corporate bonds as of the Measurement Date. A spot yield curve is developed from this data that is used to determine the present value for the obligation. The projected plan cash flows are discounted to the Measurement Date based on the spot yield curve. A single discount rate is utilized to ensure the present value of the benefits cash flow equals the present value computed using the spot yield curve. A 25-basis point change in the discount rate results in approximately a \$59 million change in the projected pension benefit obligation. The methodology includes producing a cash flow of annual accrued benefits. Refer to Note 12h. *“Assumptions”* for details on the discount rate.

e. Plan assets

The assets of the qualified pension plan are invested in a MassMutual group annuity contract and in the MassMutual Pension Plan Trust (Pension Trust). The group annuity contract includes a general investment account (GIA). As of December 31, 2023 and 2022, GIA assets managed by the Company were \$229 million and \$168 million, respectively. The Company was rated AA+ by Standards and Poor's as of December 31, 2023..

The Company's overall objective is to manage the assets in a liability framework where investments are selected that are expected to have similar changes in fair value as the related liabilities will have upon changes in interest rates. The company invests in a portfolio of both return-seeking and liability-hedging assets, to achieve long-term growth and to insulate the funded position from interest rate volatility.

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

The target range allocations are based on two broad categories, return-seeking (generally equities and alternative investments) and liability-hedging (generally fixed income). The return-seeking allocation range is 46% to 54% and liability-hedging range is 46% to 54%. Of the return-seeking assets, the range is 35% to 55% global public equity and 45% to 65% alternatives. The pension plan assets invested in the GIA through the unallocated group annuity contract earn a fixed interest. These assets comprised approximately 9% of the plan assets as of December 31, 2023 and 7% as of December 31, 2022.

The following presents the change in plan assets:

			December 31,		2023		2022	
			2022		Pension	Other	Postretirement	Benefits
			(In Millions)					
Plan assets, beginning of year	\$	2,483	\$	3,053	\$	2	\$	2
Actual return on plan assets		230		(415)		-		-
Employer contributions		30		25		14		14
Benefits paid		(222)		(180)		(14)		(14)
Other		-		-		2		-
Plan assets, end of year	\$	<u>2,521</u>	\$	<u>2,483</u>	\$	<u>4</u>	\$	<u>2</u>

The GIA is designed to provide stable, long-term investment growth. Investments in the GIA are stated at contract value. Contract value is the amount participants would receive if they were to initiate certain transactions under the terms of the plan. It provides for a stated return on principal invested over a specified period and permits withdrawals at contract value for benefit payments, loans, or transfers.

Investments in the Pension Trust are stated at fair value. Noninterest bearing cash is stated at cost value.

Fair Value Measurements

The Company's fair value hierarchy is defined in *Note 4. "Fair Value of financial instruments"*.

The following is a description of the valuation methodologies used to measure fair value for the investments in the qualified pension plan.

Cash, cash equivalents and short-term investments: Short-term investments are stated at cost, which is equal to fair value. Foreign currencies are stated at cost and adjusted for foreign currency gains and losses.

Government securities: Marked to market daily based on values provided by third-party vendors or market makers to the extent available or based on model prices. Valuations furnished by a pricing service take into account factors such as institutional-size trading in similar securities, yield, quality, coupon rate, maturity, type of issue, trading characteristics, and other market data and are therefore classified as Level 2.

Bonds: If Level 1 valuations are not available, the fair value is determined using models such as matrix pricing and therefore, is classified as Level 2, which uses quoted market prices of debt securities with similar characteristics. Valued using the closing price reported on the active market on which the individual securities are traded.

Mutual funds: Mutual funds are valued at the daily closing price as reported by the fund. Certain mutual funds held by the plan are registered with the SEC and are required to publish their daily NAV. These mutual funds held by the Plan are deemed to be actively traded and are therefore classified as Level 1. The remaining mutual funds do not publish their daily NAV and are therefore classified as Level 2.

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

Collective investment trusts: Valued using the NAV per unit. The net asset value per unit of the funds is calculated on each business day by dividing the total value of assets, less liabilities, by the number of units outstanding. Unit issuances and redemptions are based on the net asset value determined at the end of the current day and therefore is classified as NAV practical expedient.

Real estate investment trusts: Real estate investment trusts are valued using the plan's pro-rata interest in the fund and does not have a lock-up period, a funding commitment, or a specific redemption period but are dependent upon the liquidation of underlying assets. Therefore, these investments are classified as NAV practical expedient.

Hedge funds: Hedge funds are based on the plan's pro rata interest in the fund and have a 45-day redemption period and therefore classified as NAV practical expedient.

Limited partnerships – Private equity/venture capital: The plan utilizes the NAV practical expedient to calculate fair value of its investments based on the Plan's pro rata interest in net assets of each underlying partnership. All valuations utilize financial information supplied by the partnership, including income, expenses, gains and losses. The underlying investments are accounted for at fair value as described in the partnership's audited financial statements. These funds can be redeemed periodically with notice that generally ranges from 45 to 90 days. There are no lockups or funding commitments.

Limited partnerships – Real estate: The plan utilizes the NAV practical expedient to calculate fair value of its investments based on the Plan's pro rata interest in net assets of each underlying partnership. All valuations utilize financial information supplied by the partnership, including income, expenses, gains and losses. The underlying investments of the partnership are accounted for at fair value as described in the partnership's audited financial statements. These funds can be redeemed periodically with notice that generally ranges from 45 to 90 days. There are no lockups or funding commitments.

Limited partnerships – Hedge: The Plan utilizes the NAV practical expedient to calculate fair value of its investments based on the Plan's pro rata interest in net assets of each underlying partnership. All valuations utilize financial information supplied by the partnership, including income, expenses, gains and losses. The underlying investments of the partnership are accounted for at fair value as described in the partnership's audited financial statements. The hedge funds can be redeemed semi-annually with 95 days' notice. There are no lockups or funding commitments.

Other investments: Investments included in this category include asset backed securities, mortgage backed securities, swaps, derivatives, futures and options. Closing prices are not available on the active market. Fair value is determined using models such as matrix pricing and therefore, these securities are classified as Level 2.

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

The following tables set forth by level, within the fair value hierarchy, the plan's assets at fair value as of December 31, 2023 and 2022.

	Fair Value as of December 31, 2023				
	Level 1	Level 2	Level 3	NAV Practical Expedient	Total
	(In Millions)				
Cash, cash equivalents, and short-term investments	\$ 76	-	-	-	76
Government securities	-	486	-	-	486
Bonds	-	371	-	-	371
Mutual funds	471	-	-	-	471
Real estate investment trusts	-	-	-	54	54
Hedge funds	-	-	-	31	31
Limited partnerships					
Private equity/venture capital	-	-	-	480	480
Real estate	-	-	-	120	120
Hedge	-	-	-	205	205
Other investments	-	12	-	-	12
Total	<u>\$ 547</u>	<u>\$ 869</u>	<u>\$ -</u>	<u>\$ 890</u>	<u>\$ 2,306</u>

Plan assets measured at contract value and non-interest bearing cash are excluded from the preceding table.

	Fair Value as of December 31, 2022				
	Level 1	Level 2	Level 3	NAV Practical Expedient	Total
	(In Millions)				
Cash, cash equivalents, and short-term investments	\$ 5	\$ 24	\$ -	\$ -	\$ 29
Mutual funds	458	293	-	-	751
Collective investment trusts	-	63	-	-	63
Hedge funds	-	-	-	27	27
Limited partnerships					
Private equity/venture capital	-	-	-	414	414
Real estate	-	-	-	135	135
Hedge	-	-	-	185	185
Debt Instruments:					
Corporate and other bonds	-	331	-	-	331
Other:					
Government securities	-	378	-	-	378
Other	-	2	-	-	2
Total pension trust assets	<u>\$ 463</u>	<u>\$ 1,091</u>	<u>\$ -</u>	<u>\$ 761</u>	<u>\$ 2,315</u>
Total General Investment Account	-	-	168	-	168
Total	<u>\$ 463</u>	<u>\$ 1,091</u>	<u>\$ 168</u>	<u>\$ 761</u>	<u>\$ 2,483</u>

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

f. Amounts recognized in the Statutory Statements of Financial Position

Unrecognized prior service cost is the adjustment to the projected benefit obligation as a result of plan amendments. It represents the increase or decrease in benefits for service performed in prior periods. For pension benefits, this cost is amortized into net periodic benefit cost over the average remaining service years of active employees at the time of the amendment. For other postretirement benefits, this cost is amortized into net periodic benefit cost over the average remaining lifetime of eligible employees and retirees at the time of the amendment.

Unrecognized net actuarial (gains) losses are variances between assumptions used and actual experience. These assumptions include return on assets, discount rate, demographics and mortality. The unrecognized net actuarial (gains) losses are amortized if they exceed 10% of the projected benefit obligation and are amortized starting in the period after recognition. These are amortized for pension and other postretirement benefits into net periodic benefit cost over the remaining service-years of active employees.

The prepaid pension asset is a cumulative balance of employer contributions made to the plan netted against the plan's accumulated net periodic benefit costs. The prepaid pension asset is a nonadmitted asset.

The accrued benefit cost recognized is the funded status of the plan adjusted for the remaining balance of unrecognized prior service cost, unrecognized net actuarial loss and the nonadmitted prepaid pension asset.

The following sets forth the projected benefit obligation funded status of the plans:

	December 31,		2023	2022	2023	2022
					Other Postretirement Benefits	
	(In Millions)					
Projected benefit obligation	\$ (2,634)	\$ (2,590)	\$ (313)	\$ (315)		
Plan assets	2,521	2,483	4	2		
Projected benefit obligation funded status	\$ (113)	\$ (107)	\$ (309)	\$ (313)		

The qualified pension plan was overfunded by \$312 million as of December 31, 2023 and \$296 million as of December 31, 2022. The nonqualified pension plans are not funded and have total projected benefit obligations of \$425 million as of December 31, 2023 and \$403 million as of December 31, 2022.

The qualified pension plan nonadmitted pension plan asset was \$653 million as of December 31, 2023 and \$678 million as of December 31, 2022.

The Company intends to fund \$56 million in 2024 to meet its expected current obligations under its qualified and nonqualified pension plans and other postretirement benefit plans.

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

g. Net periodic cost

The net periodic cost represents the annual accounting income or expense recognized by the Company and is included in general insurance expenses in the Statutory Statements of Operations. The net periodic cost recognized is as follows:

	Years Ended December 31,					
	2023	2022	2021	2023	2022	2021
	Pension Benefits		Other Postretirement Benefits			
(In Millions)						
Service cost	\$ 86	\$ 97	\$ 110	\$ 7	\$ 9	\$ 10
Interest cost	125	86	77	15	10	9
Expected return on plan assets	(169)	(194)	(183)	-	-	-
Amortization of unrecognized (gains) and losses	27	9	39	(9)	(1)	-
Amortization of unrecognized prior service benefit	-	-	-	(5)	(6)	(6)
Total net periodic cost/(benefit)	\$ 69	\$ (2)	\$ 43	\$ 8	\$ 12	\$ 13

The expected future pension and other postretirement benefit payments which reflect expected future service are as follows:

	Pension Benefits	Other Postretirement Benefits	
		(In Millions)	(In Millions)
2024		\$ 199	\$ 19
2025		201	20
2026		206	20
2027		204	21
2028		209	21
2029-2033		1,055	109

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

h. Assumptions

The assumptions the Company used to calculate the benefit obligations and to determine the benefit costs are as follows:

	Years Ended December 31,											
	2023	2022	2021	2023	2022	2021						
	Pension Benefits			Other Postretirement Benefits								
Weighted-average assumptions used to determine:												
Benefit obligations:												
Discount rate	4.85%	5.00%	2.85%	4.85%	5.05%	2.80%						
Expected rate of compensation increase	3.50%	3.50%	3.50%	3.50%	3.50%	3.50%						
Interest Crediting rate	5.00%	5.00%	5.00%	4.85%	5.05%	2.80%						
Net periodic benefit cost:												
Discount rate	5.00%	2.85%	2.50%	5.05%	2.80%	2.45%						
Expected long-term rate of return on plan assets	7.00%	6.50%	6.50%	3.00%	3.00%	3.00%						
Expected rate of compensation increase	3.50%	3.50%	3.50%	3.50%	3.50%	3.50%						
Interest Crediting rate	5.00%	5.00%	5.00%	5.05%	2.80%	2.45%						

The discount rate used to determine the benefit obligations as of year end is used to determine the expense in the next fiscal year.

The Company determines its assumptions for the expected rate of return on plan assets for its plans using a “building block” approach, which focuses on ranges of anticipated rates of return for each asset class. A weighted range of nominal rates is determined based on target allocations for each class of asset.

13. Employee compensation plans

The Company has a long-term incentive compensation plan under which certain employees of the Company and its subsidiaries may be issued phantom stock-based compensation awards. These awards include PSARs and PRS. These awards do not grant an equity or ownership interest in the Company.

A summary of the weighted average grant price of PSARs and PRS shares granted, the intrinsic value of PSARs shares exercised, the PRS liabilities paid and the fair value of shares vested during the year is as follows:

	December 31,		
	2023	2022	2021
Weighted average grant date fair value:			
PSARs granted during the year	\$ 145.77	\$ 243.40	\$ 141.86
PRS granted during the year	145.67	238.54	153.38
Intrinsic value (in thousands):			
PSARs options exercised	65,810	135,219	124,551
PRS liabilities paid	45,600	70,029	48,298
Fair value of shares vested during the year	64,779	136,945	246,047

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

A summary of PSARs and PRS shares is as follows:

	PSARs			PRS		
	Number of Share Units	Weighted Average		Number of Share Units	Weighted Average	
		Price	Remaining Contract Terms		Price	Remaining Contract Terms
	(In Thousands)		(In Years)	(In Thousands)		(In Years)
Outstanding as of						
December 31, 2021	4,510	\$ 130.23	4.1	1,070	\$ 122.41	2.5
Granted	808	243.40		168	238.54	
Exercised	(1,616)	119.34		(288)	98.47	
Forfeited	(308)	155.09		(78)	137.13	
Outstanding as of						
December 31, 2022	3,394	160.09	4.0	872	151.41	2.4
Granted	2,762	145.77		1,002	145.67	
Exercised	(1,329)	130.59		(252)	116.36	
Forfeited	(788)	239.79		(37)	180.80	
Outstanding as of						
December 31, 2023	<u>4,039</u>	144.46	4.4	<u>1,585</u>	152.73	2.1
Exercisable as of						
December 31, 2023	28	\$ 139.51	3.9	9	\$ 149.59	2.1

The PSARs compensation was an expense of \$17 million for the year ended December 31, 2023 and an expense of \$(34) million for the year ended December 31, 2022 and an expense of \$253 million for the year ended December 31, 2021. The PSARs accrued compensation liability was \$13 million as of December 31, 2023 and \$99 million as of December 31, 2022. The unrecognized compensation expense related to nonvested PSARs awards was \$20 million for the year ended December 31, 2023, \$19 million for the year ended December 31, 2022 and \$108 million for the year ended December 31, 2021. The weighted average period over which the expense is expected to be recognized is 4.4 years. The PSARs unrecognized compensation expense represents the total intrinsic value of all shares issued if 100% vested at current stock price, minus current compensation liability.

The PRS compensation expense was \$96 million for the year ended December 31, 2023 and \$31 million for the year ended December 31, 2022 and \$77 million for the year ended December 31, 2021. The PRS accrued compensation liability was \$148 million for the year ended December 31, 2023 and \$99 million for the year ended December 31, 2022. The unrecognized compensation expense related to nonvested PRS awards was \$87 million as of December 31, 2023, \$56 million as of December 31, 2022 and \$77 million as of December 31, 2021 respectively. The weighted average period over which the expense is expected to be recognized is 2.1 years. The PRS unrecognized compensation expense represents the total value of all shares issued if 100% vested at the current stock price, minus current compensation liability

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

14. Surplus notes

The following table summarizes the surplus notes issued and outstanding as of December 31, 2023:

Issue Date	Face Amount	Carrying Value	Interest Rate	Maturity Date	Scheduled Interest Payment Dates
(\$ In Millions)					
03/01/1994	50	50	7.500%	03/01/2024	Mar 1 & Sept 1
05/12/2003	193	193	5.625%	05/15/2033	May 15 & Nov 15
06/01/2009	130	129	8.875%	06/01/2039	Jun 1 & Dec 1
01/17/2012	263	263	5.375%	12/01/2041	Jun 1 & Dec 1
04/15/2015	258	254	4.500%	04/15/2065	Apr 15 & Oct 15
03/23/2017	475	471	4.900%	04/01/2077	Apr 1 & Oct 1
10/11/2019	838	597	3.729%	10/15/2070	Apr 15 & Oct 15
04/16/2020	700	697	3.375%	04/15/2050	Apr 15 & Oct 15
06/26/2020	600	820	5.077%	02/15/2069	Feb 15 & Aug 15
03/01/2021	200	232	5.077%	02/15/2069	Feb 15 & Aug 15
11/18/2021	675	670	3.200%	12/01/2061	Jun 1 & Dec 1
12/01/2022	500	500	5.672%	12/01/2052	Jun 1 & Dec 1
Total	\$ 4,882	\$ 4,876			

All payments of interest and principal are subject to the prior approval of the Division. Interest expense is not recorded until approval for payment is received from the Division. As of December 31, 2023, the unapproved interest was \$44 million. Through December 31, 2023, the Company paid cumulative interest of \$2,609 million on surplus notes. Interest of \$231 million was approved and paid during the year ended December 31, 2023.

The anticipated sinking fund payments that are due for the notes issued in 1994 are \$50 million in 2024. There are no sinking fund requirements for the notes issued in 2003, 2009, 2012, 2015, 2017, 2019, 2020, 2021 or 2022.

These notes are unsecured and subordinate to all present and future indebtedness of the Company, all policy claims and all prior claims against the Company as provided by the Massachusetts General Laws. The surplus notes are all held by bank custodians for unaffiliated investors. All issuances were approved by the Division. Surplus notes are included in surplus on the Statutory Statements of Financial Position.

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

15. Presentation of the Statutory Statements of Cash Flows

The following table presents those transactions that have affected the Company's recognized assets or liabilities but have not resulted in cash receipts or payments during the years ended December 31, 2023, 2022 and 2021. Accordingly, the Company has excluded these non-cash activities from the Statutory Statements of Cash Flows for the years ended December 31, 2023, 2022 and 2021.

	Years Ended December 31,		
	2023	2022	2021
	(In Millions)		
Bond conversions and refinancing	\$ 1,460	\$ 1,177	\$ 729
Transfer of partnerships and limited liability companies to partnerships and limited liability companies	277	620	-
Change in market value of corporate owned life insurance asset	217	(46)	272
Stock conversions	202	13	107
Transfer of mortgage loans to bonds	132	-	-
Bonds transferred to partnerships and limited liability companies	122	441	-
Transfer of partnerships and limited liability companies to bonds	100	187	-
Transfer of mortgage loans to short-term investments	60	-	-
Transfer of stocks to partnerships and limited liability companies	38	-	-
Net investment income payment in-kind bonds	14	12	16
Accrued discount on mortgage loans	10	-	-
Transfer of partnerships and limited liability companies to stocks	3	-	-
Transfer of bonds to mortgage loans	-	626	-
Transfer of partnerships and limited liability companies to common stocks - subsidiaries and affiliates	-	227	-
Transfer of common stocks unaffiliated to common stocks - subsidiaries and affiliates	-	97	-
Transfer of mortgage loans to partnerships and limited liability companies	-	40	11
Deferred gain on real estate	-	16	-
Premium income recognized for group annuity contracts	-	-	1,237
Bonds received as consideration for group annuity contracts	-	-	(1,231)
Premium ceded in exchange for invested assets	-	-	(514)
Bonds transferred in exchange for premium	-	-	511
Surplus notes issued in exchange for bonds	-	-	233
Bonds received as consideration for surplus notes	-	-	(233)
Transfer of bonds to cash equivalent	-	-	150
Exchange of mortgage loans for other assets	-	-	18
Transfer of stocks to partnerships	-	-	4
Preferred stock transferred in exchange for premium ceded	-	-	3
Common stock received as consideration for group annuity contracts	-	-	(6)

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

16. Business risks, commitments and contingencies

a. Risks and uncertainties

The Company operates in a business environment subject to various risks and uncertainties. The principal risks include insurance and underwriting risks, investment and interest rate risks, currency exchange risk and credit risk. The combined impact of these risks could have a material, adverse effect on the Company's financial statements or result in operating losses in future periods. The Company employs the use of reinsurance, portfolio diversification, asset/liability management processes and other risk management techniques to mitigate the impact of these risks.

Insurance and underwriting risks

The Company prices its products based on estimated benefit payments reflecting assumptions with respect to mortality, morbidity, longevity, persistency, interest rates and other factors. If actual policy experience emerges that is significantly and adversely different from assumptions used in product pricing, the effect could be material to the profitability of the Company. For participating whole life products, the Company's dividends to policyholders primarily reflect the difference between actual investment, mortality, expense and persistency experience and the experience embedded in the whole life premiums and guaranteed elements. The Company also reinsurance certain life insurance and other long-term care insurance policies to mitigate the impact of its underwriting risk.

Investment and interest rate risks

The fair value, cash flows and earnings of investments can be influenced by a variety of factors including changes in interest rates, credit spreads, equity markets, portfolio asset allocation and general economic conditions. The Company employs a rigorous asset/liability management process to help mitigate the economic impacts of various investment risks, in particular interest rate risk. By effectively matching the market sensitivity of assets with the liabilities they support, the impact of interest rate changes is addressed, on an economic basis, as the change in the value of the asset is offset by a corresponding change in the value of the supported liability. The Company uses derivatives, such as interest rate swaps and swaptions, as well as synthetic assets to reduce interest rate and duration imbalances determined in asset/liability analyses.

The levels of U.S. interest rates are influenced by U.S. monetary policies and by the relative attractiveness of U.S. markets to investors versus other global markets. As interest rates increase, certain debt securities may experience amortization or prepayment speeds that are slower than those assumed at purchase, impacting the expected maturity of these securities and the ability to reinvest the proceeds at the higher yields. Rising interest rates may also result in a decrease in the fair value of the investment portfolio. As interest rates decline, certain debt securities may experience accelerated amortization and prepayment speeds than what was assumed at purchase. During such periods, the Company is at risk of lower net investment income as it may not be able to reinvest the proceeds at comparable yields. Declining interest rates may also increase the fair value of the investment portfolio.

Interest rates also have an impact on the Company's products with guaranteed minimum payouts and on interest credited to account holders. As interest rates decrease, investment spreads may contract as crediting rates approach minimum guarantees, resulting in an increased liability.

In periods of increasing interest rates, policy loans, surrenders and withdrawals may increase as policyholders seek investments with higher perceived returns. This could result in cash outflows requiring the Company to sell invested assets at a time when the prices of those assets are adversely affected by the increase in market interest rates, which could cause the Company to realize investment losses.

Currency exchange risk

The Company has currency risk due to its non-U.S. dollar denominated investments and medium-term notes along with its indirect international operations. The Company mitigates a portion of its currency risk through the use of cross-currency swaps and forward contracts. Cross-currency swaps are used to minimize currency risk for certain non-U.S. dollar assets and liabilities through a pre-specified exchange of interest and principal. Forward contracts are used to hedge movements in exchange rates.

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

Credit and other market risks

The Company manages its investments to limit credit and other market risks by diversifying its portfolio among various security types and industry sectors as well as purchasing credit default swaps to transfer some of the risk.

Stressed conditions, volatility and disruptions in global capital markets or in particular markets or financial asset classes can have an adverse effect on the Company, in part because the Company has a large investment portfolio and assets supporting the Company's insurance liabilities are sensitive to changing market factors. Global market factors, including interest rates, credit spread, equity prices, real estate markets, foreign currency exchange rates, consumer spending, business investment, government spending, the volatility and strength of the capital markets, deflation and inflation, all affect the business and economic environment and, ultimately, the profitability of the Company's business. Disruptions in one market or asset class can also spread to other markets or asset classes. Upheavals in the financial markets can also affect the Company's business through their effects on general levels of economic activity, employment and customer behavior.

Real estate markets are monitored continuously with attention on regional differences in price performance, absorption trends and supply and demand fundamentals that can impact the rate of foreclosures and delinquencies. Public sector strengths and weaknesses, job growth and macro-economic issues are factors that are closely monitored to identify any impact on the Company's real estate related investments.

The CMBS, RMBS and leveraged loan sectors are sensitive to evolving conditions that can impair the cash flows realized by investors and is subject to uncertainty. Management's judgment regarding OTTI and estimated fair value depends upon the evolving investment sector and economic conditions. It can also be affected by the market liquidity, a lack of which can make it difficult to obtain accurate market prices for RMBS and other investments, including CMBS and leveraged loans. Any deterioration in economic fundamentals, especially related to the housing sector could affect management's judgment regarding OTTI.

The Company has investments in structured products exposed primarily to the credit risk of corporate bank loans, corporate bonds or credit default swap contracts referencing corporate credit risk. Most of these structured investments are backed by corporate loans and are commonly known as collateralized loan obligations that are classified as CDO. The portfolios backing these investments are actively managed and diversified by industry and individual issuer concentrations. Due to the complex nature of CDO and the reduced level of transparency to the underlying collateral pools for many market participants, the recovery in CDO valuations generally lags the overall recovery in the underlying assets. Management believes its scenario analysis approach, based primarily on actual collateral data and forward looking assumptions, does capture the credit and most other risks in each pool. However, in a rapidly changing economic environment, the credit and other risks in each collateral pool will be more volatile and actual credit performance of CDO may differ from the Company's assumptions.

