



Government Actuary's Department

100
YEARS OF GAD

Firefighters' Pension Schemes (Scotland)

Actuarial valuation as at 31 March 2016
Advice on assumptions

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1 Executive summary

This report contains our recommendations for the best estimate assumptions to be set by Scottish Ministers for the 2016 valuation of the Firefighters' Pension Schemes (Scotland) ('the Schemes').

- 1.1 An actuarial valuation of the Firefighters' Pension Schemes (Scotland)¹ ('the Schemes'), is being carried out as at 31 March 2016. The Public Service Pensions (Valuations and Employer Cost Cap) Directions 2014 (as amended) ("the Directions") require that, unless specified otherwise², the assumptions to be adopted for this valuation will be set by Scottish Ministers, having obtained advice from the scheme actuary. Direction 19(c) requires the assumptions to be Scottish Ministers' best estimates.
- 1.2 GAD is the appointed scheme actuary to the Schemes. This report has been commissioned by the Scottish Public Pensions Agency (SPPA) and sets out GAD's formal advice to Scottish Ministers on the actuarial assumptions to be adopted where these are not otherwise specified. The advice covers the assumptions to be set by Scottish Ministers. The main advised assumptions are summarised in Table 1 with further detail in Appendix A.
- 1.3 This report relates to demographic assumptions, ie assumptions about member behaviours. When considering appropriate assumptions, experience (both recent and longer term) generally provides the most reliable evidence when considering best estimates of future experience. Anticipated future events may also influence how assumptions are set. For some assumptions, there are only small amounts of experience that can be analysed in the Schemes. The experience in other larger public service pension schemes, including the Firefighters' Pension Schemes in England ('the England Schemes'), can then provide useful reference. Where there is no reason to believe experience across the memberships of the two schemes is materially different we have also considered the conclusions reached based on the England Schemes' experience³ in formulating our recommendations for the Schemes.
- 1.4 This advice sets out relevant analysis of recent experience and indicates which other factors have been considered in deriving recommendations of best estimate assumptions.

¹ As provided by The Firefighters' Pension Scheme Order 1992 (SI 1992/129) (as amended), The Firefighters' Pension Scheme (Scotland) Order 2007 (SSI 2007/199) (as amended) and The Firefighters' Pension Scheme (Scotland) Regulations 2015 (SSI 2015/19) (as amended).

² Certain assumptions are specified in the Directions.

³ See report *Firefighters' Pension Schemes (England): Actuarial valuation as at 31 March 2016: Advice on assumptions*, dated 28 February 2019.



- 1.5 The previous completed actuarial valuation of the Schemes was carried out as at 31 March 2012. Many of the assumptions put forward in this report are the same as adopted for that valuation. The changes are:
- > Rates of pensioner mortality have been updated to reflect recent experience, the relationship between mortality in Scotland and England for other public service (and the HMT directed assumption for future changes in mortality has been updated to reflect changes in population mortality as reflected in the updated ONS population projections⁴).
 - > Age retirement (ie normal health) rates for members with 1992 Scheme benefits have been updated to allow for experience over 2012-2016 and align with the equivalent assumption being proposed in England.
 - > Promotional pay increases for regular members have been updated to allow for the analysis carried out at this valuation and align with the equivalent assumption being proposed in England.
 - > The amount of pension assumed to be commuted for a cash lump sum at retirement has increased in respect of members with 2015 Scheme service.
- 1.6 The following chapters and appendices provide more detail on the advice, supporting analysis and an indication of the magnitude of financial impact of each assumption on valuation results. They also contain important background information about the context of this advice and its limitations.
- 1.7 The estimated financial impact of changing assumptions is shown in Table 1 below. These have been calculated in an approximate way and are intended to provide a broad indication of the impact and are not definitive.
- 1.8 This report was provided to Scottish Ministers in draft form, and was also circulated to the Scottish Firefighters' Pension Scheme Advisory Board in draft in October 2017. Since the draft version, the main changes have been to update our advice regarding the commutation assumption and to include two additional appendices regarding assumptions for data uncertainty and Special members. This report has been signed alongside the formal valuation report. Scottish Ministers have already confirmed to GAD that the actuarial assumptions to be adopted for the valuation should be those set out in this report.

Compliance and quality standards

- 1.9 This work has been carried out in accordance with the applicable Technical Actuarial Standards: TAS 100 and TAS 300 issued by the Financial Reporting Council (FRC). The FRC sets technical standards for actuarial work in the UK.

⁴ From the 2012 based ONS projections to the 2016 based ONS projections.



Table 1: Summary of recommended assumptions consistent with the 'best estimate' requirement

Assumption ⁵	Summary of recommended assumptions	Rationale for recommendation	Magnitude of financial impact of change from 2012 valuation assumptions ⁶	
			Employer contributions (2019-23) – past service impact ⁷ (% of pay)	Employer contributions (2019-23) – past and future service impact ⁸ (% of pay)
Pensioner baseline mortality	Aligned to standard SAPS table ^{9,10}	A combination of the existing assumption and the 2012-2016 experience, and informed by wider analysis of mortality differentials experienced by members of other public service pension schemes in Scotland compared to England.		
Current pensioners (normal and ill-health)	134% x S2NMA		+1.6% ¹¹	+2.0% ¹¹
Future pensioners (normal and ill health)	134% x S2NMA			
Dependants	118% x S2DFA			

⁵ In general, our recommendations are for the same assumptions to be used for males and females. As 95% of members are male, there is insufficient data to analyse female members separately, other than for dependant pensioners who are mostly female.

⁶ The financial impacts have been estimated on an approximate basis using the 2012 valuation results and long term financial assumptions, and should only be used as a guide to the approximate size of the impact. Each impact is specific to the change described and a combination of assumption changes will not necessarily equate to the sum of the individual impacts.

⁷ Impact on uncorrected employer contribution rate of spreading change in past service liabilities over 15 years.

⁸ Total change in employer rate of spreading past service and allowing for future service impacts.

⁹ SAPS tables are published by the Actuarial Profession and the S2 series is based on the experience of self-administered pension schemes from 2004 to 2011. The S2 series has separate standard tables, including those based on experience of members retiring in normal health (S2NMA), in ill-health (S2IMA) and for widows (S2DFA).

¹⁰ Adjusted to take account of improvements in population mortality between the base year for the tables and the date the future improvements are applied from.

¹¹ As directed by HMT, future improvements in mortality assumed to be in line with those underlying the most recent ONS population projections. The financial impact shown relates only to the change in baseline mortality.



Assumption ⁵	Summary of recommended assumptions	Rationale for recommendation	Magnitude of financial impact of change from 2012 valuation assumptions ⁶	
			Employer contributions (2019-23) – past service impact ⁷ (% of pay)	Employer contributions (2019-23) – past and future service impact ⁸ (% of pay)
Age retirement				
1992 Scheme full and tapered protection members	Age and service based rates, with many retiring on reaching 30 years' service and all retiring by age 60.	In light of 2012-16 experience and informed by wider analysis of age retirement in England.	Not material	Not material
1992 Scheme unprotected members	No retirements before age 55. Age and service based rates, with many retiring at age 55. All assumed to retire by age 60.	Based on the assumption for the protected group, but with no allowance for retirement before age 55. There is, however, no relevant evidence yet.	Not material	Not material
Standard 2006 Scheme (protected, tapered and unprotected)	All retire at age 60.	Insufficient evidence. Informed by wider analysis of age retirement in England.	No change in assumption.	
Special retained 2006 Scheme members (protected, tapered and unprotected)	All retire at age 55.	Insufficient evidence. Proposal allows for the full take up of benefits at the earliest time at which they become available on an unreduced basis in the modified scheme.	New assumption.	
2015 Scheme - new entrants	25% retire at 55 and remainder retire at 60.	Insufficient evidence. Proposal makes a reasonable allowance for the take up of benefits at the earliest time at which they become available and is in line with the assumption that was adopted for the 2012 valuation and used for the scheme reform work. To be kept under review.	No change in assumption.	