The Company continuously monitors its investments and assesses their liquidity and financial viability; however, the existence of the factors described above, as well as other market factors, could negatively impact the market value of the Company's investments. If the Company sells its investments prior to maturity or market recovery, these investments may yield a return that is less than the Company otherwise would have been able to realize.

Asset-based fees calculated as a percentage of the separate account assets are a source of revenue to the Company. Gains and losses in the investment markets may result in corresponding increases and decreases in the Company's separate account assets and related revenue.

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

Market risk arises within the Company's employee benefit plans to the extent that the obligations of the plans are not fully matched by assets with determinable cash flows. Pension and postretirement obligations are subject to change due to fluctuations in the discount rates used to measure the liabilities as well as factors such as changes in inflation, salary increases and participants living longer. The risks are that such fluctuations could result in assets that are insufficient over time to cover the level of projected benefit obligations. In addition, increases in inflation and members living longer could increase the pension and postretirement obligations. Management determines the level of this risk using reports prepared by independent actuaries and takes action, where appropriate, in terms of setting investment strategy and determining contribution levels. In the event that the pension obligations arising under the Company's employee benefit plans exceed the assets set aside to meet the obligations, the Company may be required to make additional contributions or increase its level of contributions to these plans.

The long-term impact of the COVID-19 pandemic is dependent on numerous factors including, but not limited to, the length and severity of the pandemic, the efficacy and rate of vaccine adoption and therapeutics, the responses to the pandemic taken by governments and private sector businesses, and the impacts on MassMutual's policyholders, employees and counterparties. At its height, the pandemic led to significant economic disruption, including significant volatility in the U.S. and international markets, which had an adverse effect on MassMutual's business. The extent to which the COVID-19 pandemic continues to impact MassMutual's business will depend on future developments which are highly uncertain, including the emergence of future variants of COVID-19 and the efficacy of vaccines in the broader population (including with respect to future variants).

Political Uncertainties

Political events, domestically or internationally, may directly or indirectly trigger or exacerbate risks related to product offerings, profitability, or any of the risk factors described above. Whether those underlying risk factors are driven by geopolitics or not, the Company's dynamic approach to managing risks enables management to identify risks, internally and externally, develop mitigation plans, and respond to risks in an attempt to proactively reduce the potential impact of each underlying risk factor on the Company.

b. Leases

The Company leases office space and equipment in the normal course of business under various noncancelable operating lease agreements. Additionally, the Company, as lessee, has entered various sublease agreements with affiliates for office space, such as Barings. Total rental expense on net operating leases, recorded in general insurance expenses, was \$93 million for the year ended December 31, 2023 and \$91 million for the year ended December 31, 2022. Net operating leases are net of sublease receipts of \$5 million for the year ended December 31, 2023 and \$3 million for the year ended December 31, 2022.

For the years ended December 31, 2023 and December 31, 2022, the company has not entered into any sale-leaseback transactions with any unrelated parties.

Future minimum commitments for all lease obligations as of December 31, 2023 were as follows:

	Gross	Affiliated Subleases	Nonaffiliated Subleases		Net
			(In Millions)		
2024	\$ 85	\$ 2	\$ 4	\$ 79	
2025	73	2	4	67	
2026	58	2	4	52	
2027	52	2	2	48	
2028	48	1	2	45	
Thereafter	304	-	7	297	
Total	\$ 620	\$ 9	\$ 23	\$ 588	

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

c. Guaranty funds

The Company is subject to state insurance guaranty fund laws. These laws assess insurance companies' amounts to be used to pay benefits to policyholders and policy claimants of insolvent insurance companies. Many states allow these assessments to be credited against future premium taxes. The Company believes such assessments in excess of amounts accrued will not materially impact its financial position, results of operations or liquidity.

b. Litigation and regulatory matters

In the normal course of business, the Company is involved in disputes, litigation and governmental or regulatory inquiries, administrative proceedings, examinations and investigations, both pending and threatened. These matters, if resolved adversely against the Company or settled, may result in monetary damages, fines and penalties or require changes in the Company's business practices. The resolution or settlement of these matters is inherently difficult to predict. Based upon the Company's assessment of these pending matters, the Company does not believe that the amount of any judgment, settlement or other action arising from any pending matter is likely to have a material adverse effect on the statement of financial position. However, an adverse outcome in certain matters could have a material adverse effect on the results of operations for the period in which such matter is resolved, or an accrual is determined to be required, on the financial statement financial position, or on our reputation.

The Company evaluates the need for accruals of loss contingencies for each matter. When a liability for a matter is probable and can be estimated, the Company accrues an estimate of the loss offset by related insurance recoveries or other contributions, if any. An accrual may be subject to subsequent adjustment as a result of additional information and other developments. The resolution of matters is inherently difficult to predict, especially in the early stages of matter. Even if a loss is probable, due to many complex factors, such as speed of discovery and the timing of court decisions or rulings, a loss or range of loss may not be reasonably estimated until the later stages of the matter. For matters where a loss is material and it is either probable or reasonably possible then it is disclosed. For matters where a loss may be reasonably possible, but not probable, or is probable but not reasonably estimated, no accrual is established, but the matter, if material, is disclosed.

e. Commitments

In the normal course of business, the Company provides specified guarantees and funding to MMHLLC and certain of its subsidiaries. As of December 31, 2023, the Company had approximately \$800 million of these unsecured funding commitments to its subsidiaries and \$261 million as of December 31, 2022. The unsecured commitments are included in private placements in the table below. As of December 31, 2023 and 2022, the Company had not funded, nor had an outstanding balance due on, these commitments.

In the normal course of business, the Company enters into letter of credit arrangements. The Company had outstanding letter of credit arrangements of approximately \$77 million as of December 31, 2023 and approximately \$77 million as of December 31, 2022. As of December 31, 2023 and 2022, the Company did not have any funding requests attributable to these letter of credit arrangements.

In the normal course of business, the Company enters into commitments to purchase certain investments. The majority of these commitments have funding periods that extend between one and five years. The Company is not required to fund commitments once the commitment period expires.

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

As of December 31, 2023, the Company had the following outstanding commitments:

	2024	2025	2026	2027	2028	Thereafter	Total
	(In Millions)						
Private placements	\$ 3,803	\$ 1,770	\$ 2,620	\$ 1,236	\$ 373	\$ 727	\$ 10,529
Mortgage loans	402	361	588	63	80	77	1,571
Partnerships and LLC	1,703	1,055	951	961	336	1,226	6,232
LIHTCs (including equity contributions)	-	-	-	-	1	42	43
Total	\$ 5,908	\$ 3,186	\$ 4,159	\$ 2,260	\$ 790	\$ 2,072	\$ 18,375

In the normal course of business the Company enters into commitments related to property lease arrangements, certain indemnities, investments and other business obligations. As of December 31, 2023 and 2022, the Company had no outstanding obligations attributable to these commitments.

f. Guarantees

In the normal course of business the Company enters into guarantees related to employee and retirement benefits, the maintenance of subsidiary regulatory capital, surplus levels and liquidity sufficient to meet certain obligations, and other property lease arrangements. If the Company were to recognize a liability, the financial statement impact would be to recognize either an expense or an investment in a subsidiary, controlled, or affiliated entity. The Company has no expectations for recoveries from third parties should these guarantees be triggered. As of December 31, 2023 and 2022, the Company had no outstanding obligations to any obligor attributable to these guarantees.

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

The following details contingent guarantees that are made on behalf of the Company's subsidiaries and affiliates as of December 31, 2023.

Type of guarantee	Nature of guarantee (including term) and events and circumstances that would require the guarantor to perform under guarantee	Carrying amount of liability	Maximum potential amount of future payments (undiscounted) required under the guarantee
Employee and Retirement Benefits	The Company guarantees the payment of certain employee and retirement benefits for its wholly-owned subsidiary Barings, if the subsidiary is unable to pay.	-	The liabilities for these plans of \$564 million have been recorded on the subsidiaries' books and represent the Company's maximum obligation.
Capital and Surplus Support of Subsidiaries	Certain guarantees of the Company provide for the maintenance of a subsidiary's regulatory capital, surplus levels and liquidity sufficient to meet certain obligations. These unlimited guarantees are made on behalf of certain wholly-owned subsidiaries. (C.M. Life and MML Bay State Life).	-	These guarantees are not limited and cannot be estimated.
Other Property Lease Arrangements	The Company guarantees the payment of various lease obligations on behalf of its subsidiaries and affiliates.	-	The future maximum potential obligations are immaterial to the Company.
Real Estate Development Guarantee	The construction lender for an office building in London, UK required a cost overrun guarantee equivalent to 8% of the total budgeted cost (£6 million). The Company will only be responsible for its pro rata share of any cost overruns with a maximum additional commitment of approximately £3 million.	-	£9 million
Secure Capital for Variable Annuity Separate Accounts	The Company guarantees the capital contributions required to be made by a variable annuity separate account contract holder in the event the contract holder fails to payoff a subscription line utilized to deploy capital for the separate account.	-	\$135 million with the right to increase the line to \$175 million.

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

17. Related party transactions

MassMutual has management and service contracts and cost-sharing arrangements with various subsidiaries and affiliates where MassMutual, for a fee, will furnish a subsidiary or affiliate, as required, operating facilities, human resources, computer software development and managerial services.

MassMutual has agreements with its subsidiaries and affiliates, including Insurance Road LLC, Copper Hill LLC, MML Investment Advisers LLC, The MassMutual Trust Company, FSB, MassMutual International LLC and Baring International Investment Limited, where MassMutual receives revenue for certain recordkeeping and other services that MassMutual provides to customers who select, as investment options, mutual funds managed by these affiliates.

MassMutual has agreements with its subsidiaries, Barings, MML Investment Advisers LLC and MassMutual Intellectual Property LLC, which provide investment advisory services and licensing agreements to MassMutual.

The following table summarizes the transactions between the Company and the related parties:

	Years Ended December 31,		
	2023	2022	2021
	(In Millions)		
Fee income:			
Management and service contracts and cost-sharing arrangements	\$ 425	\$ 366	\$ 364
Investment advisory income	16	18	23
Recordkeeping and other services	11	16	20
Fee expense:			
Investment advisory services	221	236	240
Royalty and licensing fees	84	71	58

The Company reported amounts due from subsidiaries and affiliates of \$132 million as of December 31, 2023 and \$103 million as of December 31, 2022. The Company reported amounts due to subsidiaries and affiliates of \$39 million as of December 31, 2023 and \$33 million as of December 31, 2022. Terms generally require settlement of these amounts within 30 to 90 days.

The Company held debt issued by MMHLLC that amounted to \$2,144 million as of December 31, 2023 and \$2,315 million as of December 31, 2022. The Company recorded interest income on MMHLLC debt of \$125 million in 2023 and \$94 million in 2022. The notes maturing as of June 2022 were refinanced at 5.00% for \$257 million. The notes maturing as of December 15, 2023 were refinanced at 5.75% for \$380 million. A new note was issued on December 22, 2023 with a maturity date of December 22, 2030 at 5.90% for \$375 million.

As of December 31, 2023, MMIH and C.M. Life, together, provided financing of \$5,500 million, \$5,253 million and \$247 million respectively, for MMAF that can be used to finance ongoing asset purchases. MMIH provided financing of \$5,253 million as of December 31, 2023 and \$5,253 million as of December 31, 2022. During 2022, MMAF borrowed \$2,244 million and repaid \$1,123 million under the credit facility. During 2023, MMAF borrowed \$2,271 million and repaid \$2,203 million under the credit facility. Outstanding borrowings under the facility were \$4,824 million as of December 31, 2023 and \$3,703 million as of December 31, 2022. Interest for these borrowings was \$131 million for the year ended December 31, 2023 and \$86 million for the year ended December 31, 2022. The floating rate borrowings bear interest at a spread over the 30 day LIBOR. The fixed rate borrowings bear an interest at a spread over average life Treasuries.

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

Together, MassMutual and C.M. Life, provide a credit facility to Jefferies Finance, LLC whereby Jefferies Finance, LLC (Jefferies) borrows cash through short-term approved financings to fund the purchase of loans for securitization. During 2023, Jefferies borrowed \$79 million and repaid \$79 million under the credit facility. During 2022, Jefferies borrowed \$225 million and repaid \$225 million under the credit facility. As of December 31, 2023, there were no outstanding borrowings under this facility. All outstanding interest due under the facility, as of December 31, 2023, had been paid. The interest of this facility is calculated based on a full pass through of interest accrued on the underlying loans purchased.

In 2023, MassMutual made capital contributions of \$13 million to HavenTech Asia.

In 2023, MassMutual made capital contributions of \$116 million to ITPS Holdings LLC.

In 2023, MassMutual made capital contributions of \$88 million to MassMutual Mortgage Lending LLC, \$50 million to MMIH Bond Holdings LLC, and \$13 million to MML CM LLC.

In 2023, MassMutual purchased \$531 million of private placement corporate assets from C.M. Life.

In 2022, Insurance Road LLC paid \$90 million in dividends and a \$123 million return of capital to MassMutual.

In 2022, MassMutual made capital contributions of \$17 million to MassMutual International LLC.

In 2022, MassMutual made capital contributions of \$35 million to ITPS Holding LLC.

In 2022, MassMutual transferred its ownership in Martello Re to MMHLLC of (\$58) million.

In 2022, MassMutual transferred its ownership of partnerships and LLCs to MMHLLC of \$194 million.

In 2022, MassMutual made contributions to DPI Acres Capital for \$154 million.

In 2022, MassMutual made contributions of \$27 million to downstream subsidiaries.

The Company has reinsurance agreements with its subsidiary, C.M. Life, and its indirect subsidiary, MML Bay State, including stop-loss, Modco and yearly renewable term agreements on life insurance and annuity products. The Company also has coinsurance agreements with C.M. Life where the Company assumes substantially all of the premium on certain universal life policies.

Effective December 31, 2020, MassMutual provides C.M. Life a stop-loss coverage to transfer a specific interest rate risk. All Odyssey fixed-deferred annuity contracts issued by C.M. Life are covered under this agreement. C.M. Life pays an annual premium to MassMutual. If the coverage is triggered, there will be a settlement at year end from MassMutual to C.M. Life. The maximum total liability of MassMutual under the agreement is \$200 million over seven years.

As of December 31, 2023, the net reinsurance amounts due to C.M. Life and MML Bay State were \$29 million and as of December 31, 2022, the net reinsurance amounts due to C.M. Life and MML Bay State were \$53 million. These outstanding balances are due and payable with terms ranging from monthly to annually, depending on the agreement in effect.

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

The following table summarizes the reinsurance transactions for these reinsurance agreements:

	Years Ended December 31,		
	2023	2022	2021
	(In Millions)		
Premium assumed	\$ 43	\$ 44	\$ 49
Modco adjustments, included in fees and other income	24	12	11
Expense allowance on reinsurance assumed, included in commissions	(13)	(13)	(13)
Policyholders' benefits	(108)	(88)	(144)
Experience refunds (paid) received	1	(1)	-
Accrual for stop-loss agreement	-	(18)	-

The Company currently has one longevity swap reinsurance agreement with Rothesay Life Plc on certain inforce annuity products. Under this agreement, the Company is the reinsurer and Rothesay Life Plc is the cedent.

The following table summarizes the related party transactions between the Company and Rothesay Life Plc:

	Years Ended December 31,		
	2023	2022	2021
	(In Millions)		
Premium assumed	\$ (248)	\$ (203)	\$ (165)
Policyholders' benefits	235	192	157

For further information on common stocks - subsidiaries and affiliates, refer to *Note 5c. "Common stocks - subsidiaries and affiliates."*

In the normal course of business, the Company provides specified guarantees and funding to MMHLLC and certain of its subsidiaries. Refer to *Note 16e. "Commitments"* for information on the Company's accounting policies regarding these related party commitments and *Note 16f. "Guarantees"* for information on the guarantees.

18. Subsidiaries and affiliated companies

A summary of ownership and relationship of the Company and its subsidiaries and affiliated companies as of December 31, 2023 is illustrated below. Subsidiaries are wholly owned, except as noted.

Subsidiaries of MassMutual

C.M. Life
 Berkshire Way LLC
 MML Special Situations Investor LLC
 Timberland Forest Holding LLC – 37% (remaining 63% owned by MassMutual Trad Private Equity LLC)
 MSP – SC, LLC
 Insurance Road LLC
 MM Copper Hill Road LLC
 Jefferies Finance LLC – 50% (remaining 50% owned by Jefferies Group, Inc.)
 MML Distributors LLC – 99% (remaining 1% owned by MassMutual Holding LLC)
 MML Investment Advisers, LLC
 Pioneers Gate LLC
 MML Strategic Distributors, LLC
 The MassMutual Trust Company, FSB

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

MassMutual Mortgage Lending LLC
MML Private Placement Investment Company I, LLC
MML Private Equity Fund Investor LLC
MM Private Equity Intercontinental LLC
MassMutual Holding LLC
MassMutual Investment Holding, LLC
MassMutual International, LLC
MML Mezzanine Investor II, LLC
MML Mezzanine Investor III, LLC
MassMutual External Benefits Group LLC
EM Opportunities LLC
MassMutual MCAM Insurance Company, Inc.
CML Global Capabilities
MM Global Capabilities I LLC
MM Global Capabilities II LLC
MM Global Capabilities III LLC
MML CM LLC
Glidepath Holdings Inc
ITPS Holding LLC
MM/Barings Mutifamily TEBS 2020 LLC
MM Direct Private Investments Holding LLC
MassMutual Ventures Europe/APAC I GP, LLC
MassMutual Ventures US IV, GP, LLC
DPI-ACRES Capital LLC
Amherst Long Term Holdings, LLC

Subsidiaries of C.M. Life Insurance Company

MML Bay State Life Insurance Company
CML Mezzanine Investor III, LLC
CML Special Situations Investor LLC

Subsidiaries of MML Bay State Life Insurance Company

(No subsidiaries)

Subsidiaries of Timberland Forest Holding LLC

Lyme Adirondack Forest Company, LLC

Subsidiaries of Insurance Road LLC

MassMutual Trad Private Equity LLC
MassMutual Intellectual Property LLC
Trad Investments LLC

MML Investment Advisers, LLC

(No Subsidiaries)

Pioneers Gate LLC

(No subsidiaries)

Subsidiaries of MassMutual Holding LLC

Fern Street LLC
Low Carbon Energy Holding
Haven Life Insurance Agency, LLC
MassMutual Assignment Company
MassMutual Capital Partners LLC
MassMutual Ventures Holding LLC

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

MM Rothesay Holdco US LLC
MML Investors Services, LLC
LifeScore Labs, LLC
Sleeper Street LLC
MM Asset Management Holding LLC
MM Catalyst Fund LLC
Aland Royalty Holdings LP
GASL Holdings LLC
Barings Asset-Based Income Fund (US) LP
Babson Capital Global Special Situation Credit Fund 2
Barings Global Real Assets Fund LP
Barings Global Special Situations Credit Fund 3
Barings North American Private Loan Fund LP
Marco Hotel LLC
HB Naples Golf Owner LLC
RB Apartments LLC

Subsidiaries of MassMutual International LLC

MassMutual Solutions LLC
Yunfeng Financial Group Limited
MassMutual Asia Limited (SPV)

Subsidiaries of CML CM LLC

Blueprint Income LLC
Flourish Digital Assets LLC
Flourish Financial LLC
Flourish Holding Company LLC
Flourish Technologies LLC

Subsidiaries of Glidepath Holdings Inc

Great American Life Insurance Company
AAG Insurance Agency, LLC
Annuity Investor Life Insurance Company
Great American Advisors, LLC
Manhattan National Holding Corporation

Subsidiaries of MassMutual Ventures Holding LLC

MassMutual Ventures US I LLC
MassMutual Ventures US II LLC
MassMutual Ventures US III LLC
MassMutual Ventures US IV LLC
MassMutual Ventures UK LLC
MassMutual Ventures Southeast Asia I LLC
MassMutual Ventures Southeast Asia II LLC
MassMutual Ventures Management LLC
MassMutual Ventures SEA Management Private Limited (an indirect subsidiary of Subsidiary of MassMutual Ventures Holding LLC)
Athens Fund Management LLC
Open Alternatives LLC

MML Investors Services, LLC

MMLISI Financial Alliances, LLC
MML Insurance agency, LLC

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

Subsidiaries of Barings LLC (a subsidiary of MM Asset Management Holding LLC)

Barings Finance LLC
Barings Securities LLC
Barings Guernsey Limited
Barings Real Estate Acquisitions LLC
Barings Asset Management (Asia) Holdings Limited
Barings Multifamily Capital Holdings LLC
Barings Australia Real Estate Holdings Pty Ltd

Subsidiaries of Baring Asset Management Limited (an indirect subsidiary of MassMutual Baring Holding LLC)

Baring International Investment Limited
Baring International Investment Management Holdings Limited
Baring Fund Managers Limited
Baring Investment Services Limited
Barings Global Advisers Limited
Barings European Core Property Fund GP Sàrl
Barings BME GP Sàrl
Barings Core Fund Feeder I GP S.à.r.l.
Barings Investment Fund (LUX) GP S.à r.l
Barings GPC GP S.à.r.l
Barings Umbrella Fund (LUX) GP S.à.r.l
GPLF4(S) GP S.à r. l
PREIF Holdings Limited Partnership

Subsidiaries of Baring International Investment Limited

(No subsidiaries)

Subsidiaries of MassMutual Investment Holding

MML Management Corporation
MassMutual Asset Finance LLC
MMIH Bond Holdings LLC

Subsidiaries of MML Management Corporation

MassMutual Holding MSC, Inc.
MassMutual International Holding MSC, Inc.

Subsidiaries of MassMutual Asset Finance LLC

MMAF Equipment Finance LLC 2014-A
MMAF Equipment Finance LLC 2017-A
MMAF Equipment Finance LLC 2017-B
MMAF Equipment Finance LLC 2018-A
MMAF Equipment Finance LLC 2019-A
MMAF Equipment Finance LLC 2019-B
MMAF Equipment Finance LLC 2020-A
MMAF Equipment Finance LLC 2020-B
MMAF Equipment Finance LLC 2021-A
MMAF Equipment Finance LLC 2022-A
MMAF Equipment Finance LLC 2022-B
Rozier LLC

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

Information regarding filings of Subsidiaries and Controlled Affiliates

The following presents certain information regarding the Company's valuation filings for controlled affiliates of the Company:

	CUSIP	As of December 31, 2023				2022 Approved Valuation	Filing Code	Valuation Method	Disallowed?
		Gross Value	Non-admitted	Admitted	Latest Filing				
		(\$ in Millions)							
MassMutual Holding LLC	57543#-11-8	\$ 17,592	\$ -	\$ 17,592	8/30/2023	\$ 17,227	Sub-2	No	
The MassMutual Trust Co, FSB	57631@-10-5	25	-	25	6/30/2023	25	Sub-2	No	
MM Investment Holding	G5695@10-8	687	-	687	7/12/2023	659	Sub-2	No	
MM Investment Holding	G5695@11-6	1,162	-	1,162	7/12/2023	1,071	Sub-2	No	
Glidepath Holdings Inc	37930@-10-5	3,643	-	3,643	11/11/2022	3,475	Sub-2	No	
Aggregate Total		\$ 23,109	\$ -	\$ 23,109		\$ 22,457			

19. Subsequent events

Management of the Company has evaluated subsequent events through February 27, 2024, the date the financial statements were available to be issued to state regulators and subsequently on the Company's website. No events have occurred subsequent to the date of the financial statements, except for:

On January 17, 2024, MassMutual issued a \$650 million funding agreement with a 4.85% fixed rate and a 5-year maturity.

On January 29, 2024, MassMutual issued a \$300 million funding agreement with a floating rate based on the Secured Overnight Financing Rate and a 3-year maturity.

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

20. Impairment listing for loan-backed and structured securities

The following are the total cumulative adjustments and impairments for loan-backed and structured securities since July 1, 2009:

Period Ended	Amortized Cost before Cumulative Adjustment	Cumulative Adjustment	Amortized Cost before OTTI	Projected Cash Flow	Recognized OTTI	Amortized Cost after OTTI	Fair Value
December 31, 2023	\$ 53,672,524	\$ -	\$ 53,672,524	\$ 51,118,891	\$ (2,553,633)	\$ 51,118,891	\$ 42,903,097
September 30, 2023	24,928,010	-	24,928,010	24,065,666	(862,344)	24,065,666	21,743,474
June 30, 2023	16,432,523	-	16,432,523	15,955,963	(476,560)	15,955,963	15,431,923
March 31, 2023	56,797,193	-	56,797,193	45,999,577	(10,797,616)	45,999,577	39,477,567
December 31, 2022	47,152,655	-	47,152,655	42,630,344	(4,522,311)	42,630,344	35,962,545
September 30, 2022	23,315,048	-	23,315,048	22,016,070	(1,298,978)	22,016,070	19,284,696
June 30, 2022	17,306,639	-	17,306,639	15,826,391	(1,480,248)	15,826,391	13,534,918
March 31, 2022	30,135,997	-	30,135,997	23,857,778	(6,278,218)	23,857,778	23,674,371
December 31, 2021	6,658,614	-	6,658,615	6,490,508	(168,107)	6,490,508	6,369,198
September 30, 2021	4,061,382	-	4,061,382	3,955,723	(105,659)	3,955,723	3,595,213
June 30, 2021	11,352,643	-	11,352,642	10,386,581	(966,063)	10,386,581	11,323,900
March 31, 2021	11,247,256	-	11,247,257	5,074,493	(6,172,764)	5,074,493	5,237,174
December 31, 2020	16,071,907	-	16,071,907	14,674,300	(1,397,607)	14,674,300	15,473,517
September 30, 2020	21,375,383	-	21,375,383	19,160,250	(2,215,134)	19,160,250	18,862,027
June 30, 2020	10,180,123	-	10,180,123	8,992,610	(1,187,513)	8,992,610	9,249,851
March 31, 2020	24,799,788	-	24,799,788	20,197,344	(4,602,443)	20,197,344	24,683,947
December 31, 2019	3,992,400	-	3,992,400	3,539,281	(453,119)	3,539,281	3,439,138
September 30, 2019	16,909,029	-	16,909,029	15,191,932	(1,717,097)	15,191,932	14,639,756
June 30, 2019	6,980,030	-	6,980,030	6,187,029	(793,001)	6,187,029	7,133,620
March 31, 2019	7,791,000	-	7,791,000	7,634,637	(156,363)	7,634,637	7,683,021
December 31, 2018	4,550,173	-	4,550,173	3,815,559	(734,614)	3,815,559	4,014,514
September 30, 2018	4,320,826	-	4,320,826	3,663,181	(657,645)	3,663,181	3,687,297
June 30, 2018	634,235	-	634,235	279,221	(355,014)	279,221	386,752
March 31, 2018	645,690	-	645,690	488,181	(157,509)	488,181	448,494
December 31, 2017	3,949,513	-	3,949,513	1,958,759	(1,990,754)	1,958,759	2,023,952
September 30, 2017	4,436,542	-	4,436,542	876,942	(3,559,600)	876,942	4,647,683
June 30, 2017	40,538,551	-	40,538,551	39,808,956	(729,595)	39,808,956	60,990,732
March 31, 2017	41,788,380	-	41,788,380	41,391,889	(396,491)	41,391,889	56,156,936
December 31, 2016	42,175,938	-	42,175,938	42,045,721	(130,217)	42,045,721	54,619,477
September 30, 2016	44,266,478	-	44,266,478	41,890,535	(2,375,942)	41,890,535	61,300,066
June 30, 2016	49,097,217	-	49,097,217	48,202,703	(894,514)	48,202,703	63,207,410
March 31, 2016	57,985,071	-	57,985,071	55,783,979	(2,201,092)	55,783,979	70,578,397
December 31, 2015	4,881,394	-	4,881,394	4,783,194	(98,200)	4,783,194	4,728,736
September 30, 2015	50,531,382	-	50,531,382	45,665,859	(4,865,524)	45,665,859	58,523,652
June 30, 2015	66,924,927	-	66,924,927	65,240,585	(1,684,341)	65,240,585	72,953,475
March 31, 2015	17,856,447	-	17,856,447	17,681,510	(174,937)	17,681,510	17,553,999
December 31, 2014	69,225,743	-	69,225,743	68,301,291	(924,452)	68,301,291	79,410,553
September 30, 2014	645,721	-	645,721	604,437	(41,284)	604,437	627,381
June 30, 2014	57,012,606	-	57,012,606	55,422,168	(1,590,438)	55,422,168	75,253,388
March 31, 2014	91,702,041	-	91,702,041	80,744,074	(10,957,967)	80,744,074	97,672,071
December 31, 2013	113,707,951	-	113,707,951	108,815,640	(4,892,311)	108,815,640	111,783,052
September 30, 2013	81,945,730	-	81,945,730	80,589,482	(1,356,248)	80,589,482	77,049,314
June 30, 2013	147,215,936	-	147,215,936	142,140,572	(5,075,365)	142,140,572	130,973,023
March 31, 2013	194,772,025	-	194,772,025	188,372,089	(6,399,936)	188,372,089	176,678,910
December 31, 2012	378,096,660	-	378,096,660	366,323,110	(11,773,550)	366,323,110	333,086,073
September 30, 2012	816,573,456	-	816,573,456	788,350,823	(28,222,633)	788,350,823	697,683,289
June 30, 2012	912,025,937	-	912,025,937	890,494,221	(21,531,716)	890,494,221	708,872,106
March 31, 2012	1,095,018,529	-	1,095,018,529	1,058,132,041	(36,886,488)	1,058,132,041	841,095,013
December 31, 2011	1,090,904,993	-	1,090,904,993	1,056,761,288	(34,143,705)	1,056,761,288	754,310,838
September 30, 2011	762,320,632	-	762,320,632	738,510,048	(23,810,584)	738,510,048	546,494,232

**MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued**

June 30, 2011	1,130,732,656	-	1,130,732,656	1,078,535,670	(52,196,986)	1,078,535,670	839,143,290
March 31, 2011	1,097,705,351	-	1,097,705,351	1,068,852,204	(28,853,147)	1,068,852,204	816,688,348
December 31, 2010	968,742,508	-	968,742,508	950,111,417	(18,631,091)	950,111,417	708,895,637
September 30, 2010	915,728,030	-	915,728,030	889,896,058	(25,831,972)	889,896,058	673,462,493
June 30, 2010	1,362,887,892	-	1,362,887,892	1,335,628,212	(27,259,681)	1,335,628,212	975,241,506
March 31, 2010	1,471,905,696	-	1,471,905,696	1,391,337,543	(80,568,153)	1,391,337,543	1,015,645,802
December 31, 2009	1,349,124,214	-	1,349,124,214	1,290,817,168	(58,307,047)	1,290,817,168	852,088,739
September 30, 2009	2,953,442,689	(106,853,708)	2,846,588,981	2,700,948,264	(145,640,717)	2,700,948,264	1,692,409,640
Totals		\$ (106,853,708)			\$ (694,106,238)		

The following is the impairment listing for loan-backed and structured securities for the three months ended December 31, 2023:

CUSIP	Amortized Cost before Cumulative Adjustment	Cumulative Adjustment	Amortized Cost before OTTI	Projected Cash Flow	Recognized OTTI	Amortized Cost after OTTI	Fair Value
040104RV5	\$ 2,347,899	\$ -	\$ 2,347,899	\$ 2,282,725	\$ (65,174)	\$ 2,282,725	\$ 1,302,564
040104TF8	54,340	-	54,340	52,649	(1,691)	52,649	32,844
040104TG6	691,003	-	691,003	659,349	(31,654)	659,349	425,196
04012XAC9	181,150	-	181,150	170,182	(10,968)	170,182	110,338
12479DAC2	1,630,508	-	1,630,508	1,585,965	(44,543)	1,585,965	1,297,291
1248MGAJ3	58,623	-	58,623	57,506	(1,117)	57,506	34,138
17311YAC7	1,187,982	-	1,187,982	1,153,900	(34,082)	1,153,900	1,128,264
30247DAD3	1,217,263	-	1,217,263	1,201,793	(15,470)	1,201,793	492,353
35729RAE6	3,593,051	-	3,593,051	3,420,695	(172,356)	3,420,695	3,107,574
40431KAE0	1,990,110	-	1,990,110	1,933,246	(56,864)	1,933,246	2,021,305
45071KDD3	564,498	-	564,498	527,624	(36,874)	527,624	361,094
46629NAC7	44,849	-	44,849	43,647	(1,202)	43,647	26,205
46630KAA4	125,971	-	125,971	124,577	(1,394)	124,577	143,209
61749BAB9	80,209	-	80,209	75,699	(4,510)	75,699	62,492
61750FAE0	545,703	-	545,703	520,383	(25,320)	520,383	363,586
617526AE8	486,709	-	486,709	455,151	(31,558)	455,151	187,873
86359DXD4	453,194	-	453,194	443,928	(9,266)	443,928	154,120
073882AC6	71,557	-	71,557	48,705	(22,852)	48,705	70,671
12668ABP9	129,890	-	129,890	116,635	(13,255)	116,635	133,533
22943HAD8	3,271,684	-	3,271,684	3,247,368	(24,316)	3,247,368	1,868,818
251513AQ0	40,724	-	40,724	38,804	(1,920)	38,804	36,075
45254TRX4	72,218	-	72,218	71,387	(831)	71,387	56,387
45254TSM7	548,532	-	548,532	528,758	(19,774)	528,758	461,568
45660LAU3	56,496	-	56,496	52,294	(4,202)	52,294	56,783
45660LYW3	859,170	-	859,170	822,796	(36,374)	822,796	663,220
466247XE8	664,779	-	664,779	659,135	(5,644)	659,135	476,466
59020UW43	62,573	-	62,573	53,844	(8,729)	53,844	62,448
61915RBZ8	278,208	-	278,208	277,681	(527)	277,681	147,160
761118FM5	1,510,955	-	1,510,955	1,466,742	(44,213)	1,466,742	1,474,675
761118RJ9	128,234	-	128,234	127,627	(607)	127,627	62,725
85554NAG5	74,686	-	74,686	64,953	(9,733)	64,953	71,686
86358IHX0	174,701	-	174,701	164,900	(9,801)	164,900	128,481
86359BLQ2	695,503	-	695,503	655,372	(40,131)	655,372	471,720
92978EAA2	143,827	-	143,827	140,068	(3,759)	140,068	69,546
41161PTP8	222,917	-	222,917	220,268	(2,649)	220,268	158,889
41161PWB5	610,727	-	610,727	606,127	(4,600)	606,127	558,552
45660N5H4	1,863,029	-	1,863,029	1,822,939	(40,090)	1,822,939	1,020,735
45660NT88	20,836	-	20,836	20,337	(499)	20,337	12,881
576433H33	1,161,358	-	1,161,358	989,170	(172,188)	989,170	735,308
61915RBB1	2,021,487	-	2,021,487	2,020,812	(675)	2,020,812	1,337,686
86360UAF3	1,108,924	-	1,108,924	1,088,747	(20,177)	1,088,747	706,779
05949CCB0	31,358	-	31,358	30,629	(729)	30,629	32,023

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

17309FAE8	54,306	-	54,306	54,227	(79)	54,227	72,467
362341VU0	1,364,188	-	1,364,188	1,354,304	(9,884)	1,354,304	1,273,386
36298XAA0	5,896,550	-	5,896,550	5,835,572	(60,978)	5,835,572	4,308,340
576433NH5	314,175	-	314,175	303,311	(10,864)	303,311	189,068
57645LAA2	10,260,489	-	10,260,489	9,150,641	(1,109,848)	9,150,641	11,015,616
86359DMC8	4,340,486	-	4,340,486	4,016,353	(324,133)	4,016,353	3,563,716
86359DME4	364,895	-	364,895	359,366	(5,529)	359,366	355,243
Totals	\$ 53,672,524	\$ -	\$ 53,672,524	\$ 51,118,891	\$ (2,553,633)	\$ 51,118,891	\$ 42,903,097

The following is the impairment listing for loan-backed and structured securities for the three months ended September 30, 2023:

CUSIP	Amortized Cost before Cumulative Adjustment	Cumulative Adjustment	Amortized Cost before OTTI	Projected Cash Flow	Recognized OTTI	Amortized Cost after OTTI	Fair Value
05535DCF9	\$ 1,782,860	\$ -	\$ 1,782,860	\$ 1,774,615	\$ (8,245)	\$ 1,774,615	\$ 1,615,108
1248MGAJ3	42,122	-	42,122	40,755	(1,367)	40,755	34,109
17311YAC7	1,214,183	-	1,214,183	1,173,580	(40,603)	1,173,580	1,158,277
30247DAD3	544,986	-	544,986	530,143	(14,843)	530,143	485,430
40431KAE0	2,020,232	-	2,020,232	1,964,115	(56,117)	1,964,115	1,941,678
46629NAC7	33,121	-	33,121	32,454	(667)	32,454	26,826
46630KAA4	152,848	-	152,848	149,286	(3,562)	149,286	140,157
57643LMP8	664,369	-	664,369	615,398	(48,971)	615,398	616,435
590212AB2	33,970	-	33,970	29,921	(4,049)	29,921	33,420
86359DXD4	169,272	-	169,272	159,443	(9,829)	159,443	163,801
86363HAB8	33,650	-	33,650	32,774	(876)	32,774	29,320
93934XAB9	123,880	-	123,880	115,382	(8,498)	115,382	121,783
05535DAN4	674,819	-	674,819	518,140	(156,679)	518,140	538,849
12667FYS8	83,749	-	83,749	70,404	(13,345)	70,404	83,180
12667GKG7	44,892	-	44,892	43,316	(1,576)	43,316	45,430
22943HAD8	3,333,227	-	3,333,227	3,209,290	(123,937)	3,209,290	1,862,665
32053LAA0	18,494	-	18,494	18,440	(54)	18,440	17,268
43739EAP2	1,209,064	-	1,209,064	1,182,999	(26,065)	1,182,999	1,133,684
45254TSM7	541,921	-	541,921	538,498	(3,423)	538,498	461,187
45660LYW3	775,781	-	775,781	720,142	(55,639)	720,142	694,930
466247XE8	565,725	-	565,725	560,689	(5,036)	560,689	492,033
61749LAN1	101,590	-	101,590	90,612	(10,978)	90,612	106,962
61915RBZ8	164,901	-	164,901	163,993	(908)	163,993	148,770
65535VRK6	471,315	-	471,315	442,770	(28,545)	442,770	467,415
761118RJ9	89,235	-	89,235	81,669	(7,566)	81,669	67,865
86358HHX0	168,641	-	168,641	166,229	(2,412)	166,229	118,809
86359A6A6	484,213	-	484,213	466,106	(18,107)	466,106	432,201
92978EAA2	80,092	-	80,092	77,179	(2,913)	77,179	72,870
126694YM4	579,079	-	579,079	572,556	(6,523)	572,556	496,668
41161PTP8	204,192	-	204,192	176,002	(28,190)	176,002	158,045
41161PWB5	670,938	-	670,938	662,621	(8,317)	662,621	557,761
61915RBB1	1,481,939	-	1,481,939	1,476,700	(5,239)	1,476,700	1,345,239
17309FAE8	73,197	-	73,197	54,698	(18,499)	54,698	75,336
362341VU0	1,378,634	-	1,378,634	1,378,467	(167)	1,378,467	1,232,954
36298XAA0	4,569,319	-	4,569,319	4,451,723	(117,596)	4,451,723	4,338,427
576433NH5	347,560	-	347,560	324,557	(23,003)	324,557	428,582
Totals	\$ 24,928,010	\$ -	\$ 24,928,010	\$ 24,065,666	\$ (862,344)	\$ 24,065,666	\$ 21,743,474

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

The following is the impairment listing for loan-backed and structured securities for the three months ended June 30, 2023:

CUSIP	Amortized Cost before Cumulative Adjustment	Cumulative Adjustment	Amortized Cost before OTTI	Projected Cash Flow	Recognized OTTI	Amortized Cost after OTTI	Fair Value
00442FAB8	\$ 50,571	\$ -	\$ 50,571	\$ 38,681	\$ (11,890)	\$ 38,681	\$ 8,265
040104RV5	1,421,615	-	1,421,615	1,379,721	(41,894)	1,379,721	1,316,932
1248MGAJ3	42,545	-	42,545	42,165	(380)	42,165	34,889
17311YAC7	1,241,873	-	1,241,873	1,206,602	(35,271)	1,206,602	1,232,111
40431KAE0	2,053,478	-	2,053,478	2,006,843	(46,635)	2,006,843	2,030,117
45071KDD3	360,529	-	360,529	358,225	(2,304)	358,225	357,570
61750FAE0	396,971	-	396,971	394,270	(2,701)	394,270	358,577
84752CAE7	555,369	-	555,369	510,004	(45,365)	510,004	679,671
86359DXD4	182,513	-	182,513	169,184	(13,329)	169,184	170,546
92926SAB2	385	-	385	380	(5)	380	379
12667FYL3	212,185	-	212,185	199,941	(12,244)	199,941	201,624
12669FKR3	40,116	-	40,116	37,606	(2,510)	37,606	37,952
18974BAA7	131,289	-	131,289	130,311	(978)	130,311	133,783
18974BAN9	67,323	-	67,323	64,834	(2,489)	64,834	69,970
22540VG71	35,173	-	35,173	35,094	(79)	35,094	35,963
23321P6A1	1,405,020	-	1,405,020	1,371,044	(33,976)	1,371,044	1,329,368
32053LAA0	18,926	-	18,926	18,853	(73)	18,853	18,262
45660LAU3	69,258	-	69,258	65,015	(4,243)	65,015	67,725
466247XE8	578,949	-	578,949	575,151	(3,798)	575,151	499,997
525221AJ6	502,913	-	502,913	502,636	(277)	502,636	524,046
61915RBZ8	173,679	-	173,679	173,638	(41)	173,638	155,279
86358HHX0	176,678	-	176,678	173,936	(2,742)	173,936	129,387
92978EAA2	80,634	-	80,634	80,479	(155)	80,479	72,910
93935PAH2	112,081	-	112,081	105,729	(6,352)	105,729	109,259
05946XYP2	267,693	-	267,693	266,462	(1,231)	266,462	225,954
86360UAF3	977,832	-	977,832	929,807	(48,025)	929,807	761,473
92922FWU8	357,222	-	357,222	355,654	(1,568)	355,654	335,837
12669GTE1	4,194	-	4,194	3,937	(257)	3,937	4,201
32051DCJ9	41,478	-	41,478	41,458	(20)	41,458	39,754
36298XAA0	4,842,551	-	4,842,551	4,688,750	(153,801)	4,688,750	4,460,917
92922FBW7	31,480	-	31,480	29,553	(1,927)	29,553	29,205
Totals	\$ 16,432,523	\$ -	\$ 16,432,523	\$ 15,955,963	\$ (476,560)	\$ 15,955,963	\$ 15,431,923

The following is the impairment listing for loan-backed and structured securities for the three months ended March 31, 2023:

CUSIP	Amortized Cost before Cumulative Adjustment	Cumulative Adjustment	Amortized Cost before OTTI	Projected Cash Flow	Recognized OTTI	Amortized Cost after OTTI	Fair Value
12624QAC7	\$ 3,512,422	\$ -	\$ 3,512,422	\$ 3,120,715	\$ (391,707)	\$ 3,120,715	\$ 1,664,875
12624SAE9	2,546,182	-	2,546,182	2,252,873	(293,309)	2,252,873	672,000
36192RAL6	2,950,000	-	2,950,000	1,475,000	(1,475,000)	1,475,000	527,313
040104RV5	1,466,218	-	1,466,218	1,404,587	(61,631)	1,404,587	1,357,561
040104TF8	44,673	-	44,673	40,179	(4,494)	40,179	34,156
040104TG6	471,373	-	471,373	395,907	(75,466)	395,907	442,138
04012XAC9	136,023	-	136,023	130,363	(5,660)	130,363	111,736
1248MBAF2	12,589,914	-	12,589,914	5,496,141	(7,093,773)	5,496,141	5,479,168
1248MGAJ3	43,914	-	43,914	42,609	(1,305)	42,609	35,260
17311YAC7	1,273,018	-	1,273,018	1,228,216	(44,802)	1,228,216	1,264,914
30247DAD3	572,150	-	572,150	552,362	(19,788)	552,362	512,472
35729RAE6	3,632,752	-	3,632,752	3,523,491	(109,261)	3,523,491	3,272,827
40431KAE0	2,092,929	-	2,092,929	2,043,034	(49,895)	2,043,034	2,095,485
45071KDD3	419,880	-	419,880	359,858	(60,022)	359,858	365,022

**MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued**

46629NAC7	34,588	-	34,588	32,979	(1,609)	32,979	27,783
46630KAA4	158,523	-	158,523	155,152	(3,371)	155,152	149,476
617463AA2	8,734	-	8,734	7,949	(785)	7,949	6,705
61749BAB9	61,518	-	61,518	60,870	(648)	60,870	64,742
61750FAE0	412,694	-	412,694	394,112	(18,582)	394,112	366,377
61750MAB1	3,264	-	3,264	3,129	(135)	3,129	3,014
61755AAB2	3,183	-	3,183	2,639	(544)	2,639	2,526
86359DXD4	193,613	-	193,613	183,061	(10,552)	183,061	184,312
86363HAB8	36,193	-	36,193	34,244	(1,949)	34,244	30,923
92926SAB2	493	-	493	381	(112)	381	382
93934XAB9	137,528	-	137,528	122,528	(15,000)	122,528	129,850
12668ALV5	1,990,831	-	1,990,831	1,755,977	(234,854)	1,755,977	1,754,077
22540VG71	36,270	-	36,270	36,232	(38)	36,232	37,823
22943HAD8	3,510,613	-	3,510,613	3,380,974	(129,639)	3,380,974	1,886,340
32053LAA0	19,363	-	19,363	19,262	(101)	19,262	18,644
45254TRX4	23,933	-	23,933	23,574	(359)	23,574	23,161
45254TSM7	615,674	-	615,674	594,492	(21,182)	594,492	528,927
45660LAU3	57,004	-	57,004	56,426	(578)	56,426	55,897
45660LYW3	797,875	-	797,875	786,087	(11,788)	786,087	724,845
466247XE8	622,921	-	622,921	612,163	(10,758)	612,163	537,075
525221AJ6	561,909	-	561,909	502,260	(59,649)	502,260	551,875
61915RBZ8	178,926	-	178,926	178,879	(47)	178,879	164,881
65535VRK6	479,926	-	479,926	469,432	(10,494)	469,432	495,515
75115DAH8	3,502	-	3,502	3,266	(236)	3,266	3,118
761118FM5	1,722,865	-	1,722,865	1,583,656	(139,209)	1,583,656	1,584,522
76112BUE8	107,208	-	107,208	96,659	(10,549)	96,659	122,032
855541AC2	219,356	-	219,356	180,352	(39,004)	180,352	226,114
86359BLQ2	792,449	-	792,449	779,863	(12,586)	779,863	701,652
92978EAA2	83,791	-	83,791	81,555	(2,236)	81,555	79,259
92979DAA3	15,795	-	15,795	15,379	(416)	15,379	15,469
41161PWB5	723,595	-	723,595	713,315	(10,280)	713,315	587,280
45660N5H4	1,202,840	-	1,202,840	1,156,288	(46,552)	1,156,288	1,159,986
45660NT88	14,960	-	14,960	14,830	(130)	14,830	14,372
92922F5T1	1,438,953	-	1,438,953	1,412,027	(26,926)	1,412,027	1,244,390
939336X65	1,599,517	-	1,599,517	1,419,593	(179,924)	1,419,593	1,427,509
05949CCB0	34,367	-	34,367	34,278	(89)	34,278	35,010
32051DCJ9	44,524	-	44,524	44,461	(63)	44,461	43,405
36228FWU6	150,442	-	150,442	141,049	(9,393)	141,049	147,677
362341VU0	1,530,315	-	1,530,315	1,520,759	(9,556)	1,520,759	1,428,432
36298XAA0	4,788,213	-	4,788,213	4,743,999	(44,214)	4,743,999	4,501,267
5899292N7	48,660	-	48,660	47,935	(725)	47,935	46,874
589929N38	42,499	-	42,499	40,236	(2,263)	40,236	39,978
59020UNZ4	89,539	-	89,539	75,877	(13,662)	75,877	85,656
86359DME4	439,975	-	439,975	415,180	(24,795)	415,180	400,433
929227ZF6	6,804	-	6,804	883	(5,921)	883	3,055
Totals	\$ 56,797,193	\$ -	\$ 56,797,193	\$ 45,999,577	\$ (10,797,616)	\$ 45,999,577	\$ 39,477,567

The following is the impairment listing for loan-backed and structured securities for the three months ended December 31, 2022:

CUSIP	Amortized Cost before Cumulative Adjustment	Cumulative Adjustment	Amortized Cost before OTTI	Projected Cash Flow	Recognized OTTI	Amortized Cost after OTTI	Fair Value
12624QAC7	\$ 3,800,115	\$ -	\$ 3,800,115	\$ 3,420,115	\$ (380,000)	\$ 3,420,115	\$ 1,588,875
12624SAE9	2,716,498	-	2,716,498	2,435,538	(280,960)	2,435,538	835,883
36192RAL6	2,950,670	-	2,950,670	1,475,670	(1,475,000)	1,475,670	1,096,111
00442FAB8	54,320	-	54,320	42,042	(12,278)	42,042	9,321
02660CAH3	30,449	-	30,449	27,509	(2,940)	27,509	621

**MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued**

040104RV5	1,538,602	-	1,538,602	1,447,321	(91,281)	1,447,321	1,361,477
040104TF8	46,015	-	46,015	44,165	(1,850)	44,165	34,412
04012XAC9	140,344	-	140,344	134,035	(6,309)	134,035	114,094
04544TAB7	29,637	-	29,637	8,031	(21,606)	8,031	27,105
12479DAC2	1,754,671	-	1,754,671	1,705,748	(48,923)	1,705,748	1,321,385
1248MGAJ3	45,771	-	45,771	43,936	(1,835)	43,936	36,622
17311YAC7	1,339,319	-	1,339,319	1,249,956	(89,363)	1,249,956	1,251,680
30247DAD3	615,686	-	615,686	576,172	(39,514)	576,172	523,602
35729RAE6	3,769,442	-	3,769,442	3,620,540	(148,902)	3,620,540	3,166,561
40431KAE0	2,102,171	-	2,102,171	2,066,603	(35,567)	2,066,603	2,080,134
46630KAA4	163,709	-	163,709	160,394	(3,316)	160,394	150,262
57643LMP8	699,246	-	699,246	655,527	(43,720)	655,527	703,992
590212AB2	36,752	-	36,752	32,892	(3,860)	32,892	35,553
61749BAB9	25,730	-	25,730	18,784	(6,946)	18,784	19,869
61750FAE0	427,971	-	427,971	409,815	(18,156)	409,815	364,414
61750MAB1	3,966	-	3,966	3,252	(714)	3,252	3,061
84752CAE7	780,353	-	780,353	534,007	(246,346)	534,007	735,662
86359DXD4	207,910	-	207,910	194,222	(13,688)	194,222	192,670
86363HAB8	38,745	-	38,745	36,881	(1,864)	36,881	32,197
05535DAN4	815,322	-	815,322	781,142	(34,180)	781,142	668,809
12667GKG7	48,651	-	48,651	47,599	(1,052)	47,599	49,753
17025RAA3	274,474	-	274,474	222,741	(51,733)	222,741	264,605
22943HAD8	3,639,676	-	3,639,676	3,553,679	(85,998)	3,553,679	1,966,703
251563FB3	21,743	-	21,743	18,668	(3,075)	18,668	21,315
32053LAA0	20,430	-	20,430	19,665	(765)	19,665	19,195
362290AC2	165,551	-	165,551	119,985	(45,566)	119,985	163,292
43739EAP2	1,491,643	-	1,491,643	1,378,947	(112,696)	1,378,947	1,338,336
45254TRX4	27,269	-	27,269	24,861	(2,408)	24,861	24,629
45660LYW3	807,355	-	807,355	801,731	(5,623)	801,731	740,968
466247XE8	648,455	-	648,455	636,766	(11,689)	636,766	552,507
589929X29	476,677	-	476,677	442,351	(34,326)	442,351	455,505
59020UW43	96,706	-	96,706	67,631	(29,075)	67,631	81,213
61915RBZ8	182,035	-	182,035	180,158	(1,878)	180,158	165,479
65535VRK6	496,060	-	496,060	477,703	(18,357)	477,703	503,077
86358HHX0	185,982	-	185,982	180,224	(5,758)	180,224	138,376
86359BLQ2	912,392	-	912,392	860,886	(51,506)	860,886	788,258
92978EAA2	87,160	-	87,160	83,990	(3,170)	83,990	80,341
41161PHU0	1,288,335	-	1,288,335	1,111,121	(177,215)	1,111,121	1,242,875
41161PTP8	79,162	-	79,162	70,296	(8,866)	70,296	69,500
41161PWB5	748,794	-	748,794	743,267	(5,528)	743,267	642,772
45660N5H4	1,326,680	-	1,326,680	1,291,747	(34,933)	1,291,747	1,293,674
05949CCB0	37,242	-	37,242	34,365	(2,878)	34,365	35,868
36298XAA0	4,996,628	-	4,996,628	4,820,011	(176,617)	4,820,011	4,541,703
36298XAB8	4,960,140	-	4,960,140	4,317,655	(642,484)	4,317,655	4,428,229
Totals	\$ 47,152,655	\$ -	\$ 47,152,655	\$ 42,630,344	\$ (4,522,311)	\$ 42,630,344	\$ 35,962,545

The following is the impairment listing for loan-backed and structured securities for the three months ended September 30, 2022:

CUSIP	Amortized Cost before Cumulative Adjustment	Cumulative Adjustment	Amortized Cost before OTTI	Projected Cash Flow	Recognized OTTI	Amortized Cost after OTTI	Fair Value
01853GAB6	\$ 14,137	\$ -	\$ 14,137	\$ 14,133	\$ (4)	\$ 14,133	\$ 81,535
02660CAH3	30,416	-	30,416	30,133	(283)	30,133	520
040104RV5	1,615,798	-	1,615,798	1,524,246	(91,552)	1,524,246	1,400,628
040104TF8	51,554	-	51,554	45,567	(5,987)	45,567	35,698
040104TG6	548,457	-	548,457	448,751	(99,706)	448,751	462,045
04012XAC9	158,236	-	158,236	138,996	(19,240)	138,996	114,648
1248MGAJ3	48,376	-	48,376	46,059	(2,317)	46,059	37,828
14454AAB5	676,443	-	676,443	675,900	(543)	675,900	797,469

35729RAE6	4,081,381	-	4,081,381	3,766,230	(315,151)	3,766,230	3,254,010
40431KAE0	2,165,192	-	2,165,192	2,079,404	(85,788)	2,079,404	2,080,910

**MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued**

46629NAC7	37,064	-	37,064	34,532	(2,532)	34,532	28,639
46630KAA4	168,908	-	168,908	166,176	(2,733)	166,176	156,211
57643LMP8	794,964	-	794,964	695,958	(99,006)	695,958	707,626
617463AA2	9,759	-	9,759	8,712	(1,047)	8,712	6,788
61750FAE0	472,290	-	472,290	426,190	(46,100)	426,190	370,275
617526AE8	213,790	-	213,790	183,317	(30,473)	183,317	205,107
86359DXD4	258,372	-	258,372	209,421	(48,950)	209,421	209,160
86363HAB8	42,386	-	42,386	39,363	(3,023)	39,363	33,395
93934XAB9	173,541	-	173,541	135,596	(37,945)	135,596	152,650
05535DAN4	846,722	-	846,722	844,091	(2,632)	844,091	719,154
12667GKG7	53,610	-	53,610	50,015	(3,595)	50,015	52,574
12668ACY9	196,165	-	196,165	158,127	(38,037)	158,127	199,829
18974BAA7	139,604	-	139,604	135,673	(3,931)	135,673	142,094
22540VG71	39,290	-	39,290	38,205	(1,085)	38,205	39,865
22943HAD8	3,726,422	-	3,726,422	3,648,804	(77,618)	3,648,804	1,947,539
45254TSM7	666,066	-	666,066	648,569	(17,497)	648,569	557,450
466247XE8	670,770	-	670,770	665,673	(5,097)	665,673	576,833
525221AJ6	554,561	-	554,561	553,790	(771)	553,790	552,476
59020UW43	99,571	-	99,571	98,502	(1,069)	98,502	80,640
65535VRK6	537,959	-	537,959	492,267	(45,692)	492,267	506,957
75116CET9	52,218	-	52,218	37,480	(14,738)	37,480	51,726
92926UAC5	57,744	-	57,744	45,834	(11,910)	45,834	55,826
92978EAA2	93,378	-	93,378	87,280	(6,098)	87,280	83,812
23332UCM4	26,121	-	26,121	24,163	(1,958)	24,163	25,263
41161PTP8	76,675	-	76,675	72,259	(4,416)	72,259	68,493
41161PWB5	796,629	-	796,629	761,585	(35,044)	761,585	655,513
45660N5H4	1,475,897	-	1,475,897	1,375,793	(100,104)	1,375,793	1,309,005
362341VU0	1,644,583	-	1,644,583	1,609,277	(35,306)	1,609,277	1,524,505
Totals	\$ 23,315,048	\$ -	\$ 23,315,048	\$ 22,016,070	\$ (1,298,978)	\$ 22,016,070	\$ 19,284,696

The following is the impairment listing for loan-backed and structured securities for the three months ended June 30, 2022:

CUSIP	Amortized Cost before Cumulative Adjustment	Cumulative Adjustment	Amortized Cost before OTTI	Projected Cash Flow	Recognized OTTI	Amortized Cost after OTTI	Fair Value
01853GAB6	\$ 66,515	\$ -	\$ 66,515	\$ 11,444	\$ (55,072)	\$ 11,444	\$ 88,216
040104RV5	1,784,407	-	1,784,407	1,603,660	(180,747)	1,603,660	1,520,334
040104TF8	38,441	-	38,441	35,870	(2,572)	35,870	27,369
04012XAC9	110,303	-	110,303	106,039	(4,264)	106,039	85,613
1248MGAJ3	33,572	-	33,572	31,812	(1,760)	31,812	27,009
14454AAB5	881,442	-	881,442	677,715	(203,728)	677,715	840,850
35729RAE6	4,202,719	-	4,202,719	4,089,490	(113,229)	4,089,490	3,504,758
45071KDD3	273,858	-	273,858	258,285	(15,573)	258,285	253,045
61749BAB9	51,130	-	51,130	41,427	(9,703)	41,427	50,025
86359DXD4	272,114	-	272,114	262,835	(9,280)	262,835	230,996
86363HAB8	33,458	-	33,458	28,887	(4,571)	28,887	26,054
05535DAN4	1,158,770	-	1,158,770	873,964	(284,806)	873,964	779,790
07387AFX8	65,702	-	65,702	54,499	(11,203)	54,499	65,889
12668ABP9	177,942	-	177,942	145,191	(32,751)	145,191	170,379
18974BAA7	163,686	-	163,686	159,493	(4,193)	159,493	158,996
18974BAN9	77,869	-	77,869	70,973	(6,896)	70,973	75,478
22943HAD8	4,013,588	-	4,013,588	3,751,800	(261,788)	3,751,800	2,037,389
45254TRX4	45,557	-	45,557	40,333	(5,224)	40,333	42,158
525221AJ6	718,882	-	718,882	583,189	(135,692)	583,189	606,787
59020UW43	106,578	-	106,578	102,698	(3,880)	102,698	124,978
761118FMS	1,217,616	-	1,217,616	1,142,589	(75,026)	1,142,589	1,144,285
85554NAG5	94,558	-	94,558	80,862	(13,696)	80,862	90,860
92978EAA2	67,304	-	67,304	65,210	(2,094)	65,210	61,610
45660N5H4	1,537,499	-	1,537,499	1,502,180	(35,320)	1,502,180	1,379,463

12669GXW6	44,815	-	44,815	41,990	(2,826)	41,990	77,371
589929N38	68,312	-	68,312	63,956	(4,356)	63,956	65,216
Totals	\$ 17,306,639	\$ -	\$ 17,306,639	\$ 15,826,391	\$ (1,480,248)	\$ 15,826,391	\$ 13,534,918

**MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued**

The following is the impairment listing for loan-backed and structured securities for the three months ended March 31, 2022:

CUSIP	Amortized Cost before Cumulative Adjustment	Cumulative Adjustment	Amortized Cost before OTTI	Projected Cash Flow	Recognized OTTI	Amortized Cost after OTTI	Fair Value
00256DAA0	\$ 1,762,699	\$ -	\$ 1,762,699	\$ 1,364,210	\$ (398,489)	\$ 1,364,210	\$ 1,122,333
07388VAH1	2,364,730	-	2,364,730	244,594	(2,120,137)	244,594	244,594
22545XBB8	1,683,921	-	1,683,921	211,871	(1,472,050)	211,871	210,934
00442FAB8	70,075	-	70,075	52,264	(17,811)	52,264	10,685
040104TF8	59,249	-	59,249	53,852	(5,397)	53,852	41,892
040104TG6	623,388	-	623,388	531,410	(91,978)	531,410	545,952
04012XAC9	178,777	-	178,777	162,199	(16,578)	162,199	136,446
1248MGAJ3	52,182	-	52,182	51,033	(1,149)	51,033	45,331
17311YAC7	1,623,994	-	1,623,994	1,327,822	(296,172)	1,327,822	1,502,602
24763LFY1	134,155	-	134,155	67,703	(66,452)	67,703	106,050
35729RAE6	4,416,912	-	4,416,912	4,231,274	(185,638)	4,231,274	3,947,591
40431KAE0	2,521,316	-	2,521,316	2,214,702	(306,614)	2,214,702	2,513,960
45071KDD3	488,363	-	488,363	436,903	(51,460)	436,903	448,752
55291KAC1	633,248	-	633,248	169,402	(463,846)	169,402	598,172
57643LMP8	906,102	-	906,102	809,314	(96,788)	809,314	815,499
617463AA2	10,553	-	10,553	9,894	(659)	9,894	8,101
61750FAE0	509,354	-	509,354	473,873	(35,481)	473,873	435,242
617526AE8	262,688	-	262,688	214,229	(48,459)	214,229	243,939
86359DXD4	304,264	-	304,264	279,462	(24,802)	279,462	275,224
07384YPP5	314,885	-	314,885	207,555	(107,330)	207,555	66,352
32053LAA0	27,875	-	27,875	22,820	(5,055)	22,820	25,221
45660LAU3	78,731	-	78,731	75,334	(3,397)	75,334	76,824
59020UW43	176,900	-	176,900	108,489	(68,411)	108,489	132,229
65535VRK6	592,663	-	592,663	536,987	(55,676)	536,987	561,983
761118FM5	1,932,729	-	1,932,729	1,911,872	(20,857)	1,911,872	1,863,619
76112HAE7	13,536	-	13,536	10,283	(3,253)	10,283	13,495
92978EAA2	102,806	-	102,806	97,782	(5,024)	97,782	94,757
93935PAH2	137,585	-	137,585	115,483	(22,102)	115,483	131,766
41161PWB5	884,324	-	884,324	852,993	(31,331)	852,993	771,130
45660N5H4	1,600,750	-	1,600,750	1,533,921	(66,829)	1,533,921	1,444,261
36298XAB8	5,320,204	-	5,320,204	5,307,865	(12,338)	5,307,865	5,034,048
55274SAM3	177,495	-	177,495	25,133	(152,362)	25,133	29,827
59024WAB3	137,567	-	137,567	119,223	(18,344)	119,223	142,528
94984GAD9	31,976	-	31,976	26,026	(5,950)	26,026	33,031
Totals	\$ 30,135,997	\$ -	\$ 30,135,997	\$ 23,857,778	\$ (6,278,218)	\$ 23,857,778	\$ 23,674,371

The following is the impairment listing for loan-backed and structured securities for the three months ended December 31, 2021:

CUSIP	Amortized Cost before Cumulative Adjustment	Cumulative Adjustment	Amortized Cost before OTTI	Projected Cash Flow	Recognized OTTI	Amortized Cost after OTTI	Fair Value
040104TF8	\$ 59,686	\$ -	\$ 59,686	\$ 59,300	\$ (386)	\$ 59,300	\$ 49,870
04012XAC9	130,314	-	130,314	122,160	(8,154)	122,160	107,581
1248MGAJ3	35,096	-	35,096	34,855	(241)	34,855	31,996
35729RAE6	4,028,108	-	4,028,108	3,999,290	(28,818)	3,999,290	3,995,059
617463AA2	6,685	-	6,685	5,767	(918)	5,767	5,247
61749BAB9	61,698	-	61,698	51,363	(10,335)	51,363	60,638
61750FAE0	342,930	-	342,930	319,304	(23,626)	319,304	307,808
61750MAB1	3,456	-	3,456	3,113	(343)	3,113	3,182
86359DXD4	335,476	-	335,476	308,315	(27,161)	308,315	309,361
92926SAB2	558	-	558	494	(64)	494	521
45660LYW3	677,413	-	677,413	675,162	(2,251)	675,162	630,760
79548KXQ6	51,835	-	51,835	37,121	(14,714)	37,121	65,254

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

92978EAA2	75,569	-	75,569	72,635	(2,934)	72,635	72,325
41161PWB5	822,378	-	822,378	776,768	(45,610)	776,768	706,114
55274SAM3	27,413	-	27,413	24,861	(2,552)	24,861	23,482
Totals	\$ 6,658,614	\$ -	\$ 6,658,615	\$ 6,490,508	\$ (168,107)	\$ 6,490,508	\$ 6,369,198

The following is the impairment listing for loan-backed and structured securities for the three months ended December 31, 2021:

CUSIP	Amortized Cost before Cumulative Adjustment	Cumulative Adjustment	Amortized Cost before OTTI	Projected Cash Flow	Recognized OTTI	Amortized Cost after OTTI	Fair Value
040104TF8	\$ 59,686	\$ -	\$ 59,686	\$ 59,300	\$ (386)	\$ 59,300	\$ 49,870
04012XAC9	130,314	-	130,314	122,160	(8,154)	122,160	107,581
1248MGAJ3	35,096	-	35,096	34,855	(241)	34,855	31,996
35729RAE6	4,028,108	-	4,028,108	3,999,290	(28,818)	3,999,290	3,995,059
617463AA2	6,685	-	6,685	5,767	(918)	5,767	5,247
61749BAB9	61,698	-	61,698	51,363	(10,335)	51,363	60,638
61750FAE0	342,930	-	342,930	319,304	(23,626)	319,304	307,808
61750MAB1	3,456	-	3,456	3,113	(343)	3,113	3,182
86359DXD4	335,476	-	335,476	308,315	(27,161)	308,315	309,361
92926SAB2	558	-	558	494	(64)	494	521
45660LYW3	677,413	-	677,413	675,162	(2,251)	675,162	630,760
79548KXQ6	51,835	-	51,835	37,121	(14,714)	37,121	65,254
92978EAA2	75,569	-	75,569	72,635	(2,934)	72,635	72,325
41161PWB5	822,378	-	822,378	776,768	(45,610)	776,768	706,114
55274SAM3	27,413	-	27,413	24,861	(2,552)	24,861	23,482
Totals	\$ 6,658,614	\$ -	\$ 6,658,615	\$ 6,490,508	\$ (168,107)	\$ 6,490,508	\$ 6,369,198

The following is the impairment listing for loan-backed and structured securities for the three months ended September 30, 2021:

CUSIP	Amortized Cost before Cumulative Adjustment	Cumulative Adjustment	Amortized Cost before OTTI	Projected Cash Flow	Recognized OTTI	Amortized Cost after OTTI	Fair Value
00442FAB8	\$ 95,903	\$ -	\$ 95,903	\$ 70,276	\$ (25,627)	\$ 70,276	\$ 60,821
86359DXD4	359,657	-	359,657	339,761	(19,896)	339,761	337,895
05535DAN4	1,260,315	-	1,260,315	1,255,426	(4,889)	1,255,426	1,020,099
073879QF8	247,750	-	247,750	226,078	(21,672)	226,078	256,430
45660LYW3	907,047	-	907,047	906,647	(400)	906,647	879,977
92978EAA2	110,354	-	110,354	108,384	(1,970)	108,384	106,564
41161PWB5	1,049,397	-	1,049,397	1,023,087	(26,310)	1,023,087	908,082
55274SAM3	30,959	-	30,959	26,064	(4,895)	26,064	25,345
Totals	\$ 4,061,382	\$ -	\$ 4,061,382	\$ 3,955,723	\$ (105,659)	\$ 3,955,723	\$ 3,595,213

The following is the impairment listing for loan-backed and structured securities for the three months ended June 30, 2021:

CUSIP	Amortized Cost before Cumulative Adjustment	Cumulative Adjustment	Amortized Cost before OTTI	Projected Cash Flow	Recognized OTTI	Amortized Cost after OTTI	Fair Value
040104TG6	\$ 751,483	\$ -	\$ 751,483	\$ 596,747	\$ (154,736)	\$ 596,747	\$ 700,223
05535DCF9	2,412,525	-	2,412,525	2,168,139	(244,386)	2,168,139	2,608,461
40431KAE0	2,389,667	-	2,389,667	2,348,253	(41,414)	2,348,253	2,745,165
61750FAE0	555,370	-	555,370	534,914	(20,456)	534,914	493,887
86359DXD4	394,726	-	394,726	364,962	(29,764)	364,962	369,964
05535DAN4	1,386,766	-	1,386,766	1,038,889	(347,877)	1,038,889	1,141,961
45660LYW3	959,375	-	959,375	942,757	(16,618)	942,757	927,049
79548KXQ6	121,590	-	121,590	96,976	(24,616)	96,976	97,070
92978EAA2	115,502	-	115,502	112,103	(3,399)	112,103	110,484
41161PWB5	1,112,829	-	1,112,829	1,079,359	(33,470)	1,079,359	969,681
576433H33	1,119,491	-	1,119,491	1,071,784	(47,707)	1,071,784	1,074,403
55274SAM3	33,318	-	33,318	31,698	(1,620)	31,698	85,553
Totals	\$ 11,352,643	\$ -	\$ 11,352,642	\$ 10,386,581	\$ (966,063)	\$ 10,386,581	\$ 11,323,900

**MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued**

The following is the impairment listing for loan-backed and structured securities for the three months ended March 31, 2021:

CUSIP	Amortized Cost before Cumulative Adjustment	Cumulative Adjustment	Amortized Cost before OTTI	Projected Cash Flow	Recognized OTTI	Amortized Cost after OTTI	Fair Value
36828QQJ8	\$ 5,796,000	\$ -	\$ 5,796,000	\$ -	\$ (5,796,000)	\$ -	\$ -
05535DCF9	2,560,946	-	2,560,946	2,505,561	(55,385)	2,505,561	2,647,762
61750FAE0	582,728	-	582,728	558,079	(24,649)	558,079	500,569
18974BAA7	203,962	-	203,962	193,231	(10,731)	193,231	197,038
22540V3F7	124,724	-	124,724	11,082	(113,642)	11,082	3,496
92978EAA2	123,118	-	123,118	119,363	(3,755)	119,363	115,107
41161PWB5	1,183,481	-	1,183,481	1,153,338	(30,143)	1,153,338	1,017,022
12669GXW6	153,925	-	153,925	20,286	(133,639)	20,286	173,435
55274SAM3	38,192	-	38,192	33,418	(4,774)	33,418	84,650
86359DME4	480,180	-	480,180	480,135	(45)	480,135	498,095
Totals	\$ 11,247,256	\$ -	\$ 11,247,257	\$ 5,074,493	\$ (6,172,764)	\$ 5,074,493	\$ 5,237,174

The following is the impairment listing for loan-backed and structured securities for the three months ended December 31, 2020:

CUSIP	Amortized Cost before Cumulative Adjustment	Cumulative Adjustment	Amortized Cost before OTTI	Projected Cash Flow	Recognized OTTI	Amortized Cost after OTTI	Fair Value
01853GAB6	\$ 166,318	\$ -	\$ 166,318	\$ 58,609	\$ (107,709)	\$ 58,609	\$ 136,619
05535DCF9	2,639,139	-	2,639,139	2,595,116	(44,023)	2,595,116	2,812,127
61750FAE0	594,740	-	594,740	584,887	(9,853)	584,887	530,736
61750MAB1	4,675	-	4,675	4,502	(173)	4,502	4,545
92926SAB2	585	-	585	567	(18)	567	562
124860CB1	21,523	-	21,523	14,872	(6,651)	14,872	17,887
18974BAA7	205,451	-	205,451	204,843	(608)	204,843	186,946
18974BAN9	101,669	-	101,669	101,513	(156)	101,513	98,300
2254W0NK7	89,902	-	89,902	23,726	(66,176)	23,726	94,611
45660LYW3	1,074,456	-	1,074,456	1,035,449	(39,007)	1,035,449	1,020,046
65535VRK6	681,735	-	681,735	601,631	(80,104)	601,631	653,481
79548KXQ6	99,323	-	99,323	98,725	(598)	98,725	92,899
92978EAA2	130,042	-	130,042	125,448	(4,594)	125,448	119,223
23332UBW3	26,310	-	26,310	21,116	(5,193)	21,116	30,347
576433H33	1,207,614	-	1,207,614	1,145,808	(61,806)	1,145,808	1,116,853
125435AA5	1,635,577	-	1,635,577	1,543,519	(92,058)	1,543,519	1,596,490
36298XAA0	6,639,520	-	6,639,520	5,802,921	(836,599)	5,802,921	6,153,831
55274SAM3	61,225	-	61,225	42,760	(18,465)	42,760	93,792
86359DME4	673,784	-	673,784	662,791	(10,993)	662,791	698,159
929227ZF6	18,319	-	18,319	5,496	(12,823)	5,496	16,063
Totals	\$ 16,071,907	\$ -	\$ 16,071,907	\$ 14,674,300	\$ (1,397,607)	\$ 14,674,300	\$ 15,473,517

The following is the impairment listing for loan-backed and structured securities for the three months ended September 30, 2020:

CUSIP	Amortized Cost before Cumulative Adjustment	Cumulative Adjustment	Amortized Cost before OTTI	Projected Cash Flow	Recognized OTTI	Amortized Cost after OTTI	Fair Value
US05618HAE53	\$ 555,162	\$ -	\$ 555,162	\$ 387,040	\$ (168,122)	\$ 387,040	\$ 162,575
00442FAB8	144,957	-	144,957	79,275	(65,682)	79,275	112,060
05535DCF9	2,755,413	-	2,755,413	2,649,186	(106,228)	2,649,186	2,553,142
46630KAA4	191,718	-	191,718	184,342	(7,376)	184,342	179,699
61749BAB9	105,432	-	105,432	91,620	(13,812)	91,620	88,204
61750MAB1	4,837	-	4,837	4,672	(165)	4,672	3,421
92926SAB2	604	-	604	588	(16)	588	438

**MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued**

07384YPP5	12,990	-	12,990	9,466	(3,524)	9,466	35,174
073879QF8	45,111	-	45,111	43,889	(1,222)	43,889	39,772
17307GRU4	104,250	-	104,250	55,590	(48,659)	55,590	91,680
18974BAA7	215,833	-	215,833	212,231	(3,602)	212,231	183,053
18974BAN9	106,359	-	106,359	104,851	(1,507)	104,851	97,631
9393365V1	399,194	-	399,194	394,263	(4,932)	394,263	364,935
23332UBW3	31,650	-	31,650	29,218	(2,432)	29,218	22,244
12669GWN7	849,557	-	849,557	799,224	(50,333)	799,224	782,638
12669GXW6	244,251	-	244,251	233,647	(10,604)	233,647	223,233
32051DCK6	79,208	-	79,208	61,819	(17,389)	61,819	82,998
36298XAA0	7,738,893	-	7,738,893	7,511,130	(227,763)	7,511,130	7,120,125
36298XAB8	7,666,120	-	7,666,120	6,250,751	(1,415,369)	6,250,751	6,539,292
45660LY94	13,115	-	13,115	6,394	(6,721)	6,394	26,528
74951PBT4	110,729	-	110,729	51,052	(59,676)	51,052	153,185
Totals	\$ 21,375,383	\$ -	\$ 21,375,383	\$ 19,160,250	\$ (2,215,134)	\$ 19,160,250	\$ 18,862,027