			Magnitude of financial impact of change from 2012 valuation assumptions ⁶	
Assumption ⁵	Summary of recommended assumptions	Rationale for recommendation	Employer contributions (2019-23) – past service impact ⁷ (% of pay)	Employer contributions (2019-23) – past and future service impact ⁸ (% of pay)
III-health retirement				
Incidence	Same assumptions for males and females. Increasing by age: around 0.03% at age 30, 0.10% at age 40 and 0.50% at age 50.	Same as the assumption proposed for England and no change from 2012 assumption. Small amount of experience over 2012-16 in Scotland. Limited experience is similar to England.	No change in assumption.	
Upper/lower-tier split	40% on upper-tier.	Same as the assumption proposed for England and no change from 2012 assumption. 2012-2016 experience data inconclusive.	No change in assumption.	
Withdrawal				
Regulars (and Special retained)	Same assumptions for males and females. Decreases with age: 1.1% at age 25, 0.3% at age 45.	Same as the assumption proposed for England and no change from 2012 assumption. 2012-2016 experience is higher than 2012 assumption but events during 2012-16, suggest it is not expected to be a reliable indicator of future trends.	No change in assumption.	
Standard retained	Nine times the regular withdrawal rates.			
Death before retirement	Same assumption for males and females. Increasing by age: 0.02% at age 30, about 0.04% at age 40, 0.08% at age 50.	Same as the assumption proposed for England and no change from 2012 assumption. Very small amount of experience over 2012-16 in Scotland. Limited experience is similar to England.	No change in assumption.	



			Magnitude of financial impact of change from 2012 valuation assumptions ⁶	
Assumption ⁵	Summary of recommended assumptions	Rationale for recommendation	Employer contributions (2019-23) – past service impact ⁷ (% of pay)	Employer contributions (2019-23) – past and future service impact ⁸ (% of pay)
Promotional salary scale				
Regular firefighters	Service based scale: large increases for first four years, 0.7% a year for next 8 years, then about 1.2% a year up to 30 years, with a lower increase thereafter.	Same as the assumption proposed for England. In light of 2012-16 experience.	Not material	Not material
Retained firefighters (including Special members)	Age related scale: about 1% a year up to age 50, 0.4% a year thereafter.	Same as the assumption proposed for England and no change from 2012 assumption. In light of 2012-16 experience.	No change in assumption.	
Commutation				
1992 Scheme - protected	25% of pension commuted.	No change from 2012 assumption in light of 2012-16 experience.	No change in assumption.	
2006 Scheme (Special retained) - protected	25% of pension commuted.	In line with 1992 Scheme assumption.	New assumption.	
1992 Scheme - unprotected and tapered	25% of 1992 Scheme and 8.75% of 2015 Scheme pension commuted.	1992 Scheme offers a significantly greater lump sum for pension given up, but experience indicates members will still commute some of their 2015 Scheme pension.	Not material.	-0.3%
2006 Scheme (Special retained) - unprotected and tapered	25% of Special 2006 Scheme and 8.75% of 2015 Scheme pension commuted.	Updated as per the assumption for 1992 Scheme unprotected and tapered members.	New assumption.	
For all other members the directed commutation assumption of 17.5% of pension applies.				



			Magnitude of financial impact of change from 2012 valuation assumptions ⁶	
Assumption ⁵	Summary of recommended assumptions	Rationale for recommendation	Employer contributions (2019-23) – past service impact ⁷ (% of pay)	Employer contributions (2019-23) – past and future service impact ⁸ (% of pay)
Family statistics				
Proportion married	75% at retirement (consistent assumptions for existing pensioners).	Same as the assumption proposed for England and no change from 2012 assumption.	No change in assumptions.	
Proportion partnered	80% at retirement (consistent assumptions for existing pensioners).	Same as the assumption proposed for England and no change from 2012 assumption.		
Age difference	Males 3 years older than partner.	Same as the assumption proposed for England and no change from 2012 assumption.		
Remarriage	No allowance.	No change (no evidence).		



2 Introduction

This report contains our advice to Scottish Ministers but will be of interest to other parties who should note the limitations.

- 2.1 An actuarial valuation of the Firefighters' Pension Schemes (Scotland) ('the Schemes') is being undertaken as at 31 March 2016. The Public Service Pensions (Valuations and Employer Cost Cap) Directions 2014 (as amended) ('the Directions') require that, unless specified otherwise¹², the actuarial assumptions to be adopted for this valuation are the responsibility of Scottish Ministers, having taken advice from the scheme actuary. Direction 19(c) requires the assumptions to be Scottish Ministers' best estimates.
- 2.2 GAD is the appointed scheme actuary to the Schemes. This report is addressed to Scottish Ministers and contains our formal advice on the appropriate assumptions to be adopted for the 2016 valuation, as required by the Directions. The purpose of this advice is to enable Scottish Ministers to determine the required best estimate assumptions.
- 2.3 The advice also has regard to HM Treasury's suggested approach¹³ for setting assumptions in the absence of direct evidence.
- 2.4 The advice covers the main assumptions to be set by Scottish Ministers. In particular, we consider the following sets of demographic assumptions in this report:
- > Pensioner mortality
 - > Age retirement from service
 - > Ill-health retirement from service
 - > Voluntary withdrawal from service
 - > Death before retirement
 - > Promotional pay progression
 - > Commutation of pension for cash at retirement
 - > Family statistics

¹² Certain assumptions are specified in the Directions.

¹³ Set out in Annex A of HM Treasury's *Public service pensions: actuarial valuations and the employer cost cap mechanism* dated March 2014.



Appendix B includes details about the modelling approach and other calculation assumptions as required to complete the valuation, Appendix C sets out assumptions made for data uncertainties, Appendix D includes sensitivities around the choice of assumptions set by Scottish Ministers and Appendix E sets out assumptions for the calculation of the prior value of the cost cap fund in respect of Special retained members of the 2006 Scheme as at 31 March 2015..

- 2.5 This report was provided to Scottish Ministers in draft form, and was also circulated to the Scottish Firefighters' Pension Scheme Advisory Board in draft in October 2017. Since the draft version, the main changes have been to update our advice regarding the commutation assumption and to include two additional appendices regarding assumptions for data uncertainty and Special members. This report has been signed alongside the formal valuation report. Scottish Ministers have already confirmed to GAD, having consulted with relevant stakeholders, that the actuarial assumptions to be adopted for the valuation should be those set out in this report.
- 2.6 SPPA, the Schemes' administrator supplied data on the experience of the membership of the Schemes over the four-year period to 31 March 2016. We have used this data to analyse the Schemes' experience in order to develop our advice on the assumptions. Our report, *Firefighters' Pension Schemes (Scotland) Actuarial Valuation as at 31 March 2016: Report on membership data*, also finalised today, provides information about this data and should be read in conjunction with this advice. The report includes details of the checks carried out on the data, the amendments made to the data and our residual concerns about the quality of the data. In preparing our advice, we have relied upon the general completeness and accuracy of the data provided.
- 2.7 When considering appropriate assumptions, experience (both recent and longer term) generally provides the most reliable evidence when considering best estimates of future experience. However, robust analysis of scheme experience will only be possible where there is both sufficient quality, and quantity, of data. The level of reliance that can be placed on any assumptions derived from the analysis will also vary depending on these two factors. Anticipated future events may also influence how assumptions are set.
- 2.8 It is generally accepted that larger datasets will be subject to less volatility and statistical variation, and may be less prone to the impact of errors in individual records. For the smallest public service pension schemes it may therefore not be possible to undertake, in isolation, a statistically reliable analysis of that scheme's own experience. For other schemes it may only be possible to complete a reliable analysis of certain aspects of the scheme's own experience. Where appropriate, it may be preferable to consider whether the experience of similar larger schemes might be used when setting assumptions.



- 2.9 The Schemes in aggregate are a small public service pension scheme with around 12,000 members. In this advice we propose to set certain assumptions based on an analysis of the scheme's own experience. In some cases the data available to analyse inter-valuation experience for the Schemes is less reliable and complete than corresponding information for the larger Firefighters' Pension Schemes in England ('the England Schemes'). Where there is no reason to believe experience across the membership of the two schemes should be materially different we have also considered the conclusions reached based on the England Schemes experience¹⁴ in formulating our recommendations for the Schemes. This is consistent with the approach used in previous valuations where in many cases the same assumptions have been used for both schemes.
- 2.10 This report sets out relevant analysis of recent experience and indicates which other factors have been considered in deriving recommendations of best estimate assumptions. Scottish Ministers should consider whether there is any reason why the conclusions reached would be inappropriate. Scottish Ministers should consider whether there is any reason why the approach taken to setting the assumptions would be inappropriate.
- 2.11 For a number of assumptions considered in this report the experience data available from the Schemes is not sufficient to set a robust assumption. Placing full reliance on the Schemes' recent experience, might lead to assumptions which vary significantly between valuations simply as a result of one-off events or random variation in the experience. This could lead to unstable valuation results. To mitigate this risk we have made use of the experience of the England Schemes. We have adopted the following approach where there is insufficient evidence from the Schemes to set a robust assumption directly:
- > If the Scottish experience is very similar to the experience in England then the assumption recommended for the England Schemes has been recommended for the Schemes as well.
 - > If the Scottish experience differs from England but the underlying experience in the two regions could reasonably be expected to be the same with the differences resulting only from natural random variation then the assumption recommended for the England Schemes has been recommended for the Schemes as well.
 - > If the difference between the experience in Scotland and England cannot reasonably be the result of natural random variation then the recommended assumption will reflect the experience in Scotland where that is expected to be the best guide for the future. It may still be possible to make use of the experience in England if the experience in Scotland has a similar pattern by age, but the overall level is higher or lower. This does not mitigate the risk of the assumption changing significantly between valuations but is more sensible than adopting an assumption which seems clearly inappropriate.

¹⁴ See report *Firefighters' Pension Schemes (England): Actuarial valuation as at 31 March 2016: Advice on assumptions*, dated 28 February 2019.



- > If no analysis of Scottish experience has been possible due to the lack of credible data then the assumption recommended for the England Schemes has been recommended for the Schemes.

2.12 We are content for Scottish Ministers to release this report to third parties, provided that:

- > it is released in full
- > the advice is not quoted selectively or partially
- > GAD is identified as the source of the report, and
- > GAD is notified of such release.

2.13 Third parties whose interests may differ from those of Scottish Ministers should be encouraged to seek their own actuarial advice where appropriate. Other than to Scottish Ministers, GAD has no liability to any person or third party for any act or omission taken, either in whole or in part, on the basis of this report.



3 General considerations

This chapter sets out a number of general considerations common to the setting of the different assumptions considered in this report.

- 3.1 The key considerations taken into account in formulating the advice in this report are explained in this section.

Directions

- 3.2 The advice in this report reflects the requirements of the Directions issued by HM Treasury that assumptions should be set as Scottish Ministers' 'best estimates' of future experience and should contain no margin for prudence or optimism. They should be set having regard to:

- > assumptions set for previous valuations;
- > analysis of demographic experience in the period up to the valuation date;
- > historic long term trends and emerging evidence which may illustrate long-term trends in the future; and
- > relevant data from any other sources.

Different populations

- 3.3 The Directions require this actuarial valuation of the Schemes covers both the scheme established under the Public Service Pensions Act 2013¹⁵ ("2015 Scheme") and the previous pension schemes ("pre-2015 schemes"), being the 1992 Scheme and 2006 Scheme. Assumptions appropriate to both the 2015 Scheme and the pre-2015 schemes are required for the valuation. The Directions also require assessment of benefit accrual costs over the **implementation period**¹⁶. This requires assumptions about anticipated member behaviour and characteristics during 2019-2023, as well as assumptions about member behaviour and characteristics in the longer term.
- 3.4 There are currently 3 distinct groups of members.
- > Those with full protection and remaining in the pre-2015 schemes to retirement. The introduction of the 2015 Scheme is not expected to have any impact on this group's behaviours.
 - > New members to the 2015 Scheme. These members' retirement behaviours are expected to be heavily influenced by the provisions of the 2015 Scheme.

¹⁵ http://www.legislation.gov.uk/ukpga/2013/25/pdfs/ukpga_20130025_en.pdf

¹⁶ 1 April 2019 to 31 March 2023.



- > Members with service in both the 2015 Scheme and a pre-2015 scheme (including members with tapered protection). Over time, as the proportion of 2015 Scheme service increases, the retirement behaviours are expected to become increasingly influenced by the provisions of that scheme.
- 3.5 Within the 2006 Scheme and 2015 Scheme, members are separately identified as either regular firefighters or retained firefighters. There are no retained firefighter members of the 1992 Scheme.
- 3.6 Where relevant we indicate in each of the following chapters the relative importance of each set of assumptions to the groups of members identified above.

Relative importance of assumptions

- 3.7 The Directions require the valuation results to be estimated to the nearest 0.1% of pensionable payroll. This is a required level of accuracy for a particular calculation and based on a particular set of assumptions. Appendix D provides an indication of the sensitivity of the valuation results to the particular assumptions under consideration.

Males and Females

- 3.8 There are relatively few female firefighters (ie 1% of pensioner members and 5% of active members are female) and as such it is not possible to perform any separate robust experience analysis for females. Our analysis therefore covers male members only. We recommend that the same assumptions are used for male and female firefighters in any given sub-group, based on the analysis of the males in the sub-group. We do not expect the use of different assumptions for females would have a material impact on the valuation results.
- 3.9 The only exception is for dependant pensioners, who are nearly all females. Therefore, the analysis and proposed assumption for these members is based entirely on an analysis of the females in this sub-group.

Special Retained Members

- 3.10 An amendment¹⁷ to the 2006 Scheme regulations made in May 2014 introduced a modified section of the 2006 Scheme for retained firefighters who were employed during the period 1 July 2000 to 5 April 2006 to provide them with access to a pension scheme (known as 'Special' members). The Special members could purchase past pensionable service in the modified section of the 2006 Scheme from the date their service began or from 1 July 2000, if later.

¹⁷ http://www.legislation.gov.uk/ssi/2014/110/pdfs/ssi_20140110_en.pdf



- 3.11 Special members were not present in the 2012 valuation, so there are no existing assumptions for them. Therefore, we have considered assumptions for these members in this report and set out in the relevant sections where assumptions for Special members differ from those for standard 2006 members for use in the 2016 valuation.
- 3.12 We have also considered assumptions for Special members for the purposes of calculating the prior value of the cost cap fund as at 31 March 2015. The Directions require that the assumptions used for this purpose are the assumptions adopted at the 2012 valuation. As no such assumptions already exist for Special members, we have set out proposed assumptions for these members in Appendix E that are consistent with those adopted for standard retained members at the 2012 valuation.



4 Pensioner Mortality

This chapter sets out our recommendation for the baseline pensioner mortality assumptions and summarises the analysis undertaken in order to inform that recommendation.

- 4.1 The assumptions we recommend for baseline pensioner mortality for the 2016 valuation may be summarised by reference to standard mortality tables as follows. The corresponding assumptions for the 2012 valuation are also shown.

Table 4.1: Recommended mortality assumptions

Baseline mortality	2012 valuation		2016 valuation	
	Standard table ¹⁸	Adjustment*	Standard table ¹⁹	Adjustment*
Current normal and ill-health pensioners	S1PMA	132%	S2NMA	134%
Future normal health pensioners	S1NMA	132%	S2NMA	134%
Future ill-health pensioners	S1IMA	100%	S2NMA	134%
Dependants	S1DFA	131%	S2DFA	118%

*An adjustment of 132% means that mortality rates are 32% higher than in the standard table.

- 4.2 As specified by HM Treasury, future improvements in mortality will be assumed to be in line with those underlying the most recent ONS population projections, ONS 2016.

¹⁸ SAPS (S1) tables are published by the Actuarial Profession and based on the experience of self-administered pension schemes over the period 2000 to 2006. The 'S1' series has separate standard tables based on experience of members including all male pensioners (S1PMA), males retiring in normal health (S1NMA), males retiring in ill-health (S1IMA) and for female dependants (S1DFA).

¹⁹ SAPS (S2) tables are published by the Actuarial Profession and based on the experience of self-administered pension schemes over the period 2004 to 2011. The 'S2' series includes separate standard tables based on experience of male members retiring in normal health (S2NMA) and in ill health (S2IMA) and for female dependants (S2DFA). The S3 series of tables were released by CMI on 5 December 2018 and these updated mortality tables cover experience between 2009 and 2016. The final tables are unchanged from the working paper issued during 2018, from which GAD concluded that moving to the S3 tables would likely have no material impact on the valuation results as a whole. It therefore remains appropriate to use the S2 tables for the current valuation.



Comparison of expected pensioner longevity

4.3 The table below gives a comparison of the resulting life expectancies²⁰ (allowing for future improvements) assumed for the 2012 valuation and recommended for the 2016 valuation. The life expectancies shown under each column are calculated using the following assumptions:

- > The mortality assumption adopted for the 2012 valuation allowing for ONS 2012 future mortality improvements.
- > As previous column, but with life expectancies calculated from the year 2016, rather than from 2012.
- > As previous column, but using ONS 2016, rather than ONS 2012.
- > The proposed mortality assumption for the 2016 valuation allowing for ONS 2016 future mortality improvements.