The following is the impairment listing for loan-backed and structured securities for the three months ended June 30, 2020:

CUSIP	Amortized Cost before Cumulative Adjustment	Cumulative Adjustment	Amortized Cost before OTTI	Projected Cash Flow	Recognized OTTI	Amortized Cost after OTTI	Fair Value
17307GRU4	\$ 107,326	\$ -	\$ 107,326	\$ 77,392	\$ (29,934)	\$ 77,392	\$ 160,449
18974BAA7	245,427	-	245,427	235,230	(10,197)	235,230	201,416
18974BAN9	119,509	-	119,509	114,571	(4,938)	114,571	107,924
362290AC2	220,776	-	220,776	219,541	(1,235)	219,541	307,360
79548KXQ6	172,175	-	172,175	170,007	(2,168)	170,007	130,248
855541AC2	508,940	-	508,940	384,558	(124,383)	384,558	460,800
9393365V1	433,313	-	433,313	415,261	(18,053)	415,261	356,247
45660LY94	28,987	-	28,987	13,258	(15,729)	13,258	21,174
57643QAE5	2,203,118	-	2,203,118	1,819,560	(383,558)	1,819,560	2,367,000
74951PBT4	260,811	-	260,811	143,231	(117,579)	143,231	157,616
86359DMC8	5,799,490	-	5,799,490	5,333,524	(465,966)	5,333,524	4,907,737
92990GAE3	80,251	-	80,251	66,477	(13,773)	66,477	71,880
Totals	\$ 10,180,123	\$ -	\$ 10,180,123	\$ 8,992,610	\$ (1,187,513)	\$ 8,992,610	\$ 9,249,851

The following is the impairment listing for loan-backed and structured securities for the three months ended March 31, 2020:

CUSIP	Amortized Cost before Cumulative Adjustment	Cumulative Adjustment	Amortized Cost before OTTI	Projected Cash Flow	Recognized OTTI	Amortized Cost after OTTI	Fair Value
05535DCF9	\$ 3,012,907	\$ -	\$ 3,012,907	\$ 2,862,429	\$ (150,478)	\$ 2,862,429	\$ 2,528,432
24763LFY1	147,758	-	147,758	146,827	(931)	146,827	180,454
45071KDD3	575,329	-	575,329	510,787	(64,542)	510,787	491,576
07384YPP5	33,493	-	33,493	28,061	(5,431)	28,061	46,723
12667GKG7	93,290	-	93,290	83,622	(9,668)	83,622	98,905
17307GRU4	114,325	-	114,325	112,699	(1,625)	112,699	157,144
362290AC2	316,883	-	316,883	225,907	(90,976)	225,907	322,987
59020UW43	214,183	-	214,183	182,719	(31,463)	182,719	200,181
65535VRK6	716,497	-	716,497	699,498	(16,998)	699,498	646,333
75115DAH8	6,842	-	6,842	6,564	(279)	6,564	6,397
76112BUE8	181,578	-	181,578	148,845	(32,733)	148,845	129,998
79548KXQ6	187,063	-	187,063	182,973	(4,090)	182,973	137,728
92926UAC5	136,220	-	136,220	130,734	(5,486)	130,734	130,957
23332UBW3	46,195	-	46,195	32,143	(14,052)	32,143	24,852
12669GWN7	889,281	-	889,281	871,126	(18,155)	871,126	863,235
32051DCK6	88,205	-	88,205	86,848	(1,358)	86,848	89,678
362334CN2	14,634	-	14,634	11,177	(3,457)	11,177	13,996
466247K93	7,584	-	7,584	6,335	(1,249)	6,335	7,318
57645LAA2	18,017,521	-	18,017,521	13,868,050	(4,149,471)	13,868,050	18,607,055
Totals	\$ 24,799,788	\$ -	\$ 24,799,788	\$ 20,197,344	\$ (4,602,443)	\$ 20,197,344	\$ 24,683,947

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

The following is the impairment listing for loan-backed and structured securities for the three months ended December 31, 2019:

CUSIP	Amortized Cost before Cumulative Adjustment	Cumulative Adjustment	Amortized Cost before OTTI	Projected Cash Flow	Recognized OTTI	Amortized Cost after OTTI	Fair Value
24763LFY1	\$ 182,113	\$ -	\$ 182,113	\$ 160,832	\$ (21,281)	\$ 160,832	\$ 200,613
05535DAN4	1,930,918	-	1,930,918	1,855,207	(75,711)	1,855,207	1,598,238
07384YPP5	187,700	-	187,700	39,691	(148,009)	39,691	71,760
17307GRU4	164,558	-	164,558	133,524	(31,034)	133,524	229,670
18974BAN9	134,619	-	134,619	125,398	(9,221)	125,398	126,170
65535VRK6	797,949	-	797,949	712,007	(85,942)	712,007	774,700
79548KXQ6	207,254	-	207,254	192,282	(14,972)	192,282	113,588
85554NAG5	194,730	-	194,730	158,214	(36,515)	158,214	187,575
12669FXR9	117,999	-	117,999	114,307	(3,692)	114,307	101,165
23332UBW3	74,561	-	74,561	47,819	(26,742)	47,819	35,659
Totals	\$ 3,992,400	\$ -	\$ 3,992,400	\$ 3,539,281	\$ (453,119)	\$ 3,539,281	\$ 3,439,138

The following is the impairment listing for loan-backed and structured securities for the three months ended September 30, 2019:

CUSIP	Amortized Cost before Cumulative Adjustment	Cumulative Adjustment	Amortized Cost before OTTI	Projected Cash Flow	Recognized OTTI	Amortized Cost after OTTI	Fair Value
12667F2A2	\$ 642,800	\$ -	\$ 642,800	\$ 484,346	\$ (158,455)	\$ 484,346	\$ 68,241
32053LAA0	47,447	-	47,447	40,280	(7,167)	40,280	47,846
761118FM5	2,843,393	-	2,843,393	2,789,133	(54,260)	2,789,133	2,918,992
79548KXQ6	297,379	-	297,379	277,239	(20,140)	277,239	60,979
23332UBW3	78,084	-	78,084	76,934	(1,151)	76,934	43,636
576433H33	1,579,401	-	1,579,401	1,448,247	(131,155)	1,448,247	1,448,863
12669GWN7	1,037,688	-	1,037,688	957,205	(80,484)	957,205	936,853
17309FAE8	161,243	-	161,243	129,536	(31,707)	129,536	159,357
36298XAA0	10,097,887	-	10,097,887	8,887,246	(1,210,641)	8,887,246	8,841,272
92990GAE3	86,314	-	86,314	85,680	(634)	85,680	87,117
US74951PBV94	37,392	-	37,392	16,087	(21,305)	16,087	26,602
Totals	\$ 16,909,029	\$ -	\$ 16,909,029	\$ 15,191,932	\$ (1,717,097)	\$ 15,191,932	\$ 14,639,756

The following is the impairment listing for loan-backed and structured securities for the three months ended June 30, 2019:

CUSIP	Amortized Cost before Cumulative Adjustment	Cumulative Adjustment	Amortized Cost before OTTI	Projected Cash Flow	Recognized OTTI	Amortized Cost after OTTI	Fair Value
61750MAB1	\$ 4,942	\$ -	\$ 4,942	\$ 4,899	\$ (42)	\$ 4,899	\$ 4,344
18974BAN9	143,913	-	143,913	143,911	(2)	143,911	141,999
761118FM5	3,338,972	-	3,338,972	3,276,460	(62,512)	3,276,460	3,468,889
79548KXQ6	335,309	-	335,309	321,864	(13,445)	321,864	218,663
55274SAM3	114,173	-	114,173	79,608	(34,565)	79,608	119,029
57643QAE5	3,042,722	-	3,042,722	2,360,287	(682,436)	2,360,287	3,180,695
Totals	\$ 6,980,030	\$ -	\$ 6,980,030	\$ 6,187,029	\$ (793,001)	\$ 6,187,029	\$ 7,133,620

**MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued**

The following is the impairment listing for loan-backed and structured securities for the three months ended March 31, 2019:

CUSIP	Amortized Cost before Cumulative Adjustment	Cumulative Adjustment	Amortized Cost before OTTI	Projected Cash Flow	Recognized OTTI	Amortized Cost after OTTI	Fair Value
61750MAB1	\$ 5,275	\$ -	\$ 5,275	\$ 4,933	\$ (341)	\$ 4,933	\$ 4,989
65106FAG7	232,843	-	232,843	215,726	(17,118)	215,726	6,316
18974BAA7	285,889	-	285,889	270,801	(15,088)	270,801	278,616
18974BAN9	149,774	-	149,774	139,333	(10,441)	139,333	148,234
22541QQR6	1,569	-	1,569	-	(1,569)	-	1
32051GCF0	22,786	-	22,786	(6,720)	(29,507)	(6,720)	17,553
761118FM5	3,259,303	-	3,259,303	3,218,368	(40,935)	3,218,368	3,244,154
17309FAE8	200,512	-	200,512	200,501	(11)	200,501	208,828
466247UG6	467,713	-	467,713	452,359	(15,354)	452,359	459,812
57643QAE5	3,114,325	-	3,114,325	3,109,376	(4,949)	3,109,376	3,256,107
US74951PBV94	51,011	-	51,011	29,960	(21,051)	29,960	58,411
Totals	\$ 7,791,000	\$ -	\$ 7,791,000	\$ 7,634,637	\$ (156,362)	\$ 7,634,637	\$ 7,683,021

The following is the impairment listing for loan-backed and structured securities for the three months ended December 31, 2018:

CUSIP	Amortized Cost before Cumulative Adjustment	Cumulative Adjustment	Amortized Cost before OTTI	Projected Cash Flow	Recognized OTTI	Amortized Cost after OTTI	Fair Value
65106FAG7	\$ 205,885	\$ -	\$ 205,885	\$ 17,668	\$ (188,218)	\$ 17,668	\$ 21,031
18974BAA7	306,428	-	306,428	295,291	(11,137)	295,291	294,986
22541QQR6	28,742	-	28,742	(9,704)	(38,446)	(9,704)	1
32051GCF0	32,493	-	32,493	20,481	(12,012)	20,481	20,063
17309FAE8	203,743	-	203,743	202,326	(1,417)	202,326	201,875
57643QAE5	3,657,695	-	3,657,695	3,177,611	(480,084)	3,177,611	3,365,017
92990GAE3	115,186	-	115,186	111,886	(3,300)	111,886	111,541
Totals	\$ 4,550,173	\$ -	\$ 4,550,173	\$ 3,815,559	\$ (734,614)	\$ 3,815,559	\$ 4,014,514

The following is the impairment listing for loan-backed and structured securities for the three months ended September 30, 2018:

CUSIP	Amortized Cost before Cumulative Adjustment	Cumulative Adjustment	Amortized Cost before OTTI	Projected Cash Flow	Recognized OTTI	Amortized Cost after OTTI	Fair Value
05535DCF9	\$ 3,454,425	\$ -	\$ 3,454,425	\$ 3,141,048	\$ (313,377)	\$ 3,141,048	\$ 3,134,409
07384YPP5	321,829	-	321,829	148,884	(172,945)	148,884	132,968
07386HCP4	2,164	-	2,164	(6,255)	(8,418)	(6,255)	320
76110H4M8	1,715	-	1,715	(3,719)	(5,434)	(3,719)	641
79548KXQ6	423,086	-	423,086	383,222	(39,864)	383,222	292,015
939336Z48	117,607	-	117,607	-	(117,607)	-	126,945
Totals	\$ 4,320,826	\$ -	\$ 4,320,826	\$ 3,663,181	\$ (657,645)	\$ 3,663,181	\$ 3,687,297

The following is the impairment listing for loan-backed and structured securities for the three months ended June 30, 2018:

CUSIP	Amortized Cost before Cumulative Adjustment	Cumulative Adjustment	Amortized Cost before OTTI	Projected Cash Flow	Recognized OTTI	Amortized Cost after OTTI	Fair Value
59020UW43	\$ 337,732	\$ -	\$ 337,732	\$ 271,686	\$ (66,046)	\$ 271,686	\$ 354,508
76110H4M8	6,848	-	6,848	1,969	(4,879)	1,969	1,713
863579DV7	289,655	-	289,655	5,567	(284,089)	5,567	30,531
Totals	\$ 634,235	\$ -	\$ 634,235	\$ 279,221	\$ (355,014)	\$ 279,221	\$ 386,752

The following is the impairment listing for loan-backed and structured securities for the three months ended March 31, 2018:

CUSIP	Amortized Cost before Cumulative Adjustment	Cumulative Adjustment	Amortized Cost before OTTI	Projected Cash Flow	Recognized OTTI	Amortized Cost after OTTI	Fair Value

07386HEN7	\$ 43,711	\$ -	\$ 43,711	\$ 2,334	\$ (41,377)	\$ 2,334	\$ 1,609
79548KXQ6	520,764	-	520,764	476,293	(44,471)	476,293	365,994
45660NZY4	81,215	-	81,215	9,554	(71,661)	9,554	80,891
Totals	\$ 645,690	\$ -	\$ 645,690	\$ 488,181	\$ (157,509)	\$ 488,181	\$ 448,494

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

The following is the impairment listing for loan-backed and structured securities for the three months ended December 31, 2017:

CUSIP	Amortized Cost before Cumulative Adjustment	Cumulative Adjustment	Amortized Cost before OTTI	Projected Cash Flow	Recognized OTTI	Amortized Cost after OTTI	Fair Value
03927RAA2	\$ 2,886,563	\$ -	\$ 2,886,563	\$ 1,464,907	\$ (1,421,656)	\$ 1,464,907	\$ 1,481,241
03927RAB0	910,639	-	910,639	363,543	(547,096)	363,543	362,176
07386HCP4	7,995	-	7,995	1,386	(6,609)	1,386	2,673
12669GMS7	25,101	-	25,101	21,923	(3,177)	21,923	21,921
22541QQR6	21,202	-	21,202	12,504	(8,698)	12,504	16,106
2254W0NK7	97,695	-	97,695	94,495	(3,200)	94,495	139,833
86359ACG6	318	-	318	-	(318)	-	2
Totals	\$ 3,949,513	\$ -	\$ 3,949,513	\$ 1,958,759	\$ (1,990,754)	\$ 1,958,759	\$ 2,023,952

The following is the impairment listing for loan-backed and structured securities for the three months ended September 30, 2017:

CUSIP	Amortized Cost before Cumulative Adjustment	Cumulative Adjustment	Amortized Cost before OTTI	Projected Cash Flow	Recognized OTTI	Amortized Cost after OTTI	Fair Value
22541NMA4	\$ 42,273	\$ -	\$ 42,273	\$ 41,434	\$ (839)	\$ 41,434	\$ 41,095
22541NMB2	11,869	-	11,869	11,634	(234)	11,634	11,535
22541SSD1	12,232	-	12,232	20	(12,213)	20	5,978
52108MDP5	3,497,947	-	3,497,947	-	(3,497,947)	-	1,925,413
55274SAM3	167,196	-	167,196	153,991	(13,206)	153,991	179,429
76110W4J2	1,131	-	1,131	229	(902)	229	556
88157QAL2	686,945	-	686,945	660,921	(26,024)	660,921	2,125,943
89789KAC9	16,949	-	16,949	8,714	(8,235)	8,714	357,735
Totals	\$ 4,436,542	\$ -	\$ 4,436,542	\$ 876,942	\$ (3,559,600)	\$ 876,942	\$ 4,647,683

The following is the impairment listing for loan-backed and structured securities for the three months ended June 30, 2017:

CUSIP	Amortized Cost before Cumulative Adjustment	Cumulative Adjustment	Amortized Cost before OTTI	Projected Cash Flow	Recognized OTTI	Amortized Cost after OTTI	Fair Value
76110H4M8	\$ 4,413	\$ -	\$ 4,413	\$ 2,326	\$ (2,087)	\$ 2,326	\$ 4,073
86358RLG0	3,485	-	3,485	2,670	(815)	2,670	30,171
86359ACG6	16,324	-	16,324	2	(16,322)	2	2
88157QAL2	774,182	-	774,182	675,599	(98,583)	675,599	1,947,675
89789KAC9	17,294	-	17,294	8,920	(8,374)	8,920	356,047
77277LAF4	22,514,590	-	22,514,590	22,167,493	(347,097)	22,167,493	34,318,674
77277LAH0	1,135,088	-	1,135,088	1,118,159	(16,929)	1,118,159	2,738,435
77277LAJ6	16,073,175	-	16,073,175	15,833,787	(239,388)	15,833,787	21,595,653
Totals	\$ 40,538,551	\$ -	\$ 40,538,551	\$ 39,808,956	\$ (729,595)	\$ 39,808,956	\$ 60,990,732

The following is the impairment listing for loan-backed and structured securities for the three months ended March 31, 2017:

CUSIP	Amortized Cost before Cumulative Adjustment	Cumulative Adjustment	Amortized Cost before OTTI	Projected Cash Flow	Recognized OTTI	Amortized Cost after OTTI	Fair Value
17307GH76	\$ 274,894	\$ -	\$ 274,894	\$ 44,730	\$ (230,163)	\$ 44,730	\$ 152,777
22541QJR4	11,175	-	11,175	54	(11,122)	54	6,866
32051DCK6	182,177	-	182,177	160,728	(21,449)	160,728	179,180
55274SAM3	225,790	-	225,790	209,839	(15,951)	209,839	218,832
86358RA23	1,326,199	-	1,326,199	1,253,636	(72,563)	1,253,636	1,289,099
86359ACG6	6,287	-	6,287	49	(6,239)	49	2

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
NOTES TO STATUTORY FINANCIAL STATEMENTS, continued

US77277LAF40	22,537,014	-	22,537,014	22,514,590	(22,424)	22,514,590	31,699,907
US77277LAH06	1,136,182	-	1,136,182	1,135,088	(1,094)	1,135,088	2,662,526
US77277LAJ61	16,088,661	-	16,088,661	16,073,175	(15,486)	16,073,175	19,947,746
Totals	\$ 41,788,380	\$ -	\$ 41,788,380	\$ 41,391,889	\$ (396,491)	\$ 41,391,889	\$ 56,156,936



KPMG LLP
Two Financial Center
60 South Street
Boston, MA 02111

Report of Independent Registered Public Accounting Firm

The Board of Directors of Massachusetts Mutual Life Insurance Company and Contract Owners of Massachusetts Mutual Variable Annuity Separate Account 1:

Opinion on the Financial Statements

We have audited the accompanying statements of assets and liabilities of the divisions in Appendix A that comprise Massachusetts Mutual Variable Annuity Separate Account 1 (Separate Account), as of December 31, 2023, the related statements of operations and changes in net assets for each of the years in the two-year period then ended, and the related notes, including the financial highlights in Note 8, for each of the years in the five-year period then ended (collectively, the financial statements). In our opinion, the financial statements present fairly, in all material respects, the financial position of each division as of December 31, 2023, the results of their operations and changes in their net assets for each of the years in the two-year period then ended, and the financial highlights for each of the years in the five-year period then ended, in conformity with U.S. generally accepted accounting principles.

Basis for Opinion

These financial statements are the responsibility of the Separate Account's management. Our responsibility is to express an opinion on these financial statements based on our audits. We are a public accounting firm registered with the Public Company Accounting Oversight Board (United States) (PCAOB) and are required to be independent with respect to the Separate Account in accordance with the U.S. federal securities laws and the applicable rules and regulations of the Securities and Exchange Commission and the PCAOB.

We conducted our audits in accordance with the standards of the PCAOB. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement, whether due to error or fraud. Our audits included performing procedures to assess the risks of material misstatement of the financial statements, whether due to error or fraud, and performing procedures that respond to those risks. Such procedures included examining, on a test basis, evidence regarding the amounts and disclosures in the financial statements. Such procedures also included confirmation of securities owned as of December 31, 2023, by correspondence with the underlying mutual funds or their transfer agent. Our audits also included evaluating the accounting principles used and significant estimates made by management, as well as evaluating the overall presentation of the financial statements. We believe that our audits provide a reasonable basis for our opinion.

/s/ KPMG LLP

We have served as the Separate Account's auditor since 2004.

Boston, Massachusetts
March 7, 2024

F-1

KPMG LLP, a Delaware limited liability partnership and a member firm of the KPMG global organization of independent member firms affiliated with KPMG International Limited, a private English company limited by guarantee.

Appendix A

Massachusetts Mutual Variable Annuity Separate Account 1 was comprised of the following divisions as of December 31, 2023.

Divisions

Invesco V.I. Discovery Mid Cap Growth Division

Invesco V.I. Global Division

Invesco V.I. Global Strategic Income Division

MML Blend Division

MML Equity Division

MML Managed Bond Division

MML U.S. Government Money Market Division

LA2055

Massachusetts Mutual Variable Annuity Separate Account 1

STATEMENTS OF ASSETS AND LIABILITIES

December 31, 2023

	Invesco V.I. Discovery Mid Cap Growth Division	Invesco V.I. Global Division	Invesco V.I. Global Strategic Income Division	MML Blend Division	MML Equity Division	MML Managed Bond Division	MML U.S. Government Money Market Division
ASSETS							
Investments							
Number of shares	1,487,587	2,425,014	1,523,603	9,415,366	7,225,242	1,124,944	7,065,092
Identified cost	\$ 108,944,299	\$ 90,142,425	\$ 7,430,213	\$ 196,650,136	\$ 185,210,441	\$ 13,965,491	\$ 7,065,082
Value	\$ 93,435,361	\$ 88,658,522	\$ 6,536,255	\$ 183,163,844	\$ 189,826,136	\$ 12,211,034	\$ 7,065,092
Dividends receivable	-	-	-	-	-	-	1
Receivable from Massachusetts Mutual Life Insurance Company	1,600	2,337	-	-	2,720	-	10,622
Total assets	93,436,961	88,660,859	6,536,255	183,163,844	189,828,856	12,211,034	7,075,715
LIABILITIES							
Payable to Annuitant mortality fluctuation fund reserve	75,535	63,124	3,314	260,161	202,764	10,449	67,835
Payable to Massachusetts Mutual Life Insurance Company	-	-	131	1,593	-	223	-
Total liabilities	75,535	63,124	3,445	261,754	202,764	10,672	67,835
NET ASSETS	\$ 93,361,426	\$ 88,597,735	\$ 6,532,810	\$ 182,902,090	\$ 189,626,092	\$ 12,200,362	\$ 7,007,880
Net Assets:							
Accumulation units - value	\$ 90,843,584	\$ 86,493,607	\$ 6,422,353	\$ 174,904,693	\$ 182,867,302	\$ 11,852,046	\$ 4,746,705
Contracts in payout (annuitization) period	2,517,842	2,104,128	110,457	7,997,397	6,758,790	348,316	2,261,175
Net assets	\$ 93,361,426	\$ 88,597,735	\$ 6,532,810	\$ 182,902,090	\$ 189,626,092	\$ 12,200,362	\$ 7,007,880
Outstanding units							
Contract owners	12,878,101	9,912,700	2,338,064	17,170,263	15,974,003	2,654,381	3,764,325
UNIT VALUE							
Flex Extra (Qualified)	\$ 7.25	\$ 8.94	\$ 2.79	\$ 9.93	\$ 11.30	\$ 4.43	\$ 1.77
Variable Annuity Fund 4	-	-	-	20.45	38.48	10.17	3.32
Flex-Annuity IV (Qualified)	-	-	-	16.62	31.12	7.57	2.49

See Notes to Financial Statements.