Table 4.2: Comparison of life expectancies (years) at the valuation date

Base table:	2012 assumption	2012 assumption	2012 assumption	2016 assumption
Future mortality improvements:	ONS 2012	ONS 2012	ONS 2016	ONS 2016
Effective year for life expectancies:	2012	2016	2016	2016
Current pensioners (normal and ill-health)				
Member aged 50	35.3	35.9	34.6	35.3
Member aged 55	30.2	30.8	29.6	30.2
Member aged 60	25.5	25.9	24.8	25.2
Member aged 65	20.8	21.3	20.2	20.4
Future pensioners (normal and ill-health) – current age 45²¹				
Member life expectancy from age 50	36.0	36.5	35.2	35.9
Member life expectancy from age 55	31.6	32.0	30.8	31.2
Member life expectancy from age 60	27.2	27.6	26.4	26.7
Member life expectancy from age 65	22.9	23.3	22.1	22.3

²⁰ Cohort life expectancies based on ages shown in the effective year, ie allowing for future mortality improvement.

²¹ Life expectancies for future pensions based (on a combined health basis) on 2012 valuation assumptions use 132% of S1PMA base table to follow an approach consistent to the proposed 2016 assumptions.



Use of the assumption

- 4.4 Pensioner mortality is a key valuation assumption and is a measure of how long members retiring in normal or ill-health, or their dependants, are expected to live and receive benefits.

Analysis and setting the assumption

- We have analysed the actual pensioner mortality experience over the four-year period to 31 March 2016 for male retirements. There is insufficient data to carry out a credible analysis for female retirements and so we have proposed use of the same standard mortality tables as those applying to members of the opposite sex. This is consistent with the approach adopted at the 2012 valuation.
- 4.5 For male retirements, we have analysed the actual pensioner mortality experience over the four-year period to 31 March 2016 on an 'amounts' basis. To derive an assumption on an amounts basis we have compared the actual amounts of pension ceasing on deaths with those amounts expected had the members' experience been in line with the mortality rates in the relevant current SAPS tables ("S2 Tables"). The recommended assumption of baseline pensioner mortality is expressed by reference to suitable adjustments to the rates in the relevant S2 Table ("the base table"). The analysis is carried out using ONS 2014 projections, being the set of projections available at the time that the analysis was carried out. Previous analysis carried out by GAD suggested that the impact of using ONS 2014 or 2016 projections for mortality analysis would be minimal.
- 4.6 The four year period ending on the valuation date showed significant volatility in mortality experience year on year. This is illustrated in Table 4.3 below. The figures shown are the ratios of actual to expected death rates with expected rates based on the 2012 valuation assumptions, adjusted as appropriate for each period analysed. This analysis suggests that differing conclusions may have been drawn had the valuation date and inter-valuation period fallen differently. As assumptions are intended to reflect long term expectations it is reasonable to seek to smooth out the impact of these short term effects. Our recommendation is that the short term effects should be smoothed out by averaging between the 2012 assumption and the 2012-2016 experience, weighted appropriately.
- 4.7 At the previous valuation, the mortality assumption for current pensioners was based on the standard male mortality table 'S1PMA', which is a standard table calculated from both normal and ill-health retirements. This was chosen as it provided a better match to the results of the mortality analysis in the 2012 valuation. We propose that the standard male mortality table 'S2NMA', which was calculated from normal health retirements, is adopted as the base table for the mortality assumption for the 2016 valuation. This is the same base table as that being used for the England Schemes, meaning that comparisons are straightforward, and it provides at least as good a match to the 2012-16 analysis as using the relevant table from the S2 Tables that is derived from both normal and ill-health retirements.



- 4.8 We also recommend that the mortality assumption for future pensioners, for both normal and ill-health retirement, is the same as the assumption proposed for current pensioners. This is a change from the 2012 approach which used:
- > 100% of a standard ill-health mortality table for future ill-health retirements; and
 - > an adjusted standard normal health mortality table, with the adjustment calculated such that the combination of expected future normal and ill-health retirements would have the same mortality as the assumption for current pensioners (both normal and ill-health).
- 4.9 The changes outlined in paragraphs 4.7 and 4.8 are not expected to have a material impact on the valuation results, but have the advantage that the proposed mortality assumptions are easier to understand. The change set out in paragraph 4.8 is also consistent with the approach being taken by other public sector pension schemes which use a combined normal and ill-health mortality assumption for current pensioners, such as for the England Schemes.

Table 4.3 – Variation in rates of death by scheme year

Year	Combined normal health and ill-health males (Actual / Expected based on 2012 assumption*)
2012-2013	67.4%
2013-2014	97.3%
2014-2015	94.0%
2015-2016	107.4%
Overall	91.9%

* 2012 baseline with ONS 2014 improvements

‘Amounts’ analysis vs ‘lives’ analysis

- 4.10 Provided adequate data is available, mortality can be analysed on either a ‘lives’ basis or an ‘amounts’ basis:
- > A lives basis gives an equal weighting to every member of the population being analysed.
 - > An amounts basis weights the experience by the size of each member’s pension (with the longevity of those with larger pensions given more of a weighting).



- 4.11 There is much evidence²² to demonstrate that the size of pension is positively correlated with longevity, ie on average those with bigger pensions live longer. For a population with significant variation in the characteristics of the membership and in the amounts of pension being paid, an amounts mortality analysis is generally expected to show lower rates of mortality than a corresponding lives analysis.
- 4.12 Where possible it is usually preferable to use an amounts analysis rather than a lives analysis to set the mortality assumption for an actuarial valuation as in an amounts analysis the weighting given to different members' mortality experience more closely reflects the relative size of their financial liabilities to the pension scheme.
- 4.13 At the 2012 valuation it was not possible to complete an amounts analysis as data on pension amounts at death was not available. Therefore, a lives analysis was done and this was used to set the assumptions which were adopted for the valuation. GAD's *Advice on assumptions* report dated 4 March 2015 included the following comment:

... we have carried out our analysis on a 'lives' basis, which considers the number of deaths without weighting by pension amount. We consider this to be a reasonable method for the Schemes, as the underlying population is largely homogeneous, and so pension amounts are less widely spread than would be the case in a more diverse scheme. However, if the amounts data were available it is possible that analysis could lead to different mortality assumptions.

For the 2016 valuation it has been possible to do an amounts analysis and a lives analysis.

Results of analysis

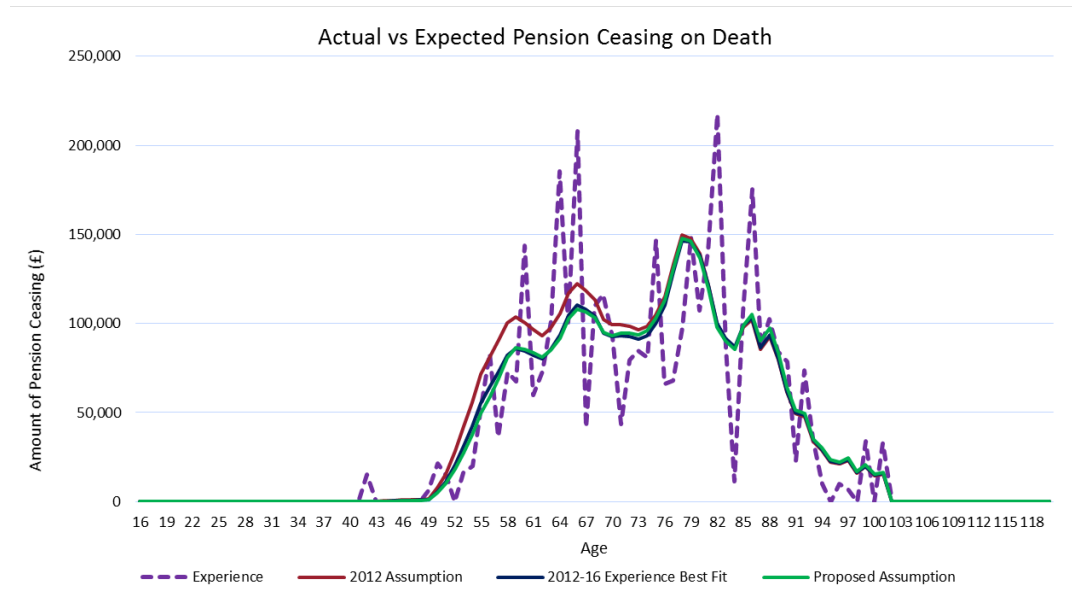
- 4.14 After excluding any data that was not credible, there were 278 pensioner deaths over the four years from 2012 to 2016. Graph 4.1 below shows, by age, a comparison of:
- > the actual mortality experience (amount of pension ceasing) for male normal and ill-health pensioners over the four year period (purple dashed line).
 - > the expected amount of pension ceasing based on the 2012 valuation assumption (red line)²³.
 - > the 'best fit' of experience to the most appropriate S2 base table (blue line).
 - > the proposed assumption for the 2016 valuation (green line).