Massachusetts Mutual Variable Annuity Separate Account 1

STATEMENTS OF OPERATIONS AND CHANGES IN NET ASSETS
For The Year Ended December 31, 2023

	Invesco V.I. Discovery Mid Cap Growth Division	Invesco V.I. Global Division	Invesco V.I. Global Strategic Income Division	MML Blend Division	MML Equity Division	MML Managed Bond Division	MML U.S. Government Money Market Division
Investment Income							
Dividends	\$ -	\$ 186,837	\$ -	\$ 3,042,965	\$ 3,935,782	\$ 476,526	\$ 315,058
Expenses							
Mortality and expense risk fees and administrative expense charges	1,198,913	1,073,196	84,880	2,312,634	2,414,156	158,282	89,373
Net investment income (loss)	(1,198,913)	(886,359)	(84,880)	730,331	1,521,626	318,244	225,685
Net realized and unrealized gain (loss) on investments							
Realized gain (loss) on sale of fund shares	(507,065)	2,925,439	(258,178)	(5,623,791)	7,474,828	(355,879)	-
Realized gain distribution	-	9,448,282	-	-	14,997,865	-	-
Realized gain (loss)	(507,065)	12,373,721	(258,178)	(5,623,791)	22,472,693	(355,879)	-
Change in net unrealized appreciation/depreciation of investments	11,895,444	11,898,941	817,993	31,772,647	(9,949,703)	680,063	-
Net gain (loss) on investments	11,388,379	24,272,662	559,815	26,148,856	12,522,990	324,184	-
Net increase (decrease) in net assets resulting from operations							
Capital transactions:							
Transfers of net premiums	588,875	575,097	97,085	1,807,214	1,393,189	262,363	146,334
Transfers due to death benefits	(432,245)	(694,887)	(84,381)	(3,081,968)	(1,773,922)	(119,295)	(92,840)
Transfers due to annuity benefit payments	(224,446)	(172,320)	(11,290)	(765,395)	(602,326)	(32,155)	(201,423)
Transfers due to withdrawal of funds	(8,991,222)	(8,107,260)	(540,224)	(18,106,792)	(17,112,699)	(996,554)	(1,263,150)
Transfers due to annual administrative and contingent deferred sales charges	(50,891)	(23,847)	(1,956)	(223,898)	(187,469)	(48,251)	(6,113)
Transfers due to net charge (credit) to annuitant mortality fluctuation reserve	(31,027)	(64,695)	(5,714)	(241,475)	(141,577)	(9,198)	(131,002)
Transfers between divisions and to/from General Account	(1,857,774)	(816,797)	(68,541)	(1,653,150)	(1,306,885)	(351,437)	1,670,618
Net increase (decrease) in net assets resulting from capital transactions	(10,998,730)	(9,304,709)	(615,021)	(22,265,464)	(19,731,689)	(1,294,527)	122,424
Total increase (decrease)	(809,264)	14,081,594	(140,086)	4,613,723	(5,687,073)	(652,099)	348,109
NET ASSETS, at beginning of the year	94,170,690	74,516,141	6,672,896	178,288,367	195,313,165	12,852,461	6,659,771
NET ASSETS, at end of the year	\$ 93,361,426	\$ 88,597,735	\$ 6,532,810	\$ 182,902,090	\$ 189,626,092	\$ 12,200,362	\$ 7,007,880

See Notes to Financial Statements.

Massachusetts Mutual Variable Annuity Separate Account 1

STATEMENTS OF OPERATIONS AND CHANGES IN NET ASSETS

For The Year Ended December 31, 2022

	Invesco V.I. Discovery Mid Cap Growth Division	Invesco V.I. Global Division	Invesco V.I. Global Strategic Income Division	MML Blend Division	MML Equity Division	MML Managed Bond Division	MML U.S. Government Money Market Division
Investment Income							
Dividends	\$ -	\$ -	\$ -	\$ 2,715,852	\$ 3,272,440	\$ 437,464	\$ 84,285
Expenses							
Mortality and expense risk fees and administrative expense charges	1,386,012	1,119,042	93,924	2,580,383	2,628,654	182,501	87,164
Net investment income (loss)	(1,386,012)	(1,119,042)	(93,924)	135,469	643,786	254,963	(2,879)
Net realized and unrealized gain (loss) on investments							
Realized gain (loss) on sale of fund shares	5,990,407	6,562,227	(455,337)	2,115,905	4,025,519	(186,872)	-
Realized gain distribution	28,854,453	14,548,379	-	3,636,697	21,874,672	146,383	-
Realized gain (loss)	34,844,860	21,110,606	(455,337)	5,752,602	25,900,191	(40,489)	-
Change in net unrealized appreciation/depreciation of investments	(80,314,355)	(58,708,943)	(517,378)	(47,333,917)	(40,053,947)	(2,812,712)	-
Net gain (loss) on investments	(45,469,495)	(37,598,337)	(972,715)	(41,581,315)	(14,153,756)	(2,853,201)	-
Net increase (decrease) in net assets resulting from operations	(46,855,507)	(38,717,379)	(1,066,639)	(41,445,846)	(13,509,970)	(2,598,238)	(2,879)
Capital transactions:							
Transfers of net premiums	1,446,187	790,931	129,253	1,250,909	3,193,767	164,402	55,827
Transfers due to death benefits	(539,897)	(387,995)	(35,033)	(4,339,780)	(2,248,302)	(60,905)	(24,753)
Transfers due to annuity benefit payments	(225,964)	(148,446)	(10,363)	(744,129)	(567,035)	(32,646)	(177,303)
Transfers due to withdrawal of funds	(8,556,876)	(7,351,728)	(971,748)	(15,726,806)	(17,565,163)	(1,125,016)	(1,123,071)
Transfers due to annual administrative and contingent deferred sales charges	(53,815)	(25,183)	(2,247)	(244,155)	(201,128)	(52,090)	(6,097)
Transfers due to net charge (credit) to annuitant mortality fluctuation reserve	(110,155)	(158,311)	(1,280)	(176,004)	(153,233)	(27,766)	(49,583)
Transfers between divisions and to/from General Account	(838,304)	(1,139,324)	(19,011)	(1,471,132)	(1,591,616)	25,917	1,362,063
Net increase (decrease) in net assets resulting from capital transactions	(8,878,824)	(8,420,056)	(910,429)	(21,451,097)	(19,132,710)	(1,108,104)	37,083
Total increase (decrease)	(55,734,331)	(47,137,435)	(1,977,068)	(62,896,943)	(32,642,680)	(3,706,342)	34,204
NET ASSETS, at beginning of the year	149,905,021	121,653,576	8,649,964	241,185,310	227,955,845	16,558,803	6,625,567
NET ASSETS, at end of the year	\$ 94,170,690	\$ 74,516,141	\$ 6,672,896	\$ 178,288,367	\$ 195,313,165	\$ 12,852,461	\$ 6,659,771

See Notes to Financial Statements.

Massachusetts Mutual Variable Annuity Separate Account 1

Notes To Financial Statements

1. ORGANIZATION

Massachusetts Mutual Variable Annuity Separate Account 1 (“the Separate Account”) is a separate investment account of Massachusetts Mutual Life Insurance Company (“MassMutual”) established on April 8, 1981. The Separate Account is registered as a unit investment trust under the Investment Company Act of 1940 (“the 1940 Act”).

MassMutual maintains three segments within the Separate Account, Variable Annuity Fund 4, Flex-Annuity IV (Qualified) and Flex Extra (Qualified).

The assets and liabilities of the Separate Account are clearly identified and distinguished from MassMutual’s other assets and liabilities. The Separate Account assets are not chargeable with liabilities arising from any other MassMutual business.

2. INVESTMENT OF THE SEPARATE ACCOUNT’S ASSETS

As of December 31, 2023, the Separate Account consists of seven divisions which invest in the following mutual funds. All of the funds may not be available to all of the three segments of the Separate Account:

Divisions	The division listed in the first column invests in the fund in this column
Invesco V.I. Discovery Mid Cap Growth Division	Invesco V.I. Discovery Mid Cap Growth Fund ¹
Invesco V.I. Global Division	Invesco V.I. Global Fund ¹
Invesco V.I. Global Strategic Income Division	Invesco V.I. Global Strategic Income Fund ¹
MML Blend Division	MML Blend Fund ²
MML Equity Division	MML Equity Fund ²
MML Managed Bond Division	MML Managed Bond Fund ²
MML U.S. Government Money Market Division	MML U.S. Government Money Market Fund ²

In addition to the seven divisions, some contract owners may also allocate funds to the Fixed Interest Account (“FIA”), which is part of MassMutual’s general investment account (“General Account”). Because of exemptive and exclusionary provisions in the securities law, interests in the FIA are not registered under the Securities Act of 1933, and the General Account and the FIA are not registered as an investment company under the 1940 Act.

¹Invesco Advisers, Inc. is the investment adviser to this Fund.

²MML Investment Advisers, LLC is the investment adviser to this Fund.

3. SIGNIFICANT ACCOUNTING POLICIES

The following is a summary of significant accounting policies followed by the Separate Account in preparation of the financial statements in conformity with generally accepted accounting principles. Massachusetts Mutual Variable Annuity Separate Account 1 follows the accounting and reporting guidance in FASB Accounting Standards Codification 946.

A. Investment Valuation

Investments in the underlying funds held by each division are carried at fair value which is based on the closing net asset value of each of the respective underlying funds, which value their investment securities at fair value.

B. Accounting for Investments

Investment transactions are accounted for on a trade-date basis and identified cost is the basis followed in determining the cost of investments sold for financial statement purposes. Dividend income and gains from realized gain distributions are recorded on the ex-distribution date and they are generally reinvested in the underlying investment funds.

C. Federal Income Taxes

MassMutual is taxed under federal law as a life insurance company under the provisions of the 1986 Internal Revenue Code, as amended. Under existing federal law, no taxes are payable on net investment income and net realized capital gains attributable to contracts, which depend on the Separate Account's investment performance. Accordingly, no provision for federal income tax has been made. MassMutual may, however, make such a charge in the future if an unanticipated change of current law results in a company tax liability attributable to the Separate Account.

D. Contract Charges

See Note 8B for charges associated with the contracts.

E. Estimates

The preparation of financial statements in conformity with U.S. generally accepted accounting principles requires management to make estimates and assumptions that affect the reported amounts of assets and liabilities and disclosure of contingent assets and liabilities at the date of the financial statements and the reported amounts of revenues and expenses during the reporting period. Actual results could differ from those estimates.

F. Loans

If the certificate is a tax-sheltered annuity ("TSA"), the contract owners may be able to take a loan under their certificate. All such loans must conform to the requirements of the Internal Revenue Code. There are limitations on the amount of the loan the participants can take, and there is a required loan repayment schedule. When a loan is made, the Separate Account transfers the amount of the loan to MassMutual, thereby decreasing both the investments and net assets of the Separate Account. The contract owner is charged interest on the outstanding loan amount based on the interest rate then in effect.

G. Annuitant Mortality Fluctuation

The Separate Account contributes to an Annuitant Mortality Fluctuation Fund (AMFF) reserve maintained by MassMutual as required by regulatory authorities to provide for mortality losses incurred. The AMFF reserve is adjusted quarterly for mortality losses and gains and its proportionate share of changes in value. Transfers to or from MassMutual are then made quarterly to adjust the AMFF reserve which is held in the Separate Account. Net transfers from the Separate Account to MassMutual totaled \$624,688 and \$676,332 for the years ended December 31, 2023 and 2022, respectively. The AMFF reserve is subject to a maximum of 3% of the Separate Account's annuity reserves. Any mortality losses in excess of this reserve will be borne by MassMutual. The AMFF reserve is not available to owners of the contracts except to the extent necessary to cover mortality losses under the contracts.

H. Annuity Reserves

Annuity reserves are developed by using accepted actuarial methods and are computed using the 83 IAM, 1994 MGDB or Annuity 2000 table, depending on the year of issue.

4. FAIR VALUE OF FINANCIAL INSTRUMENTS

The Separate Account defines fair value as the price that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants at the measurement date. In determining fair value, the Separate Account generally uses the market approach as the valuation technique due to the nature of the mutual fund investments offered in the Separate Account. This technique maximizes the use of observable inputs and minimizes the use of unobservable inputs. Investments in mutual funds are valued at the mutual fund's closing net asset value per share on the day of valuation.

Valuation Inputs: Various inputs are used to determine the value of the Separate Account's investments. These inputs are summarized in the three broad levels listed below:

- **Level 1** – quoted prices in active markets for identical securities
- **Level 2** – observable inputs other than Level 1 quoted prices (including, but not limited to, quoted prices for similar securities, interest rates, prepayment speeds and credit risk)
- **Level 3** – unobservable inputs

The investments of the Separate Account are measured at fair value. All the investments are categorized as Level 1 as of December 31, 2023. There have been no transfers between levels for the year ended December 31, 2023.

5. RELATED PARTY TRANSACTIONS

A. Sales Agreements

Pursuant to separate underwriting agreements with MassMutual, on its own behalf and on behalf of the Separate Account, MML Investors Services, LLC ("MMLIS") serves as principal underwriter of the contracts sold by its registered representatives, and MML Strategic Distributors, LLC ("MSD") serves as principal underwriter of the contracts sold by registered representatives of other broker-dealers who have entered into distribution agreements with MSD.

Both MMLIS and MSD are registered with the Securities and Exchange Commission (the "SEC") as broker-dealers under the Securities Exchange Act of 1934 and are members of the Financial Industry Regulatory Authority ("FINRA"). Commissions for sales of contracts by MMLIS registered representatives are paid on behalf of MMLIS to its registered representatives. Commissions for sales of contracts by registered representatives of other broker-dealers are paid on behalf of MSD to those broker-dealers. MMLIS and MSD also receive compensation for their actions as principal underwriters of the contracts.

The contracts are no longer offered for sale. Contract owners may continue, however, to make purchase payments under existing contracts.

B. Receivable from/Payable to MassMutual

Certain fees such as mortality and expense risk fees are charges paid between the general investment account (the "General Account") and the Separate Account. The General account is not registered as an investment company under the 1940 Act.

Notes To Financial Statements (Continued)

6. PURCHASES AND SALES OF INVESTMENTS

The cost of purchases and proceeds from sales of investments for each of the years in the two-year period ended December 31, 2023 were as follows:

	Invesco V.I. Discovery Mid Cap Growth Division	Invesco V.I. Global Division	Invesco V.I. Global Strategic Income Division	MML Blend Division	MML Equity Division
<u>2023</u>					
Cost of purchases	\$ 93,152	\$ 9,760,972	\$ 89,694	\$ 4,239,307	\$ 19,685,072
Proceeds from sales	(12,280,714)	(10,485,945)	(788,910)	(25,739,104)	(22,875,776)
	MML Managed Bond Division	MML U.S. Government Money Market Division			
<u>2023 (continued)</u>					
Cost of purchases	\$ 699,997	\$ 2,865,353			
Proceeds from sales	(1,675,581)	(2,511,672)			
	Invesco V.I. Discovery Mid Cap Growth Division	Invesco V.I. Global Division	Invesco V.I. Global Strategic Income Division	MML Blend Division	MML Equity Division
<u>2022</u>					
Cost of purchases	\$ 29,951,241	\$ 15,173,592	\$ 216,968	\$ 7,672,692	\$ 26,627,687
Proceeds from sales	(11,384,447)	(10,177,596)	(1,221,536)	(25,414,731)	(23,247,042)
	MML Managed Bond Division	MML U.S. Government Money Market Division			
<u>2022 (continued)</u>					
Cost of purchases	\$ 814,635	\$ 2,048,242			
Proceeds from sales	(1,521,925)	(2,014,970)			

Notes To Financial Statements (Continued)

7. NET INCREASE (DECREASE) IN OUTSTANDING UNITS

The changes in outstanding units for each of the years in the two-year period ended December 31, 2023 were as follows:

	Invesco V.I. Discovery Mid Cap Growth Division	Invesco V.I. Global Division	Invesco V.I. Global Strategic Income Division	MML Blend Division	MML Equity Division
2023					
Units purchased	127,703	110,588	44,834	316,715	230,075
Units withdrawn	(1,476,455)	(1,181,959)	(248,063)	(2,377,257)	(1,903,922)
Units transferred between divisions and to/from General Account	(281,953)	(104,470)	(25,564)	(184,004)	(126,816)
Net increase (decrease)	(1,630,705)	(1,175,841)	(228,793)	(2,244,546)	(1,800,663)
	MML Managed Bond Division	MML U.S. Government Money Market Division			
2023 (continued)					
Units purchased	73,155	527,445			
Units withdrawn	(279,214)	(1,370,324)			
Units transferred between divisions and to/from General Account	(74,990)	960,801			
Net increase (decrease)	(281,049)	117,922			
	Invesco V.I. Discovery Mid Cap Growth Division	Invesco V.I. Global Division	Invesco V.I. Global Strategic Income Division	MML Blend Division	MML Equity Division
2022					
Units purchased	295,513	192,009	56,182	271,889	400,424
Units withdrawn	(1,399,586)	(1,145,096)	(391,366)	(2,278,736)	(1,970,858)
Units transferred between divisions and to/from General Account	(121,627)	(151,436)	(6,007)	(150,356)	(147,047)
Net increase (decrease)	(1,225,700)	(1,104,523)	(341,191)	(2,157,203)	(1,717,481)
	MML Managed Bond Division	MML U.S. Government Money Market Division			
2022 (continued)					
Units purchased	59,188	197,192			
Units withdrawn	(304,748)	(952,035)			
Units transferred between divisions and to/from General Account	7,984	738,937			
Net increase (decrease)	(237,576)	(15,906)			

Notes To Financial Statements (Continued)

8. FINANCIAL HIGHLIGHTS

A. A summary of units outstanding, unit values, net assets, investment income ratios, expense ratios (excluding expenses of the underlying funds) and total return ratios for each of the years in the five-year period ended December 31, 2023 follows:

	At December 31,					For the Years Ended December 31,						
	Units	Unit Value ³ (Lowest to Highest)			Net Assets	Investment Income Ratio ¹	Expense Ratio ² (Lowest to Highest)			Total Return ³ (Lowest to Highest)		
							%	1.30	%	%	11.69	%
Invesco V.I. Discovery Mid Cap Growth Division												
2023	12,878,101	\$	\$	7.25	\$	93,361,426	- %	%	1.30	%	%	11.69 %
2022	14,508,807			6.49		94,170,690	-		1.30			(31.87)
2021	15,734,508			9.53		149,905,021	-		1.30			17.56
2020	17,285,180			8.10		140,079,744	0.04		1.30			38.87
2019	19,414,886			5.84		113,297,678	-		1.30			37.56
Invesco V.I. Global Division												
2023	9,912,700			8.94		88,597,735	0.23		1.30			33.00
2022	11,088,541			6.72		74,516,141	-		1.30			(32.65)
2021	12,193,063			9.98		121,653,576	-		1.30			14.00
2020	13,321,943			8.75		116,595,532	0.70		1.30			25.99
2019	14,820,580			6.95		102,954,417	0.90		1.30			30.09
Invesco V.I. Global Strategic Income Division												
2023	2,338,064			2.79		6,532,810	-		1.30			7.48
2022	2,566,857			2.60		6,672,896	-		1.30			(12.60)
2021	2,908,049			2.97		8,649,964	4.57		1.30			(4.66)
2020	3,190,830			3.12		9,955,074	5.82		1.30			2.07
2019	3,492,081			3.06		10,674,503	3.79		1.30			9.37
MML Blend Division												
2023	17,170,263	9.93	to	20.45		182,902,090	1.69	0.73	1.30	16.10	to	16.76
2022	19,414,809	8.55	to	17.51		178,288,367	1.35	0.73	1.30	(17.67)	to	(17.20)
2021	21,572,012	10.39	to	21.15		241,185,310	2.11	0.73	1.30	13.54	to	14.19
2020	23,854,964	9.15	to	18.52		234,775,939	-	0.73	1.30	11.41	to	12.05
2019	26,441,844	8.21	to	16.53		232,931,445	2.42	0.73	1.30	19.81	to	20.50
MML Equity Division												
2023	15,974,003	11.30	to	38.48		189,626,092	2.11	0.73	1.30	7.92	to	8.53
2022	17,774,666	10.47	to	35.46		195,313,165	1.61	0.73	1.30	(5.87)	to	(5.34)
2021	19,492,149	11.12	to	37.46		227,955,845	1.66	0.73	1.30	28.58	to	29.31
2020	21,487,056	8.65	to	28.97		195,353,360	2.31	0.73	1.30	1.69	to	2.28
2019	23,850,325	8.50	to	28.32		213,018,172	2.03	0.73	1.30	24.30	to	25.01
MML Managed Bond Division												
2023	2,654,381	4.43	to	10.17		12,200,362	3.88	0.73	1.30	5.33	to	5.93
2022	2,935,430	4.21	to	9.60		12,852,461	3.09	0.73	1.30	(16.10)	to	(15.63)
2021	3,173,007	5.01	to	11.38		16,558,803	3.13	0.73	1.30	(0.49)	to	0.08
2020	3,509,103	5.04	to	11.37		18,313,931	0.09	0.73	1.30	6.32	to	6.93
2019	3,827,248	4.74	to	10.64		18,807,923	3.67	0.73	1.30	8.39	to	9.01
MML U.S. Government Money Market Division												
2023	3,764,325	1.77	to	3.32		7,007,880	4.53	0.73	1.30	3.29	to	3.88
2022	3,646,403	1.71	to	3.20		6,659,771	1.24	0.73	1.30	(0.09)	to	0.48
2021	3,662,309	1.72	to	3.18		6,625,567	-	0.73	1.30	(1.29)	to	(0.73)
2020	3,919,070	1.74	to	3.20		7,164,559	0.22	0.73	1.30	(1.06)	to	(0.50)
2019	3,634,786	1.76	to	3.22		6,706,503	1.69	0.73	1.30	0.40	to	0.97

¹ The investment income ratios represent the dividends, excluding distributions of capital gains, received by the division from the underlying mutual fund, divided by the average net assets. These ratios exclude those expenses, such as mortality and expense charges, that are assessed against contract owner accounts either through reductions in the unit values or the redemption of units. The recognition of investment income by the division is affected by the timing of the declaration of dividends by the underlying fund in which the division invests.

Notes To Financial Statements (Continued)

² The expense ratios represent the annualized contract expense of the divisions of the Separate Account, consisting primarily of mortality and expense charges, for each period indicated. The ratios include only those expenses that result in a direct reduction of unit values. Charges made directly to contract owner accounts through the redemption of units and expenses of the underlying fund have been excluded.

³ The total returns are for the periods indicated, including changes in the value of the underlying fund, and the expenses assessed through the reduction of unit values. These ratios do not include any expenses assessed through the redemption of units. As the total return is presented as a range of minimum to maximum values, based on the product grouping representing the minimum and maximum expense ratio amounts, some individual contract total returns and unit values are not within the ranges presented.

B. The Separate Account assesses charges associated with the contract. These charges are either assessed as a direct reduction in unit values, a reduction in the number of units purchased, or through a redemption of units for all contracts contained within the Separate Account.

Mortality and Expense Risk Charge* This charge is assessed through reduction of unit values.	This charge is equal, on an annual basis, to 0.73%-1.25% of the daily value of the assets invested in each fund.
Administrative Expense Charge This charge is assessed through reduction of unit values.	This charge is equal, on an annual basis, to 0.00%-0.15% of the daily value of the assets invested in each fund.
Annual Administrative Charge ** This charge is assessed through the redemption of units.	\$30 - \$35 per contract, annually.
Contingent Deferred Sales Charge This charge is assessed through the redemption of units.	0.00% - 11.00%
Sales and Administrative Charges This charge is assessed through a reduction in the number of units purchased.	8.75% for single purchase payment 9.00% for periodic purchase payments

* Right reserved to increase to 1.2045% for Variable Annuity Fund 4 and right reserved to increase to 1.25% for Flex Extra (Qualified).

** Right reserved to increase to \$50.

9. SUBSEQUENT EVENTS

The Separate Account's management has reviewed events occurring through March 7, 2024, the date the financial statements were issued, and no subsequent events occurred requiring accrual or disclosure.



KPMG LLP
Two Financial Center
60 South Street
Boston, MA 02111

Report of Independent Registered Public Accounting Firm

The Board of Directors of Massachusetts Mutual Life Insurance Company and Contract Owners of Massachusetts Mutual Variable Annuity Separate Account 2:

Opinion on the Financial Statements

We have audited the accompanying statements of assets and liabilities of the divisions listed in Appendix A that comprise Massachusetts Mutual Variable Annuity Separate Account 2 (Separate Account), as of December 31, 2023, the related statements of operations and changes in net assets for each of the years in the two-year period then ended, and the related notes, including the financial highlights in Note 8, for each of the years in the five-year period then ended (collectively, the financial statements). In our opinion, the financial statements present fairly, in all material respects, the financial position of each division as of December 31, 2023, the results of their operations and changes in their net assets for each of the years in the two-year period then ended, and the financial highlights for each of the years in the five-year period then ended, in conformity with U.S. generally accepted accounting principles.

Basis for Opinion

These financial statements are the responsibility of the Separate Account's management. Our responsibility is to express an opinion on these financial statements based on our audits. We are a public accounting firm registered with the Public Company Accounting Oversight Board (United States) (PCAOB) and are required to be independent with respect to the Separate Account in accordance with the U.S. federal securities laws and the applicable rules and regulations of the Securities and Exchange Commission and the PCAOB.

We conducted our audits in accordance with the standards of the PCAOB. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement, whether due to error or fraud. Our audits included performing procedures to assess the risks of material misstatement of the financial statements, whether due to error or fraud, and performing procedures that respond to those risks. Such procedures included examining, on a test basis, evidence regarding the amounts and disclosures in the financial statements. Such procedures also included confirmation of securities owned as of December 31, 2023, by correspondence with the underlying mutual funds or their transfer agent. Our audits also included evaluating the accounting principles used and significant estimates made by management, as well as evaluating the overall presentation of the financial statements. We believe that our audits provide a reasonable basis for our opinion.

/s/ KPMG LLP

We have served as the Separate Account's auditor since 2004.

Boston, Massachusetts
March 7, 2024

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KPMG LLP, a Delaware limited liability partnership and a member firm of the KPMG global organization of independent member firms affiliated with KPMG International Limited, a private English company limited by guarantee.

Appendix A

Massachusetts Mutual Variable Annuity Separate Account 2 was comprised of the following divisions as of December 31, 2023.

Divisions

Invesco V.I. Discovery Mid Cap Growth Division

Invesco V.I. Global Division

Invesco V.I. Global Strategic Income Division

MML Blend Division

MML Equity Division

MML Managed Bond Division

MML U.S. Government Money Market Division

LA2056

Massachusetts Mutual Variable Annuity Separate Account 2

STATEMENTS OF ASSETS AND LIABILITIES

December 31, 2023

	Invesco V.I. Discovery Mid Cap Growth Division	Invesco V.I. Global Division	Invesco V.I. Global Strategic Income Division	MML Blend Division	MML Equity Division	MML Managed Bond Division	MML U.S. Government Money Market Division
ASSETS							
Investments							
Number of shares	505,679	985,601	686,620	2,725,946	2,157,551	452,932	2,320,281
Identified cost	\$ 37,253,499	\$ 36,692,819	\$ 3,423,046	\$ 56,775,068	\$ 55,929,221	\$ 5,609,631	\$ 2,320,281
Value	\$ 31,761,710	\$ 36,033,575	\$ 2,945,601	\$ 53,029,772	\$ 56,684,542	\$ 4,916,484	\$ 2,320,281
Receivable from Massachusetts Mutual Life Insurance Company	2,615	3,165	158	739	1,502	11	184
Total assets	31,764,325	36,036,740	2,945,759	53,030,511	56,686,044	4,916,495	2,320,465
LIABILITIES							
Payable to fund Annuitant mortality fluctuation fund reserve	14,940	13,976	1,085	40,290	36,666	5,177	13,948
Total liabilities	14,940	13,976	1,085	40,290	36,666	5,177	13,948
NET ASSETS	\$ 31,749,385	\$ 36,022,764	\$ 2,944,674	\$ 52,990,221	\$ 56,649,378	\$ 4,911,318	\$ 2,306,517
Net Assets:							
Accumulation units - value	\$ 31,251,388	\$ 35,556,900	\$ 2,908,496	\$ 51,647,216	\$ 55,427,186	\$ 4,738,746	\$ 1,841,580
Contracts in payout (annuitization) period	497,997	465,864	36,178	1,343,005	1,222,192	172,572	464,937
Net assets	\$ 31,749,385	\$ 36,022,764	\$ 2,944,674	\$ 52,990,221	\$ 56,649,378	\$ 4,911,318	\$ 2,306,517
Outstanding units							
Contract owners	4,379,451	4,030,384	1,053,885	5,080,716	4,947,159	1,089,815	1,294,767
UNIT VALUE							
Flex-Extra (Non-Qualified)	\$ 7.25	\$ 8.94	\$ 2.79	\$ 9.93	\$ 11.30	\$ 4.43	\$ 1.77
Flex-Annuity IV (Non-Qualified)	-	-	-	17.02	30.04	8.07	2.52

See Notes to Financial Statements.

Massachusetts Mutual Variable Annuity Separate Account 2

STATEMENTS OF OPERATIONS AND CHANGES IN NET ASSETS

For The Year Ended December 31, 2023

	Invesco V.I. Discovery Mid Cap Growth Division	Invesco V.I. Global Division	Invesco V.I. Global Strategic Income Division	MML Blend Division	MML Equity Division	MML Managed Bond Division	MML U.S. Government Money Market Division
Investment Income							
Dividends	\$ -	\$ 75,963	\$ -	\$ 870,880	\$ 1,188,718	\$ 194,991	\$ 97,049
Expenses							
Mortality and expense risk fees and administrative expense charges	405,778	436,126	37,836	662,159	728,285	64,321	27,626
Net investment income (loss)	(405,778)	(360,163)	(37,836)	208,721	460,433	130,670	69,423
Net realized and unrealized gain (loss) on investments							
Realized gain (loss) on sale of fund shares	(347,142)	491,162	(110,685)	(1,326,075)	1,805,841	(143,507)	-
Realized gain distribution	-	3,841,445	-	-	4,529,781	-	-
Realized gain (loss)	(347,142)	4,332,607	(110,685)	(1,326,075)	6,335,622	(143,507)	-
Change in net unrealized appreciation/depreciation of investments	4,183,442	5,541,783	360,596	8,752,774	(2,603,612)	270,591	-
Net gain (loss) on investments	3,836,300	9,874,390	249,911	7,426,699	3,732,010	127,084	-
Net increase (decrease) in net assets resulting from operations	3,430,522	9,514,227	212,075	7,635,420	4,192,443	257,754	69,423
Capital transactions:							
Transfers of net premiums	160,456	91,926	32,029	293,492	176,880	26,451	8,313
Transfers due to death benefits	(671,914)	(521,741)	(80,986)	(1,853,215)	(1,853,491)	(137,720)	(253,476)
Transfers due to annuity benefit payments	(42,638)	(36,079)	(3,373)	(176,190)	(150,902)	(22,865)	(57,357)
Transfers due to withdrawal of funds	(2,466,322)	(2,660,017)	(122,092)	(2,414,803)	(3,606,850)	(372,060)	28,158
Transfers due to annual administrative and contingent deferred sales charges	(11,649)	(5,978)	(809)	(45,439)	(42,722)	(12,636)	(1,549)
Transfers due to net charge (credit) to annuitant mortality fluctuation	(7,501)	(13,002)	(2,605)	(29,649)	(146,781)	7,385	(37,440)
Transfers between Divisions and to/from General Account	(127,541)	(326,129)	(93,948)	(184,042)	(348,220)	32,887	654,656
Net increase (decrease) in net assets resulting from capital transactions	(3,167,109)	(3,471,020)	(271,784)	(4,409,846)	(5,972,086)	(478,558)	341,305
Total increase (decrease)	263,413	6,043,207	(59,709)	3,225,574	(1,779,643)	(220,804)	410,728
NET ASSETS, at beginning of the year	31,485,972	29,979,557	3,004,383	49,764,647	58,429,021	5,132,122	1,895,789
NET ASSETS, at end of the year	\$ 31,749,385	\$ 36,022,764	\$ 2,944,674	\$ 52,990,221	\$ 56,649,378	\$ 4,911,318	\$ 2,306,517

See Notes to Financial Statements.

Massachusetts Mutual Variable Annuity Separate Account 2

STATEMENTS OF OPERATIONS AND CHANGES IN NET ASSETS

For The Year Ended December 31, 2022

	Invesco V.I. Discovery Mid Cap Growth Division	Invesco V.I. Global Division	Invesco V.I. Global Strategic Income Division	MML Blend Division	MML Equity Division	MML Managed Bond Division	MML U.S. Government Money Market Division
Investment Income							
Dividends	\$ -	\$ -	\$ -	\$ 754,319	\$ 982,303	\$ 173,038	\$ 23,903
Expenses							
Mortality and expense risk fees and administrative expense charges	464,548	448,805	41,368	717,012	789,399	74,276	26,243
Net investment income (loss)	(464,548)	(448,805)	(41,368)	37,307	192,904	98,762	(2,340)
Net realized and unrealized gain (loss) on investments							
Realized gain (loss) on sale of fund shares	1,826,391	1,438,152	(102,798)	148,243	1,751,613	(95,894)	22
Realized gain distribution	9,707,131	5,832,113	-	1,010,081	6,566,216	57,902	-
Realized gain (loss)	11,533,522	7,270,265	(102,798)	1,158,324	8,317,829	(37,992)	22
Change in net unrealized appreciation/depreciation of investments	(26,722,758)	(22,290,864)	(312,129)	(12,688,918)	(12,509,104)	(1,128,970)	(22)
Net gain (loss) on investments	(15,189,236)	(15,020,599)	(414,927)	(11,530,594)	(4,191,275)	(1,166,962)	-
Net increase (decrease) in net assets resulting from operations	(15,653,784)	(15,469,404)	(456,295)	(11,493,287)	(3,998,371)	(1,068,200)	(2,340)
Capital transactions:							
Transfers of net premiums	219,365	154,771	9,501	360,504	367,236	32,920	10,165
Transfers due to death benefits	(509,986)	(656,103)	(70,548)	(1,584,439)	(1,543,804)	(173,190)	(1,823)
Transfers due to annuity benefit payments	(43,002)	(33,416)	(2,941)	(177,715)	(154,879)	(23,560)	(49,008)
Transfers due to withdrawal of funds	(1,998,530)	(1,904,527)	(186,445)	(2,836,994)	(3,190,392)	(640,697)	(118,359)
Transfers due to annual administrative and contingent deferred sales charges	(13,057)	(6,308)	(869)	(49,380)	(46,399)	(13,896)	(1,638)
Transfers due to net charge (credit) to annuitant mortality fluctuation	2,639	(2,379)	819	28,792	(24,838)	(3,863)	(96,483)
Transfers between Divisions and to/from General Account	(406,362)	(274,105)	(7,884)	(661,231)	(494,544)	(48,386)	98,555
Net increase (decrease) in net assets resulting from capital transactions	(2,748,933)	(2,722,067)	(258,367)	(4,920,463)	(5,087,620)	(870,672)	(158,591)
Total increase (decrease)	(18,402,717)	(18,191,471)	(714,662)	(16,413,750)	(9,085,991)	(1,938,872)	(160,931)
NET ASSETS, at beginning of the year	49,888,689	48,171,028	3,719,045	66,178,397	67,515,012	7,070,994	2,056,720
NET ASSETS, at end of the year	\$ 31,485,972	\$ 29,979,557	\$ 3,004,383	\$ 49,764,647	\$ 58,429,021	\$ 5,132,122	\$ 1,895,789

See Notes to Financial Statements.

Massachusetts Mutual Variable Annuity Separate Account 2

Notes To Financial Statements

1. ORGANIZATION

Massachusetts Mutual Variable Annuity Separate Account 2 (“the Separate Account”) is a separate investment account of Massachusetts Mutual Life Insurance Company (“MassMutual”) established on October 14, 1981. The Separate Account is registered as a unit investment trust under the Investment Company Act of 1940 (“the 1940 Act”).

MassMutual maintains two segments within the Separate Account: Flex-Annuity IV (Non-Qualified) and Flex-Extra (Non-Qualified).

The assets and liabilities of the Separate Account are clearly identified and distinguished from MassMutual’s other assets and liabilities. The Separate Account assets are not chargeable with liabilities arising from any other MassMutual business.

2. INVESTMENT OF THE SEPARATE ACCOUNT’S ASSETS

As of December 31, 2023, the Separate Account consists of seven divisions which invest in the following mutual funds. All of the Divisions may not be available to both segments of the Separate Account:

Divisions	The division listed in the first column invests in the fund in this column
Invesco V.I. Discovery Mid Cap Growth Division	Invesco V.I. Discovery Mid Cap Growth Fund ¹
Invesco V.I. Global Division	Invesco V.I. Global Fund ¹
Invesco V.I. Global Strategic Income Division	Invesco V.I. Global Strategic Income Fund ¹
MML Blend Division	MML Blend Fund ²
MML Equity Division	MML Equity Fund ²
MML Managed Bond Division	MML Managed Bond Fund ²
MML U.S. Government Money Market Division	MML U.S. Government Money Market Fund ²

In addition to the seven divisions, some contract owners may also allocate funds to the Fixed Interest Account (“FIA”), which is part of MassMutual’s general investment account (“General Account”). Because of exemptive and exclusionary provisions in the securities law, interests in the FIA are not registered under the Securities Act of 1933, and the General Account and the FIA are not registered as an investment company under the 1940 Act.

¹Invesco Advisers, Inc. is the investment adviser to this Fund.

²MML Investment Advisors, LLC is the investment adviser to this Fund.

3. SIGNIFICANT ACCOUNTING POLICIES

The following is a summary of significant accounting policies followed by the Separate Account in preparation of the financial statements in conformity with generally accepted accounting principles. Massachusetts Mutual Variable Annuity Separate Account 2 follows the accounting and reporting guidance in FASB Accounting Standards Codification 946.

A. Investment Valuation

Investments in the underlying funds held by each division are carried at fair value which is based on the closing net asset value of each of the respective underlying funds, which value their investment securities at fair value.

B. Accounting for Investments

Investment transactions are accounted for on a trade-date basis and identified cost is the basis followed in determining the cost of investments sold for financial statement purposes. Dividend income and gains from realized gain distributions are recorded on the ex-distribution date and they are generally reinvested in the underlying investment funds.

C. Federal Income Taxes

MassMutual is taxed under federal law as a life insurance company under the provisions of the 1986 Internal Revenue Code, as amended. Under existing federal law, no taxes are payable on net investment income and net realized capital gains attributable to contracts, which depend on the Separate Account's investment performance. Accordingly, no provision for federal income tax has been made. MassMutual may, however, make such a charge in the future if an unanticipated change of current law results in a company tax liability attributable to the Separate Account.

D. Contract Charges

See Note 8B for charges associated with the contracts.

E. Estimates

The preparation of financial statements in conformity with U.S. generally accepted accounting principles requires management to make estimates and assumptions that affect the reported amounts of assets and liabilities and disclosure of contingent assets and liabilities at the date of the financial statements and the reported amounts of revenues and expenses during the reporting period. Actual results could differ from those estimates.

F. Loans

If the certificate is a tax-sheltered annuity ("TSA"), the contract owners may be able to take a loan under their certificate. All such loans must conform to the requirements of the Internal Revenue Code. There are limitations on the amount of the loan the participants can take, and there is a required loan repayment schedule. When a loan is made, the Separate Account transfers the amount of the loan to MassMutual, thereby decreasing both the investments and net assets of the Separate Account. The contract owner is charged interest on the outstanding loan amount based on the interest rate then in effect.

G. Annuitant Mortality Fluctuation

The Separate Account contributes to an Annuitant Mortality Fluctuation Fund (AMFF) reserve maintained by MassMutual as required by regulatory authorities to provide for mortality losses incurred. The AMFF reserve is adjusted quarterly for mortality losses and gains and its proportionate share of changes in value. Transfers to or from MassMutual are then made quarterly to adjust the AMFF reserve which is held in the Separate Account. Net transfers from Separate Account to the MassMutual totaled \$229,593 and \$95,313 for the years ended December 31, 2023 and 2022, respectively. The AMFF reserve is subject to a maximum of 3% of the Separate Account's annuity reserves. Any mortality losses in excess of this reserve will be borne by MassMutual. The AMFF reserve is not available to owners of the contracts except to the extent necessary to cover mortality losses under the contracts.

H. Annuity Reserves

Annuity reserves are developed by using accepted actuarial methods and are computed using the 83 IAM, Annuity 2000, or 1994 MGDB table.

4. FAIR VALUE OF FINANCIAL INSTRUMENTS

The Separate Account defines fair value as the price that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants at the measurement date. In determining fair value, the Separate Account generally uses the market approach as the valuation technique due to the nature of the mutual fund investments offered in the Separate Account. This technique maximizes the use of observable inputs and minimizes the use of unobservable inputs. Investments in mutual funds are valued at the mutual fund's closing net asset value per share on the day of valuation.

Valuation Inputs: Various inputs are used to determine the value of the Separate Account's investments. These inputs are summarized in the three broad levels listed below:

- **Level 1** – quoted prices in active markets for identical securities
- **Level 2** – observable inputs other than Level 1 quoted prices (including, but not limited to, quoted prices for similar securities, interest rates, prepayment speeds and credit risk)
- **Level 3** – unobservable inputs

The investments of the Separate Account are measured at fair value. All the investments are categorized as Level 1 as of December 31, 2023. There have been no transfers between levels for the year ended December 31, 2023.

5. RELATED PARTY TRANSACTIONS

A. Sales Agreements

Pursuant to separate underwriting agreements with MassMutual, on its own behalf and on behalf of the Separate Account, MML Investors Services, LLC ("MMLIS") serves as principal underwriter of the contracts sold by its registered representatives, and MML Strategic Distributors, LLC ("MSD") serves as principal underwriter of the contracts sold by registered representatives of other broker-dealers who have entered into distribution agreements with MSD.

Both MMLIS and MSD are registered with the Securities and Exchange Commission (the "SEC") as broker-dealers under the Securities Exchange Act of 1934 and are members of the Financial Industry Regulatory Authority ("FINRA"). Commissions for sales of contracts by MMLIS registered representatives are paid on behalf of MMLIS to its registered representatives. Commissions for sales of contracts by registered representatives of other broker-dealers are paid on behalf of MSD to those broker-dealers. MMLIS and MSD also receive compensation for their actions as principal underwriters of the contracts.

The contracts are no longer offered for sale to the public. Contract owners may continue, however, to make purchase payments under existing contracts.

B. Receivable from/Payable to MassMutual

Certain fees such as mortality and expense risk fees are charges paid between the general investment account (the "General Account") and the Separate Account. The General Account is not registered as an investment company under the 1940 Act.

Notes To Financial Statements (Continued)

6. PURCHASES AND SALES OF INVESTMENTS

The cost of purchases and proceeds from sales of investments for each of the years in the two-year period ended December 31, 2023 were as follows:

	Invesco V.I. Discovery Mid Cap Growth Division	Invesco V.I. Global Division	Invesco V.I. Global Strategic Income Division	MML Blend Division	MML Equity Division
<u>2023</u>					
Cost of purchases	\$ 173,121	\$ 4,102,302	\$ 67,843	\$ 1,277,621	\$ 5,985,195
Proceeds from sales	(3,744,893)	(4,089,615)	(377,278)	(5,475,861)	(6,971,768)
	MML Managed Bond Division	MML U.S. Government Money Market Division			
<u>2023 (continued)</u>					
Cost of purchases	\$ 302,590	\$ 920,313			
Proceeds from sales	(650,650)	(511,875)			
	Invesco V.I. Discovery Mid Cap Growth Division	Invesco V.I. Global Division	Invesco V.I. Global Strategic Income Division	MML Blend Division	MML Equity Division
<u>2022</u>					
Cost of purchases	\$ 10,033,464	\$ 5,906,716	\$ 11,851	\$ 2,205,639	\$ 7,987,095
Proceeds from sales	(3,544,302)	(3,248,725)	(311,768)	(6,090,753)	(6,319,561)
	MML Managed Bond Division	MML U.S. Government Money Market Division			
<u>2022 (continued)</u>					
Cost of purchases	\$ 445,599	\$ 980,869			
Proceeds from sales	(1,159,864)	(1,136,356)			

Notes To Financial Statements (Continued)

7. NET INCREASE (DECREASE) IN OUTSTANDING UNITS

The changes in outstanding units for each of the years in the two-year period ended December 31, 2023 were as follows:

	Invesco V.I. Discovery Mid Cap Growth Division	Invesco V.I. Global Division	Invesco V.I. Global Strategic Income Division	MML Blend Division	MML Equity Division
2023					
Units purchased	41,632	31,527	17,840	49,576	38,409
Units withdrawn	(493,331)	(422,008)	(84,448)	(505,963)	(572,585)
Units transferred between Divisions and to/from General Account	(19,869)	(40,310)	(35,200)	(21,041)	(32,527)
Net increase (decrease)	(471,568)	(430,791)	(101,808)	(477,428)	(566,703)
	MML Managed Bond Division	MML U.S. Government Money Market Division			
2023 (continued)					
Units purchased	9,117	122,621			
Units withdrawn	(128,621)	(298,740)			
Units transferred between Divisions and to/from General Account	7,950	376,164			
Net increase (decrease)	(111,554)	200,045			
	Invesco V.I. Discovery Mid Cap Growth Division	Invesco V.I. Global Division	Invesco V.I. Global Strategic Income Division	MML Blend Division	MML Equity Division
2022					
Units purchased	37,348	26,218	3,646	46,699	44,978
Units withdrawn	(364,250)	(357,341)	(94,965)	(507,566)	(459,864)
Units transferred between Divisions and to/from General Account	(58,553)	(35,776)	(3,301)	(75,772)	(49,095)
Net increase (decrease)	(385,455)	(366,899)	(94,620)	(536,639)	(463,981)
	MML Managed Bond Division	MML U.S. Government Money Market Division			
2022 (continued)					
Units purchased	19,867	160,942			
Units withdrawn	(197,088)	(300,509)			
Units transferred between Divisions and to/from General Account	(11,537)	57,369			
Net increase (decrease)	(188,758)	(82,198)			

Notes To Financial Statements (Continued)

8. FINANCIAL HIGHLIGHTS

A. A summary of units outstanding, unit values, net assets, investment income ratios, expense ratios (excluding expenses of the underlying funds) and total return ratios for each of the years in the five-year period ended December 31, 2023 follows:

	At December 31,			For the Years Ended December 31,					
	Units	Unit Value ³ (Lowest to Highest)		Net Assets	Investment Income Ratio ¹	Expense Ratio ² (Lowest to Highest)		Total Return ³ (Lowest to Highest)	
Invesco V.I. Discovery Mid Cap Growth Division									
2023	4,379,451	\$ 7.25	\$ 31,749,385		- %	%	1.30%	% 11.69%	
2022	4,851,020	6.49	31,485,972		-		1.30	(31.87)	
2021	5,236,476	9.53	49,888,689		-		1.30	17.56	
2020	5,547,282	8.10	44,955,381	0.04			1.30	38.87	
2019	6,205,235	5.84	36,211,320		-		1.30	37.56	
Invesco V.I. Global Division									
2023	4,030,384	8.94	36,022,764	0.23			1.30	33.00	
2022	4,461,175	6.72	29,979,557	-			1.30	(32.65)	
2021	4,828,074	9.98	48,171,028	-			1.30	14.00	
2020	5,370,524	8.75	47,003,584	0.69			1.30	25.99	
2019	5,993,864	6.95	41,637,693	0.90			1.30	30.09	
Invesco V.I. Global Strategic Income Division									
2023	1,053,885	2.79	2,944,674	-			1.30	7.48	
2022	1,155,693	2.60	3,004,384	-			1.30	(12.60)	
2021	1,250,313	2.97	3,719,045	4.63			1.30	(4.66)	
2020	1,316,772	3.12	4,108,202	5.82			1.30	2.07	
2019	1,460,437	3.06	4,464,228	3.77			1.30	9.37	
MML Blend Division									
2023	5,080,716	9.93 to	17.02	52,990,221	1.70	1.25 to	1.30	16.10 to 16.16	
2022	5,558,144	8.55 to	14.65	49,764,647	1.36	1.25 to	1.30	(17.67) to (17.63)	
2021	6,094,783	10.39 to	17.79	66,178,397	2.13	1.25 to	1.30	13.54 to 13.60	
2020	6,728,951	9.15 to	15.66	64,170,525	-	1.25 to	1.30	11.41 to 11.46	
2019	7,288,954	8.21 to	14.05	62,382,930	2.43	1.25 to	1.30	19.81 to 19.87	
MML Equity Division									
2023	4,947,159	11.30 to	30.04	56,649,378	2.12	1.25 to	1.30	7.92 to 7.97	
2022	5,513,863	10.47 to	27.82	58,429,021	1.61	1.25 to	1.30	(5.87) to (5.83)	
2021	5,977,844	11.12 to	29.54	67,515,012	1.65	1.25 to	1.30	28.58 to 28.64	
2020	6,541,553	8.65 to	22.96	58,022,333	2.33	1.25 to	1.30	1.69 to 1.75	
2019	6,882,684	8.50 to	22.57	59,970,999	2.04	1.25 to	1.30	24.30 to 24.36	
MML Managed Bond Division									
2023	1,089,815	4.43 to	8.07	4,911,318	3.93	1.25 to	1.30	5.33 to 5.38	
2022	1,201,369	4.21 to	7.66	5,132,122	3.02	1.25 to	1.30	(16.10) to (16.06)	
2021	1,390,126	5.01 to	9.13	7,070,994	3.14	1.25 to	1.30	(0.49) to (0.44)	
2020	1,481,684	5.04 to	9.17	7,572,162	0.09	1.25 to	1.30	6.32 to 6.37	
2019	1,647,672	4.74 to	8.62	7,907,113	3.64	1.25 to	1.30	8.39 to 8.45	
MML U.S. Government Money Market Division									
2023	1,294,767	1.77 to	2.52	2,306,517	4.54	1.25 to	1.30	3.29 to 3.34	
2022	1,094,722	1.71 to	2.44	1,895,789	1.18	1.25 to	1.30	(0.09) to (0.04)	
2021	1,176,920	1.72 to	2.44	2,056,720	-	1.25 to	1.30	(1.29) to (1.24)	
2020	1,305,035	1.74 to	2.47	2,340,089	0.19	1.25 to	1.30	(1.06) to (1.01)	
2019	1,024,568	1.76 to	2.49	1,872,371	1.70	1.25 to	1.30	0.40 to 0.45	

8. FINANCIAL HIGHLIGHTS (Continued)

¹ The investment income ratios represent the dividends, excluding distributions of capital gains, received by the division from the underlying mutual fund, divided by the average net assets. These ratios exclude those expenses, such as mortality and expense charges, that are assessed against contract owner accounts either through reductions in the unit values or the redemption of units. The recognition of investment income by the division is affected by the timing of the declaration of dividends by the underlying fund in which the division invests.

² The expense ratios represent the annualized contract expense of the divisions of the Separate Account, consisting primarily of mortality and expense charges, for each period indicated. The ratios include only those expenses that result in a direct reduction of unit values. Charges made directly to contract owner accounts through the redemption of units and expenses of the underlying fund have been excluded.

³ The total returns are for the periods indicated, including changes in the value of the underlying fund, and the expenses assessed through the reduction of unit values. These ratios do not include any expenses assessed through the redemption of units. As the total return is presented as a range of minimum to maximum values, based on the product grouping representing the minimum and maximum expense ratio amounts.

B. The Separate Account assesses charges associated with the contract. These charges are either assessed as a direct reduction in unit values or through a redemption of units for all contracts contained within the Separate Account.