²² For example see CMI self-administered Pension Schemes Mortality Committee, Working Paper 65: *Analysis of the mortality experience of pensioners of self-administered pension schemes for the period 2004 to 2011*, April 2013.

²³ With ONS-2014 improvements.



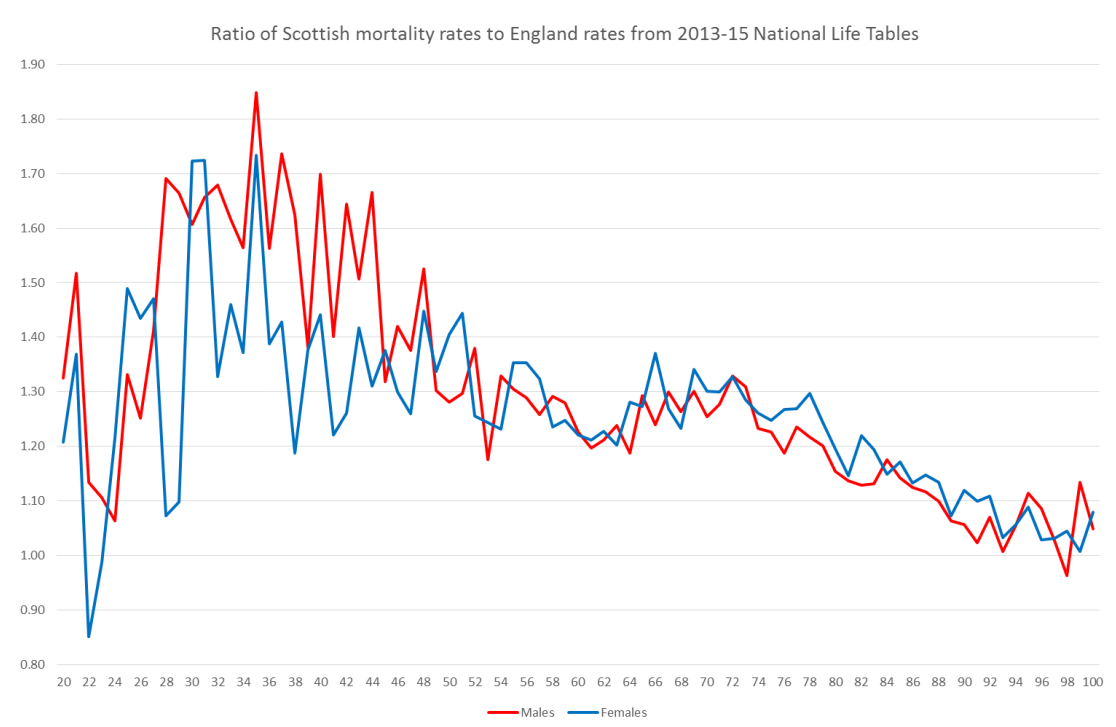
Graph 4.1: Combined male normal health and ill-health pensioner mortality experience 2012-2016



- 4.15 At the 2012 valuation, the difference between the mortality assumption for current pensioners in Scotland and England was around 21%, ie mortality rates in the Schemes were assumed to be about 21% higher than those in the England Schemes. In order to make a direct comparison of the assumption from the 2012 valuation, we expressed the 2012 assumption in Scotland of 132% of S1PMA in terms of the S1NMA table (which resulted in an equivalent assumption of 137% of S1NMA).
- 4.16 We have made a comparison of the mortality table that provides a best fit for the mortality experience in the Schemes over 2012-16, with the equivalent mortality table which provides a best fit for the mortality experience in the England Schemes over 2012-16 (with both analyses carried out on an 'amounts' basis). This showed a difference of about 27%, with the mortality rates in Scotland continuing to be greater than those in England.
- 4.17 We have also considered analysis of differences between population mortality rates for Scotland and England (so not just limited to firefighters). Graph 4.2 shows the ratio of Scottish population mortality rates to those for England for ages 20 to 100. Looking at ages 60 and older (as relevant for pensioner mortality), mortality rates for Scotland are generally around 25% higher for ages 60 to 70; the ratio then declines in a relatively linear fashion until around age 90 after which mortality rates in Scotland are around 5% greater in Scotland.



Graph 4.2: Ratio of Scottish mortality rates to England rates from 2013-15 Interim Life tables



- 4.18 We can also consider the differential between mortality rates in Scotland over those in England and Wales that are being proposed for the other public service pension schemes in Scotland (including the Police Pension Scheme, which is a comparable uniformed workforce). A differential of 12.5% is being proposed for these schemes for the 2016 valuations. This is a relevant differential for the Schemes, as this relates to other workforces, rather than including the whole population, and has been derived from analyses of much larger data sets. It can then be used as a reference point when setting an assumption for firefighters. Although other schemes have based the differential on a comparison between Scotland and the aggregate of England and Wales, similar conclusions can be made for a comparison of Scotland with just England, as the overall mortality experience for England and the aggregate of England and Wales is very similar.

Comments on analysis

- 4.19 The 2012-16 experience of the Schemes suggests relatively higher mortality rates in Scotland compared to England than was observed at the 2012 valuation. However, this relationship is also dependant on changes in the mortality experience in England, which showed much lower mortality rates over 2012-16 than expected. This has the effect of increasing the observed differential between Scotland and England over 2012-16 and, given the relatively low levels of experience data, could have been significantly impacted by random fluctuations.



- 4.20 Therefore, we propose that a 50/50 approach is taken when using the results of the firefighter specific analysis, to result in a Scotland/England differential of 24%, being the average of the 21% from the 2012 valuation and the 27% observed from the 2012-16 analysis.
- 4.21 The significant changes in the differential from one valuation to the next are symptomatic of the random fluctuations that might be expected from a relatively small scheme. We also note that, other than from the scheme experience observed, it is not obvious why the mortality differential for firefighters in Scotland should be any different from the differential for any other public service workforce in Scotland. Therefore, we propose that the differential observed from firefighter data alone is combined with the differential being used by other public service pension schemes in Scotland.
- 4.22 For the 2016 valuation, we therefore propose that the mortality assumption is set to be the average of the 24% differential from the firefighter specific analysis and the 12.5% differential being proposed for use by other schemes. This results in an overall differential of 18.25%, which equates to an assumption of 134% of S2NMA (compared to 113% of S2NMA in England).
- 4.23 This approach to averaging with the differential being used by other schemes provides some stability to the mortality assumption and makes use of the larger data sets that underlies those schemes, whilst still recognising the higher differential that is currently being observed for the firefighter workforce.

Dependant pensioner mortality

- 4.24 After excluding any data that was not credible, there were 118 dependant pensioner deaths in the Schemes over 2012-16. The experience of the England Schemes shows 500 dependant pensioner deaths.
- 4.25 Given the relatively small size of the dependant pensioner experience in Scotland, we recommend the mortality assumption for dependants is set by reference to the equivalent assumption for the England Schemes, using the same 18.25% differential between England and Scotland mortality rates, as is proposed for current pensioners. This results in a proposed assumption for dependants of 118% of S2DFA, compared to an assumption of 100% of S2DFA being proposed for the England Schemes.
- 4.26 This approach is consistent with that generally being proposed for the dependants' mortality assumption in other public service pension schemes in Scotland.



5 Age retirement from service

This chapter sets out our recommendation for the assumed patterns of retirement on grounds other than ill-health, and summarises the analysis undertaken in order to inform that recommendation.

Proposed assumptions for 2016 valuation

- 5.1 We recommend that rates of age retirement are set separately for the following groups of members:
- > 1992 Scheme members who have full protection or tapered protection.
 - > Unprotected 1992 Scheme members.
 - > Members with any standard 2006 Scheme service (ie including protected, tapered and unprotected members).
 - > Special members with any modified 2006 Scheme service (ie including protected, tapered and unprotected members).
 - > 2015 Scheme members with no previous service in the pre-2015 schemes.