Mortality and Expense Risk Charge* This charge is assessed through reduction in unit values.	This charge is equal, on an annual basis, to 1.15% - 1.25% of the daily value of the assets invested in each fund.
Administrative Expense Charge This charge is assessed through reduction in unit values.	This charge is equal, on an annual basis, to 0.00% - 0.15% of the daily value of the assets invested in each fund.
Annual Administrative Charge** This charge is assessed through the redemption of units.	\$30 - \$35 per contract annually.
Contingent Deferred Sales Charge This charge is assessed through the redemption of units.	0.00% - 11.00%

* Right reserved to increase to 1.25%.

** Right reserved to increase to \$50.

9. SUBSEQUENT EVENTS

The Separate Account's management has reviewed events occurring through March 7, 2024, the date the financial statements were issued, and no subsequent events occurred requiring accrual or disclosure.

PART C OTHER INFORMATION

Item 27. Exhibits

Exhibit (a)	<u>Copy of Resolution of the Executive Committee of the Board of Directors of Massachusetts Mutual Life Insurance Company, authorizing the establishment of the Separate Account – Incorporated by reference to Post-Effective Amendment No. 39 to Registration Statement File No. 033-07724 filed April 25, 2023</u>
Exhibit (b)	Not Applicable.
Exhibit (c)	i. <u>Underwriting and Servicing Agreement dated December 16, 2014 by and between MML Investors Services, LLC and Massachusetts Mutual Life Insurance Company – Incorporated by reference to Post-Effective Amendment No. 28 to Registration Statement File No. 333-45039 filed June 25, 2021</u>
Exhibit (d)	i. <u>Form of Flexible Purchase Payment Multi-Fund Variable Annuity Contract – Incorporated by reference to Post-Effective Amendment No. 38 to Registration Statement File No. 033-07724 filed April 28, 2022</u> ii. <u>Qualified Plan Rider – Incorporated by reference to Post-Effective Amendment No. 38 to Registration Statement File No. 033-07724 filed April 28, 2022</u> iii. <u>Individual Retirement Annuity Rider – Incorporated by reference to Post-Effective Amendment No. 38 to Registration Statement File No. 033-07724 filed April 28, 2022</u> iv. <u>Roth Individual Retirement Annuity Rider – Incorporated by reference to Post-Effective Amendment No. 38 to Registration Statement File No. 033-07724 filed April 28, 2022</u> v. <u>Simple Individual Retirement Annuity Rider – Incorporated by reference to Post-Effective Amendment No. 38 to Registration Statement File No. 033-07724 filed April 28, 2022</u>
Exhibit (e)	<u>Form of Application used with the Flexible Purchase Payment Multi-Fund Variable Annuity Contract – Incorporated by reference to Post-Effective Amendment No. 38 to Registration Statement File No. 033-07724 filed April 28, 2022</u>
Exhibit (f)	i. <u>Copy of Charter documentation as amended through August 10, 2008 of Massachusetts Mutual Life Insurance Company – Incorporated by reference to Post-Effective Amendment No. 28 to Registration Statement File No. 333-45039 filed June 25, 2021</u> ii. <u>By-Laws of Massachusetts Mutual Life Insurance Company as adopted April 8, 2015 – Incorporated by reference to Post-Effective Amendment No. 28 to Registration Statement File No. 333-45039 filed June 25, 2021</u>
Exhibit (g)	Not Applicable.
Exhibit (h)	i. Fund Participation Agreements a. AIM Funds (Invesco Funds) 1. <u>Participation Agreement dated April 30, 2004 with revised Schedule A as of July 6, 2005 (AIM Variable Insurance Funds, AIM Distributors, Inc., and Massachusetts Mutual Life Insurance Company) – Incorporated by reference to Post-Effective Amendment No. 28 to Registration Statement File No. 333-45039 filed June 25, 2021</u> i. <u>Amendment No. 1 effective as of July 1, 2008 – Incorporated by reference to Post-Effective Amendment No. 28 to Registration Statement File No. 333-45039 filed June 25, 2021</u> ii. <u>Amendment No. 2 effective April 30, 2010 – Incorporated by reference to Post-Effective Amendment No. 28 to Registration Statement File No. 333-45039 filed June 25, 2021</u> iii. <u>Amendment No. 3 effective May 1, 2011 – Incorporated by reference to Post-Effective Amendment No. 28 to Registration Statement File No. 333-45039 filed June 25, 2021</u>

- iv. [Amendment dated May 3, 2021 regarding Rules 30e-3 and 498A – Incorporated by reference to Post-Effective Amendment No. 11 to Registration Statement File No. 333-206438 filed November 15, 2021](#)
- 2. [Financial Support Agreement dated October 1, 2016 \(Invesco Distributors, Inc. and Massachusetts Mutual Life Insurance Company\) – Incorporated by reference to Post-Effective Amendment No. 9 to Registration Statement File No. 333-150916 filed April 26, 2017](#)
 - i. [Amendment No. 1 dated May 24, 2019 – Incorporated by reference to Post-Effective Amendment No. 11 to Registration Statement File No. 333-206438 filed November 15, 2021](#)
 - ii. [Amendment No. 2 effective April 1, 2022 – Incorporated by reference to Post-Effective Amendment No. 2 to Registration Statement File No. 333-255824 filed April 25, 2023](#)
- 3. [Administrative Services Agreement dated October 1, 2016 \(Invesco Advisers, Inc. and Massachusetts Mutual Life Insurance Company\) – Incorporated by reference to Post-Effective Amendment No. 28 to Registration Statement File No. 333-45039 filed June 25, 2021](#)

b. MML II Funds

- 1. [Participation Agreement dated November 17, 2005 \(MML Series Investment Fund II, Massachusetts Mutual Life Insurance Company and MML Bay State Life Insurance Company and C.M. Life Insurance Company\) – Incorporated by reference to Post-Effective Amendment No. 28 to Registration Statement File No. 333-45039 filed June 25, 2021](#)
 - i. [First Amendment effective November 17, 2005 – Incorporated by reference to Post-Effective Amendment No. 28 to Registration Statement File No. 333-45039 filed June 25, 2021](#)
 - ii. [Second Amendment dated as of August 26, 2008 – Incorporated by reference to Post-Effective Amendment No. 28 to Registration Statement File No. 333-45039 filed June 25, 2021](#)
 - iii. [Third Amendment dated as of April 9, 2010 – Incorporated by reference to Post-Effective Amendment No. 28 to Registration Statement File No. 333-45039 filed June 25, 2021](#)
 - iv. [Fourth Amendment dated and effective July 23, 2010 – Incorporated by reference to Post-Effective Amendment No. 28 to Registration Statement File No. 333-45039 filed June 25, 2021](#)
 - v. [Fifth Amendment dated August 1, 2011 – Incorporated by reference to Post-Effective Amendment No. 28 to Registration Statement File No. 333-45039 filed June 25, 2021](#)
 - vi. [Sixth Amendment dated and effective August 28, 2012 – Incorporated by reference to Post-Effective Amendment No. 28 to Registration Statement File No. 333-45039 filed June 25, 2021](#)
 - vii. [Seventh Amendment dated and effective November 12, 2012 – Incorporated by reference to Post-Effective Amendment No. 28 to Registration Statement File No. 333-45039 filed June 25, 2021](#)
 - viii. [Eighth Amendment dated April 1, 2014 – Incorporated by reference to Post-Effective Amendment No. 28 to Registration Statement File No. 333-45039 filed June 25, 2021](#)
 - ix. [Ninth Amendment dated August 11, 2015 – Incorporated by reference to Post-Effective Amendment No. 28 to Registration Statement File No. 333-45039 filed June 25, 2021](#)
 - x. [Tenth Amendment dated February 20, 2020 – Incorporated by reference to Post-Effective Amendment No. 7 to Registration Statement File No. 333-202684 filed April 28, 2020](#)
 - xi. [Eleventh Amendment dated June 2, 2021 regarding Rules 30e-3 and 498A – Incorporated by reference to Pre-Effective Amendment No. 1 to Registration Statement File No. 333-255824 filed August 24, 2021](#)
- ii. Rule 22c-2 Agreements (Shareholder Information Agreements)
 - a. [AIM Investment Services, Inc. effective October 16, 2007 \(Massachusetts Mutual Life Insurance Company, and C.M. Life Insurance Company\) – Incorporated by reference to Post-Effective Amendment No. 28 to Registration Statement File No. 333-45039 filed June 25, 2021](#)
 - 1. [Amendment No. 1 dated June 30, 2020 – Incorporated by reference to Pre-Effective Amendment 3 to Registration Statement File No. 333-229670 filed October 2, 2020](#)
 - b. [MML Series Investment Fund II effective October 16, 2007 \(Massachusetts Mutual Life Insurance Company, MML Bay State Life Insurance Company, and C.M. Life Insurance Company\) – Incorporated by reference to Post-Effective Amendment No. 28 to Registration Statement File No. 333-45039 filed June 25, 2021](#)

Exhibit (i) Not Applicable.

Exhibit (j) Not Applicable.

Exhibit (k) [Opinion and Consent of Counsel – Incorporated by reference to Post-Effective Amendment No. 38 to Registration Statement File No. 033-07724 filed April 28, 2022](#)

Exhibit (l) i. [Auditor Consents:](#)

- Company Financial Statements (*)
- Separate Account Financial Statements (*)

ii. a. Powers of Attorney for:

- Roger W. Crandall
- Mark T. Bertolini
- Kathleen A. Corbet
- James H. DeGraffenreidt, Jr.
- Isabel D. Goren
- Bernard A. Harris, Jr.
- Michelle K. Lee
- Jeffrey H. Leiden
- Laura J. Sen
- William T. Spitz
- H. Todd Stitzer
- Elizabeth A. Ward

[– Incorporated by reference to Post-Effective Amendment No. 7 to Registration Statement File No. 333-229670 filed September 1, 2023](#)

b. Power of Attorney for Keith McDonagh

– Incorporated by reference to Post-Effective Amendment No. 7 to Registration Statement File No. 333-255824 filed on or about April 25, 2024

iii. [Resolution Regarding the Rules and Regulations of the Board of Directors dated February 13, 2019 – Incorporated by reference to Pre-Effective Amendment No. 3 to Registration Statement File No. 333-229670 filed October 2, 2020](#)

Exhibit (m) Not Applicable.

Exhibit (n) Not Applicable.

(*) Filed herewith

Item 28. Directors and Officers of the Depositor

Directors of Massachusetts Mutual Life Insurance Company

*Roger W. Crandall, Director,
Chairman
1295 State Street
Springfield, MA 01111*

*Mark T. Bertolini, Director
PO Box 20917
700 Columbus Avenue
New York, NY 10025*

*Jeffrey M. Leiden, Director
15 North Beach Road
Hobe Sound, FL 33455*

*H. Todd Stitzer, Lead Director
1312 Casey Key Road
Nokomis, FL 34275*

*Kathleen A. Corbet, Director
49 Cros Ridge Road
New Canaan, CT 06840*

*James H. DeGraffenreidt, Jr., Director
1340 Smith Avenue, Suite 200
Baltimore, MD 21209*

*Laura J. Sen, Director
95 Pembroke Street, Unit 1
Boston, MA 02118*

*Bernard A. Harris, Jr., Director
3333 Allen Parkway, #1709
Houston, Texas 77019*

*Isabella D. Goren, Director
8030 Acoma Lane
Dallas, TX 75252*

*William T. Spitz, Director
16 Wynstone
Nashville, TN 37215*

*Michelle K. Lee, Director
19952 Moran Lane
Saratoga, CA 95070*

Principal Officers of Massachusetts Mutual Life Insurance Company

*Roger W. Crandall, President and Chief Executive Officer
1295 State Street
Springfield, MA 01111*

*Julieta Sinisgalli, Treasurer
1295 State Street
Springfield, MA 01111*

*Michael J. O'Connor, General Counsel
1295 State Street
Springfield, MA 01111*

*Elizabeth A. Ward, Chief Financial Officer
1295 State Street
Springfield, MA 01111*

*Dominic Blue, Head of Third-Party Distribution and New Markets
1295 State Street
Springfield, MA 01111*

*Paul LaPiana, Head of Brand, Product and Affiliated Distribution
1295 State Street
Springfield, MA 01111*

*Keith McDonagh, Corporate Controller
10 Fan Pier Boulevard
Boston, MA 02210*

*Eric Partlan, Chief Investment Officer
1295 State Street
Springfield, MA 01111*

*John Rugel, Head of Operations
1295 State Street
Springfield, MA 01111*

*Susan Cicco, Head of Human Resources & Employee Experience
1295 State Street
Springfield, MA 01111*

*Sears Merritt, Head of Technology & Experience
1295 State Street
Springfield, MA 01111*

*Geoffrey Craddock, Chief Risk Officer
10 Fan Pier Boulevard
Boston, MA 02210*

*Akintokunbo Akinbajo, Corporate Secretary
1295 State Street
Springfield, MA 01111*

—

Item 29. Persons Controlled by or Under Common Control with the Depositor or the Registrant

– Incorporated by reference to Item 32 on Form N-6 in Post-Effective Amendment No. 3 to Registration Statement File No. 333-259818 filed on or about April 25, 2024

Item 30. Indemnification

MassMutual directors and officers are indemnified under Article V. of the by-laws of Massachusetts Mutual Life Insurance Company, as set forth below.

ARTICLE V. of the By-laws of MassMutual provides for indemnification of directors and officers as follows:

“ARTICLE V.

INDEMNIFICATION

Subject to limitations of law, the Company shall indemnify:

- (a) each director, officer or employee;
- (b) any individual who serves at the request of the Company as a director, board member, committee member, partner, trustee, officer or employee of any foreign or domestic organization or any separate investment account; or
- (c) any individual who serves in any capacity with respect to any employee benefit plan,

from and against all loss, liability and expense imposed upon or incurred by such person in connection with any threatened, pending or completed action, claim, suit, investigation or proceeding of any nature whatsoever, in which such person may be involved or with which he or she may be threatened to be involved, by reason of any alleged act, omission or otherwise while serving in any such capacity, whether such action, claim, suit, investigation or proceeding is civil, criminal, administrative, arbitrative, or investigative and/or formal or informal in nature. Indemnification shall be provided although the person no longer serves in such capacity and shall include protection for the person's heirs and legal representatives.

Indemnities hereunder shall include, but not be limited to, all costs and reasonable counsel fees, fines, penalties, judgments or awards of any kind, and the amount of reasonable settlements, whether or not payable to the Company or to any of the other entities described in the preceding paragraph, or to the policyholders or security holders thereof.

Notwithstanding the foregoing, no indemnification shall be provided with respect to:

- (1) any matter as to which the person shall have been adjudicated in any proceeding not to have acted in good faith in the reasonable belief that his or her action was in the best interests of the Company or, to the extent that such matter relates to service with respect to any employee benefit plan, in the best interests of the participants or beneficiaries of such employee benefit plan;
- (2) any liability to any entity which is registered as an investment company under the Federal Investment Company Act of 1940 or to the security holders thereof, where the basis for such liability is willful misfeasance, bad faith, gross negligence or reckless disregard of the duties involved in the conduct of office; and
- (3) any action, claim or proceeding voluntarily initiated by any person seeking indemnification, unless such action, claim or proceeding had been authorized by the Board of Directors or unless such person's indemnification is awarded by vote of the Board of Directors.

In any matter disposed of by settlement or in the event of an adjudication which in the opinion of the General Counsel or his or her delegate does not make a sufficient determination of conduct which could preclude or permit indemnification in accordance with the preceding paragraphs (1), (2) and (3), the person shall be entitled to indemnification unless, as determined by the majority of the disinterested directors or in the opinion of counsel (who may be an officer of the Company or outside counsel employed by the Company), such person's conduct was such as precludes indemnification under any such paragraph. The termination of any action, claim, suit, investigation or proceeding by judgment, order, settlement, conviction, or upon a plea of nolo contendere or its equivalent shall not, of itself, create a presumption that the person did not act in good faith and in a manner which he or she reasonably believed to be in the best interests of the Company.

The Company may at its option indemnify for expenses incurred in connection with any action or proceeding in advance of its final disposition, upon receipt of a satisfactory undertaking for repayment if it be subsequently determined that the person thus indemnified is not entitled to indemnification under this Article V.”

To provide certainty and more clarification regarding the indemnification provisions of the Bylaws set forth above, MassMutual has entered into indemnification agreements with each of its directors, and with each of its officers who serve as a director of a subsidiary of MassMutual, (a “Director”). Pursuant to the Agreements, MassMutual agrees to indemnify a Director, to the extent legally permissible, against (a) all expenses, judgments, fines and settlements (“Costs”), liabilities, and penalties paid in connection with a proceeding involving the Director because he or she is a director if the Director (i) acted in good faith, (ii) reasonably believed the conduct was in the Company’s best interests; (iii) had no reasonable cause to believe the conduct was unlawful (in a criminal proceeding); and, (iv) engaged in conduct for which the Director shall not be liable under MassMutual’s Charter or By-Laws. MassMutual further agrees to indemnify a Director, to the extent permitted by law, against all Costs paid in connection with any proceeding (i) unless the Director breached a duty of loyalty, (ii) except for liability for acts or omissions not in good faith, involving intentional misconduct or a knowing violation of law, (iii) except for liability under Section 6.40 of Chapter 156D of Massachusetts Business Corporation Act (“MBCA”), or (iv) except for liability related to any transaction from which the Director derived an improper benefit. MassMutual will also indemnify a Director, to the fullest extent authorized by the MBCA, against all expenses to the extent the Director has been successful on the merits or in defense of any proceeding. If any court determines that despite an adjudication of liability to MassMutual or its subsidiary that the Director is entitled to indemnification, MassMutual will indemnify the Director to the extent permitted by law. Subject to the Director’s obligation to pay MassMutual in the event that the Director is not entitled to indemnification, MassMutual will pay the expenses of the Director prior to a final determination as to whether the Director is entitled to indemnification.

Item 31. Principal Underwriters

(a) MML Investors Services, LLC (“MMLIS”) serves as principal underwriter of the contracts/policies/certificates sold by its registered representatives.

MMLIS, either jointly with certain other affiliates or individually, acts as principal underwriter for:

Massachusetts Mutual Variable Life Separate Account I, Massachusetts Mutual Variable Annuity Separate Account 1, Massachusetts Mutual Variable Annuity Separate Account 2, Massachusetts Mutual Variable Annuity Separate Account 3, Massachusetts Mutual Variable Annuity Separate Account 4, Panorama Separate Account, Connecticut Mutual Variable Life Separate Account I, MML Bay State Variable Life Separate Account I, MML Bay State Variable Annuity Separate Account 1, Panorama Plus Separate Account, C.M. Multi-Account A, C.M. Life Variable Life Separate Account I, Massachusetts Mutual Variable Life Separate Account II.

(b) MML Investors Services, LLC is the principal underwriter for this contract. The following people are officers and directors of MML Investors Services, LLC:

DIRECTORS AND OFFICERS OF MML INVESTORS SERVICES, LLC

Name	Positions and Offices	Principal Business Address
John Vaccaro	Director, Chief Executive Officer, Chairman of the Board, and Agency Field Force Supervisor	(*)
Vaughn Bowman	Director and President	(*)
Geoffrey Craddock	Director	10 Fan Pier Boulevard Boston, MA 02210
Paul LaPiana	Director	(*)
Jennifer Reilly	Director	10 Fan Pier Boulevard Boston, MA 02210
David Mink	Vice President and Chief Operations Officer	11215 North Community House Rd. Charlotte, NC 28277
Frank Rispoli	Chief Financial Officer and Treasurer	(*)
Edward K. Duch, III	Chief Legal Officer, Vice President, and Secretary	(*)
Courtney Reid	Chief Compliance Officer	(*)
James P. Puhala	Deputy Chief Compliance Officer	(*)
Michael Gilliland	Deputy Chief Compliance Officer	(*)
Thomas Bauer	Chief Technology Officer	(*)
Anthony Frogameni	Chief Privacy Officer	(*)
Linda Bestepe	Vice President	(*)
Daken Vanderburg	Vice President	(*)
Brian Foley	Vice President	(*)
James Langham	Vice President	(*)
Mary B. Wilkinson	Vice President	11215 North Community House Rd. Charlotte, NC 28277
David Holtzer	Field Risk Officer	11215 North Community House Rd. Charlotte, NC 28277
Amy Francella	Assistant Secretary	(*)
Alyssa O'Connor	Assistant Secretary	(*)
Pablo Cabrera	Assistant Treasurer	(*)
Jeffrey Sajdak	Assistant Treasurer	(*)
Julieta Sinisgalli	Assistant Treasurer	(*)
Kevin Lacomb	Assistant Treasurer	(*)
Tricia Cohen	Continuing Education Officer	(*)
Mario Morton	Registration Manager	(*)
Kelly Pirrotta	AML Compliance Officer	(*)
John Rogan	Regional Vice President	(*)
Michelle Pedigo	Regional Vice President	(*)

(*) 1295 State Street, Springfield, MA 01111-0001

(c) For information about all commissions and other compensation received by the principal underwriter, directly or indirectly, from the Registrant during the Registrant's last fiscal year, refer to the "Service Arrangements and Distribution" section of the Statement of Additional Information.

Item 32. Location of Accounts and Records

All accounts, books, or other documents required to be maintained by Section 31(a) of the Investment Company Act of 1940 and the rules promulgated thereunder are maintained by the Registrant through Massachusetts Mutual Life Insurance Company, 1295 State Street, Springfield, Massachusetts 01111-0001.

Item 33. Management Services

Not Applicable.

Item 34. Fee Representation

**REPRESENTATION UNDER SECTION 26(f)(2)(A) OF
THE INVESTMENT COMPANY ACT OF 1940**

Massachusetts Mutual Life Insurance Company hereby represents that the fees and charges deducted under the Flex Extra contract described in this Registration Statement, in the aggregate, are reasonable in relation to the services rendered, the expenses expected to be incurred, and the risks assumed by Massachusetts Mutual Life Insurance Company.

SIGNATURES

Pursuant to the requirements of Securities Act of 1933 and the Investment Company Act of 1940, the Registrant certifies that it meets all of the requirements for effectiveness of this registration statement under Rule 485(b) under the Securities Act and has duly caused this registration statement to be signed on its behalf by the undersigned, duly authorized, in the City of Wilmington, and the State of North Carolina on this 24th day of April, 2024.

MASSACHUSETTS MUTUAL VARIABLE ANNUITY SEPARATE ACCOUNT 1
(Registrant)

MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY
(Depositor)

By ROGER W. CRANDALL*
Roger W. Crandall
President and Chief Executive Officer
(principal executive officer)
Massachusetts Mutual Life Insurance Company

Pursuant to the requirements of the Securities Act of 1933, this registration statement has been signed by the following persons in the capacities and on the dates indicated.

Signature*	Title	Date
<u>ROGER W. CRANDALL *</u> Roger W. Crandall	Director and Chief Executive Officer (principal executive officer)	April 24, 2024
<u>ELIZABETH A. WARD *</u> Elizabeth A. Ward	Chief Financial Officer (principal financial officer)	April 24, 2024
<u>KEITH MCDONAGH *</u> Keith McDonagh	Corporate Controller (principal accounting officer)	April 24, 2024
<u>MARK T. BERTOLINI *</u> Mark T. Bertolini	Director	April 24, 2024
<u>KATHLEEN A. CORBET *</u> Kathleen A. Corbet	Director	April 24, 2024
<u>JAMES H. DEGRAFFENREIDT, JR. *</u> James H. DeGraffenreidt, Jr.	Director	April 24, 2024
<u>ISABELLA D. GOREN *</u> Isabella D. Goren	Director	April 24, 2024
<u>BERNARD A. HARRIS, JR. *</u> Bernard A. Harris, Jr.	Director	April 24, 2024
<u>MICHELLE K. LEE *</u> Michelle K. Lee	Director	April 24, 2024
<u>JEFFREY M. LEIDEN *</u> Jeffrey M. Leiden	Director	April 24, 2024
<u>LAURA J. SEN *</u> Laura J. Sen	Director	April 24, 2024
<u>WILLIAM T. SPITZ *</u> William T. Spitz	Director	April 24, 2024
<u>H. TODD STITZER *</u> H. Todd Stitzer	Director	April 24, 2024
<u>/s/ GARY F. MURTAGH</u> * Gary F. Murtagh Attorney-in-Fact pursuant to Powers of Attorney		

INDEX TO EXHIBITS

Item No.	Exhibit
Item 27.	Exhibit (l) i. Auditor Consents: • Company Financial Statements • Separate Account Financial Statements

[KPMG letterhead appears here]

Consent of Independent Registered Public Accounting Firm

We consent to the use of our report dated February 27, 2024, with respect to the statutory financial statements of Massachusetts Mutual Life Insurance Company, included herein, and to the reference to our firm under the heading "Experts" in the Statement of Additional Information.

/s/ KPMG LLP

Hartford, Connecticut
April 22, 2024

[KPMG letterhead appears here]

Consent of Independent Registered Public Accounting Firm

We consent to the use of our report dated March 7, 2024, with respect to the financial statements of Massachusetts Mutual Variable Annuity Separate Account 1, included herein, and to the reference to our firm under the heading “Experts” in the Statement of Additional Information.

/s/ KPMG LLP

Boston, Massachusetts

April 22, 2024

[KPMG letterhead appears here]

Consent of Independent Registered Public Accounting Firm

We consent to the use of our report dated March 7, 2024, with respect to the financial statements of Massachusetts Mutual Variable Annuity Separate Account 2, included herein, and to the reference to our firm under the heading “Experts” in the Statement of Additional Information.

/s/ KPMG LLP

Boston, Massachusetts

April 22, 2024