Sample age retirement rates are provided in Appendix A. This approach to setting assumptions was adopted for the previous valuation (other than for the new assumption for Special members). There is not yet any evidence on which to reconsider this approach.

Members with 1992 Scheme service

- 5.2 For full and taper protection members, who continued in the 1992 Scheme after 2015 (depending on length of taper), we recommend adopting the same retirement assumption proposed for firefighters in England in the 2016 valuation who have full and taper protection. Both age and service are taken into account in the retirement rates. Many members are assumed to retire on reaching 30 years' service and all are assumed to retire by age 60.
- 5.3 Using the same assumption for these members is consistent with the approach taken in 2012 and reflects an expectation for the 1992 Scheme benefits, rather than 2015 Scheme benefits, to drive member behaviours.
- 5.4 For unprotected members we also recommend adopting the same retirement assumption proposed for unprotected firefighters (with less than 16 years' service at 2012) in England in the 2016 valuation.



5.5 Although the specific percentages of members assumed to retire at each age and service combination is different from that assumed for the Schemes in 2012, the structure of this assumption is the same. This structure uses the assumption for full and tapered protection members, but reflects an expectation for the 2015 Scheme benefits to have some influence over member behaviours, in particular the availability of a reduced early retirement pension at age 55 in the 2015 Scheme.

5.6 The retirement rates for the unprotected members assume that no members retire before age 55 and most members retire at age 55. For example, for members who joined before age 25, about 99% are assumed to retire at age 55, and for members joining at age 30 (and over) about 40% are assumed to retire at age 55.

Members with standard 2006 Scheme service

5.7 We recommend that members with standard 2006 Scheme service are assumed to retire at age 60. This applies to protected members, members with tapered protection and unprotected members who have joined the 2015 Scheme.

Special Retained Members

5.8 Under the pension arrangements of the modified section of the 2006 Scheme, all Special retained members are eligible to retire at age 55 with an unreduced pension. Therefore, we propose that protected Special members take up their benefits at age 55, with this being the earliest available opportunity to draw an unreduced pension.

5.9 We propose that unprotected and tapered Special members are also assumed to retire at age 55 in the 2015 Scheme, as a (reduced) 2015 Scheme pension is available from that age.

New entrants to the 2015 Scheme

5.10 Our recommended assumption is:

- > 25% of members reaching age 55 are assumed to retire immediately; and
- > all remaining members will retire at age 60.

5.11 The assumption is intended to make a reasonable allowance for the take-up of benefits at the earliest time at which they become available (with reduction for early payment) and is the same assumption that was adopted in the 2012 valuation. It is also consistent with the assumption adopted for the scheme reform work.



Deferred Members

- 5.12 We recommend it is assumed that deferred members will take their pension at their deferred pension age. Deferred members can take a reduced pension before deferred pension age, but the reduction is actuarially neutral so allowance for this would not have a material impact on the valuation results.

Previous valuation assumptions

- 5.13 The proposed assumptions are identical in nature and effect to those which were adopted for the 2012 valuation for all categories of members except for 1992 Scheme members. For 1992 Scheme members the proposed assumptions are identical in nature to those adopted for the 2012 valuation but have been updated to account for retirement experience over 2012-2016 by aligning with the equivalent assumptions proposed for the England Schemes. There are also new assumptions for the Special retained members.

Use of the assumption

- 5.14 Age retirement rates specify the rate at which members are assumed to retire on grounds other than ill-health and therefore potentially include allowance for retirements before or after Normal Pension Age.
- 5.15 In the 1992 Scheme, members can retire on an unreduced pension once they have completed 25 years' service if they are aged 50 or over, and most members can retire from age 55 regardless of service. There is no actuarially reduced early retirement option.
- 5.16 Members in the 2006 Scheme can retire unreduced at age 60 from active service and from age 65 if deferred members. Active members can take actuarially reduced early retirement from age 55 up to age 60; the reduced pension is with reference to a pension payable from age 65.
- 5.17 Members in the 2015 Scheme can retire unreduced at age 60 from active service and from State Pension Age if deferred members. Active members can take an actuarially reduced early retirement from age 55, with reference to a pension payable from age 60 (with future increases assumed to be in line with in-service revaluation).

Analysis and setting the assumption

- 5.18 For the purposes of considering the assumptions appropriate for full and taper protection members of the 1992 Scheme, we have analysed the retirement experience of these members over 2012-16.



- 5.19 After excluding any data that was not credible, there were 402 age retirements from the 1992 Scheme over 2012-16, with an average age on retirement of 52 years. We have also considered the experience of the England Schemes, for which 2,668 retirements were included in the equivalent analysis over 2012-16, with an average age of 52 years.
- 5.20 Assumptions appropriate for unprotected 1992 Scheme members are set with reference to the assumptions for the protected group above (by assuming that members who would otherwise have retired before age 55, now retire at age 55), so no additional analysis is required.
- 5.21 There is insufficient data to undertake any meaningful analysis of retirements in the 2006 Scheme (standard and special) or in the 2015 Scheme. As most of the available retirement experience continues to relate to retirements from the 1992 Scheme, the actual scheme experience is not directly relevant for this purpose. As such, we recommend that the retirement assumption for this group of members adopted for the 2012 valuation is maintained.

Results of analysis for protected 1992 Scheme members

- 5.22 We have considered the proportion of normal health retirements by age and service over the period 2012-16 compared to those observed for the England Schemes over the same period and those expected under the proposed assumption for the England Schemes. The results of these comparisons can be seen in Graphs 5.1 (by age) and 5.2 (by service) below.

Graph 5.1: Proportion of 1992 Scheme retirements by age





Graph 5.2: Proportion of 1992 Scheme retirements by service



Comments on results of analysis for protected 1992 Scheme members

- 5.23 Both charts show a reasonable alignment of the retirements in both Scotland and England over the period, and a much closer alignment than that observed at the previous valuation. The average age of retirements has been 52 in both Scotland and England. We also note that the benefit design of both the 1992 Scheme in Scotland and England is the same in so far as it would be expected to influence retirement rates. We therefore propose that the retirement assumptions proposed for the equivalent groups of 1992 members in the England Scheme is adopted for the Schemes at the 2016 valuation.
- 5.24 The protection for 1992 Scheme members in Scotland is applied in a different way than in England, as it was based on both age and service in Scotland, rather than just based on age in England. As such, there is a different profile of protected members in Scotland than in England, which results in a group of longer serving members who are protected in Scotland, but not in England. The retirement assumption in England generally treats this group (defined as unprotected members with more than 16 years' service in 2012) in a similar way to the protected members, based on an expectation that their 1992 Scheme benefits will be the main driver of their retirement behaviour. Such an approach is not required in Scotland as these members are protected and therefore already assumed to retire in a similar pattern as other protected members.



6 Ill-health retirement from service

This chapter sets out our recommendation for the assumed rates of retirement on grounds of ill-health, and summarises the analysis undertaken in order to inform that recommendation.

Proposed assumptions for 2016 valuation

- 6.1 We recommend that a single set of assumptions is used for all members to allow for the incidence of ill-health retirement, ie applying both to those members who remain in the pre-2015 schemes and members of the 2015 Scheme. Assumed rates of ill-health increase with age but less than 1.5% of members are assumed to retire on ill-health grounds each year, even at the highest ages. Sample rates are provided in Appendix A.
- 6.2 We also recommend assuming that 40% of members retiring on ill-health grounds will receive the upper-tier benefits and the remaining 60% will receive the lower-tier benefits.

Previous valuation assumptions

- 6.3 The proposed 2016 assumptions for both the incidence of ill-health retirement and the proportion of members eligible for upper-tier benefits are the same as those adopted for the previous valuation.

Use of the assumptions

- 6.4 Ill-health retirement rates specify the rate at which members are assumed to retire on grounds of ill-health. The assumed eligibility for upper or lower-tier awards specifies the benefits which will be provided. The ill-health assumptions have a low impact on the overall results. The rates of mortality experienced after ill-health retirement are also relevant to the valuation calculations. Post retirement mortality is addressed in Chapter 4.

Analysis and setting the assumption

Ill-health incidence

- 6.5 After excluding any data that was not credible, there were 73 ill-health retirements in the Schemes over 2012-16, with an average age on ill-health retirement of 49 years.
- 6.6 As this is a relatively small number of ill-health retirements, the experience of the Schemes is not sufficient in isolation to set a robust assumption and so we have also considered the experience of the England Schemes, for which 244 retirements were included in the equivalent analysis over 2012-16, with an average age on ill-health retirement of 49 years.



- 6.7 The 73 ill-health retirements in Scotland equates to an approximate average ill-health rate of 0.32% pa over the four-year period 2012-16. The equivalent rate over the same period in the England was 0.25%. The average age on ill-health retirement over 2012-16 was the same in Scotland and in England.
- 6.8 Given the relatively small amount of ill-health experience for the Schemes and that the experience in England was similar, we propose that the ill-health assumption for England for the 2016 valuation is also adopted for the Schemes. This is consistent with the structure of the assumptions used at the 2012 valuation, when the same ill-health assumptions was used in Scotland and in England. This also means no change in the assumption from that used for the Schemes in the 2012 valuation.

Split between ill-health tiers

- 6.9 We have also analysed the proportion of members with upper-tier benefits when retiring in ill-health during 2012-16. Over this period, 41 (or 56%) of the 73 ill-health retirements were recorded as upper-tier. This compares to the assumption made in the 2012 valuation that 40% would be upper-tier.
- 6.10 The equivalent analysis in England was inconclusive in that the experience data collected as part of the valuation showed that 57% of ill-health retirements over the four year period 2012-16 were upper-tier, although this was distorted by an unusually high upper-tier proportion in 2012-13 year due to how these were recorded on the administration system that year (the overall figure reduces to 46% with that year removed from the analysis). However, separate figures published by the Department for Communities and Local Government and the Home Office²⁴ showed lower levels of upper-tier proportions than obtained from the analysis above (for example, 33% in the year 2015-2016). On balance, noting that the split between ill-health tiers is of low materiality to the valuation results, the proposed assumption in England was to maintain the 2012 assumption (ie that 40% of ill-health retirements are upper-tier).
- 6.11 With regard to the inconclusive analysis in England, we have also considered separate information²⁵ published by the Scottish Fire and Rescue Service which showed that the proportion of upper-tier benefits in 2015/16 was 21% and in 2016/17 was 39%, both of which are lower than the 2012 valuation assumption of 40%.
- 6.12 Therefore, given the small number of upper-tier ill-health pensions observed in Scotland on which an assumption can be based, the inconclusive data and that we are not aware of any reason why this proportion would be significantly different to that in England, we propose that the assumption of 40% for upper-tier ill-health benefits is maintained for the 2016 valuation in Scotland.

²⁴ <https://www.gov.uk/government/collections/firefighters-pension-scheme-statistics>

²⁵ http://www.firescotland.gov.uk/media/1064711/9_resource_budget_monitoring_february_2017.pdf



7 Voluntary withdrawal from service

This chapter sets out our recommendation for the assumed rates of withdrawal from active service, and summarises the analysis undertaken in order to inform that recommendation.

Proposed assumptions for 2016 valuation

- 7.1 We recommend that for the purposes of the 2016 valuation separate withdrawal rates are used for regular and standard retained members. We propose that Special retained members are assumed to withdraw at the same rate as regular firefighters.
- 7.2 These withdrawal rates would apply equally to those members who remain in the pre-2015 schemes and those who join the 2015 Scheme.
- 7.3 The recommended rates decrease with age; for regular firefighters they are 1.1% at age 25 and 0.3% at age 45. Withdrawal rates for standard retained firefighters are nine times the regular firefighter rates.
- 7.4 Sample rates are provided in Appendix A. The same rates apply regardless of the length of the member's service, except that no withdrawal will be assumed for members entitled to immediate retirement benefits.

Previous valuation assumptions

- 7.5 The proposed 2016 assumptions are the same as those adopted for the previous valuation, other than the new assumption for Special retained members who were not present in the 2012 valuation.

Use of the assumption

- 7.6 Withdrawal rates specify the rate at which members are assumed to leave voluntarily before retirement (including opting out), becoming entitled to either deferred benefits or, for those with less than 3 months' service, a refund of contributions, or have chosen to transfer the value of their pension out of the Schemes.
- 7.7 There is insufficient evidence to indicate the level of members re-joining the Schemes after leaving. For the avoidance of doubt, all members assumed to withdraw are assumed not to re-join.



Analysis and setting the assumption

- 7.8 After excluding any data that was not credible, there were 730 withdrawals in the Schemes over 2012-16, with an average age on withdrawal of 37 years. These split out as 150 withdrawals from the 1992 Scheme and 580 withdrawals from the 2006 Scheme. For this split, those members who moved to the 2015 Scheme before leaving are allocated to their pre-2015 scheme.
- 7.9 The 150 withdrawals of the 1992 Scheme members in Scotland equates to an approximate average withdrawal rate of 1.2% pa over the four-year period 2012-16. This is double the rate that was expected over the period based on the 2012 assumption.
- 7.10 The withdrawal data for the 2006 Scheme does not contain a credible split between withdrawals for regular and retained firefighters. Therefore, we have compared the total withdrawal rate in the 2006 Scheme against that expected, with the expected rate based on the use of the separate withdrawal assumption for regular and retained 2006 Scheme members.
- 7.11 This showed that the 580 withdrawals of the 2006 Scheme members in Scotland equates to an approximate average withdrawal rate of 5.6% pa over the four-year period 2012-16. This is about 30% higher than the rate that was expected over the period based on the 2012 assumption.
- 7.12 Therefore, for both pre-2015 schemes there was a significantly higher number of withdrawals than expected under the 2012 valuation assumptions.
- 7.13 There are a number of reasons why events in the 2012-16 period may mean that levels of withdrawal during the period are atypical and would not be expected to be repeated in future. These events include:
- > The increases to member contributions over the period 2012-15.
 - > The introduction of the 2015 scheme on 1 April 2015.
 - > Continued public sector pay restraint.
- 7.14 All of these events could reasonably have led to higher withdrawals than expected. Given that withdrawal experience in the 2012-16 period is not expected to be a good indication of future rates of withdrawal, our proposal is to maintain the existing assumption. This is in line with the proposal for the England Schemes which have also seen a substantially higher level of withdrawals over 2012-16 than expected.
- 7.15 There was insufficient data to perform a credible analysis on the withdrawal rates from the 2015 Scheme, separately from the pre-2015 schemes. We propose that members are assumed to withdraw at the same rates adopted for the 2006 Scheme. This is consistent with the approach at the 2012 valuation.



- 7.16 There was insufficient data to perform a credible analysis of the withdrawal rates for Special retained members of the 2006 Scheme. As these members are accruing benefits similar in value to those from the 1992 Scheme and, by definition, have already been retained firefighters for at least 10 years (ie since before April 2006), we expect that they may be more likely to withdraw at lower rates, closer to those assumed for regular firefighters. Therefore, we propose that the withdrawal assumption for regular firefighters is adopted for the Special retained members.
- 7.17 There was insufficient data to perform a credible analysis on withdrawal rates of female firefighters. We propose that the same withdrawal rates are adopted for both male and female members.



8 Death before retirement

This chapter sets out our recommendation for the assumed rates of death before retirement, and summarises the analysis undertaken in order to inform that recommendation.

Proposed assumptions for 2016 valuation

- 8.1 We recommend a single set of assumptions for all members to allow for the possibility of death before retirement. Assumed rates of death before retirement increase with age but fewer than 0.5% of members are assumed to die before retirement each year, even at the highest ages. Sample rates are provided in Appendix A.

Previous valuation assumptions

- 8.2 The proposed 2016 assumptions are the same as those adopted for the previous valuation.

Use of the assumption

- 8.3 Death before retirement rates are used to allow for the possibility of deaths whilst in active service or whilst entitled to a deferred pension. The numbers of deaths observed annually, and the recommended rates to be assumed, are low, and thus this assumption has relatively little financial significance.

Analysis and setting the assumption

- 8.4 After excluding any data that was not credible, there were 13 deaths in service in the Schemes over 2012-16, with an average age at death of 49 years.
- 8.5 As this is a very small number of deaths, the experience of the Schemes is not sufficient in isolation to set a robust assumption and so we have also considered the experience of the England Schemes, for which there were 47 deaths included in the equivalent analysis over 2012-16, with an average age at death of 47 years.
- 8.6 The 13 deaths in Scotland equates to an approximate average mortality rate of 0.06% pa over the four-year period 2012-16. The equivalent average mortality rate over the same period in England was 0.05% pa. The average age on death over 2012-16 was 2 years later in Scotland than in England.
- 8.7 There is little experience in Scotland to use as a firm base for this assumption, and the limited experience is similar to that observed in England. Therefore, we propose that the England assumption is adopted for the 2016 valuation. This is consistent with the structure of the assumptions used at the 2012 valuation, when the same death before retirement assumption was used in Scotland and in England. This also means no change in the assumption from that used for the Schemes in 2012.



9 Promotional pay increases

This chapter sets out our recommendation for the assumed promotional pay increases of active members, and summarises the analysis undertaken in order to inform that recommendation.

Proposed assumptions for 2016 valuation

- 9.1 We recommend assuming separate scales of promotional increases for regular firefighters and retained firefighters. The increases for regular firefighters are dependent on service and are steeper at shorter durations of service. The increases for retained firefighters are assumed to be dependent on age. Sample values from the scale are provided in Appendix A.
- 9.2 We recommend assuming that promotional pay increases for Special retained members are equal to those of standard retained members.

Previous assumption

- 9.3 For retained firefighters the assumption adopted for the 2012 valuation is the same as that recommended for the 2016 valuation. For regular firefighters, the 2012 valuation assumption allowed for a higher level of increase over years 4 to 12. There was no assumption for Special retained members in the 2012 valuation, as these members did not exist in 2012.

Use of the assumption

- 9.4 For members of the (final salary) 1992 and 2006 schemes, their benefits are linked to pay at or near retirement. Their pay will generally increase through a combination of general annual pay awards, promotional increases and any ad-hoc adjustments (eg due to changes in crewing arrangements). To calculate an estimate of the level of benefit payable in the future requires assumptions for each of these components. The assumption for general pay awards is directed by HMT. The assumption for promotional pay increases, and any other ad-hoc increases, is set by Scottish Ministers.
- 9.5 The impact on the cost of the Schemes of future pay increases will be more significant for those members with either full or tapered protection because they continue to accrue benefits linked to final pensionable pay for service beyond 31 March 2015.



Analysis and setting the assumption

- 9.6 To formulate a recommended assumption for promotional pay increases, we compared the scheme data to the assumption adopted for the 2012 valuation using a 'profile analysis'. For regular members, the profile analysis considers the overall active membership as at 31 March 2016 and compares average (WTE²⁶) pensionable pay at each length of service with that at other lengths of service. This analysis illustrates how average (WTE) pay varies by length of service. The profile analysis for retained firefighters is based on age rather than length of service. These differences in pay at each service length/age are then compared to the assumed promotional increases adopted for the 2012 valuation. The results of both profile analyses are discussed below.
- 9.7 We have made no explicit allowance for the current period of pay restraint in our analysis, on the basis that promotional/progression increases have not been significantly affected by this.

²⁶ Whole-time equivalent.

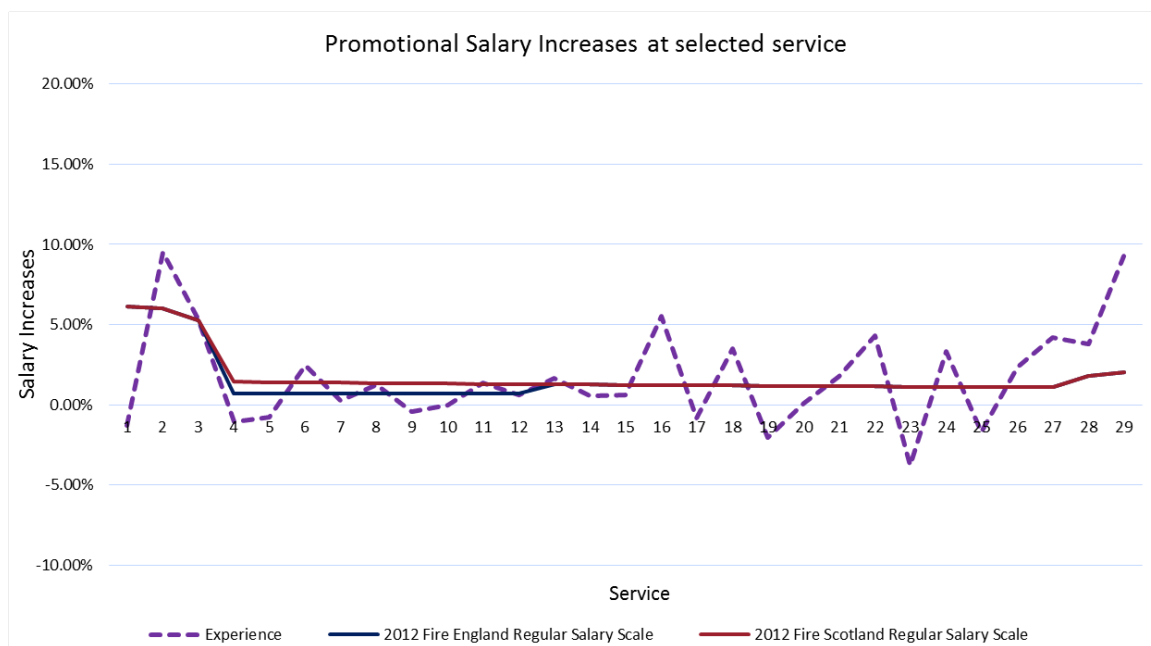


Results of profile analysis for promotional pay increases

Regular firefighter members

- 9.8 Graph 9.1 shows the change in average WTE pay for regular firefighters at each service length based on the 'profile analysis' of members at the valuation date (purple line).
- 9.9 This is compared with the assumed increase from the service related promotional scale adopted for the 2012 valuation in Scotland (blue/red line) and the assumption proposed in England (red line).

Graph 9.1: Change in average WTE pay at each service length for active population as at 31 March 2016 – Regular Firefighters

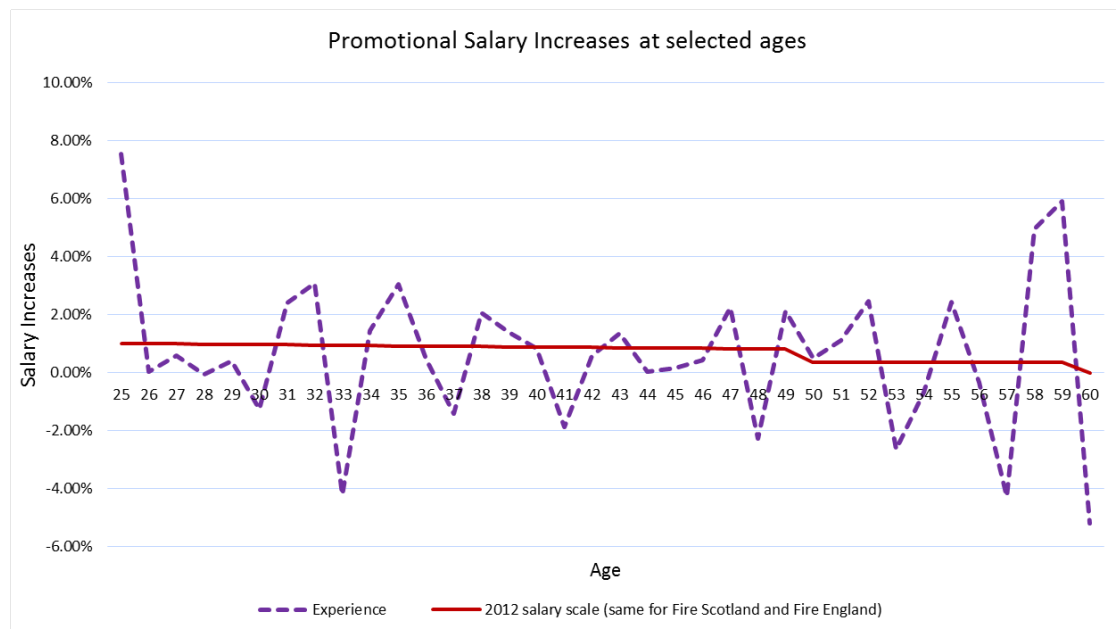




Retained firefighter members

- 9.10 Graph 9.2 shows the change in average WTE pay of retained firefighters at each age based on the 'profile analysis' of members at the valuation date (purple line). This is compared with the assumed increase from the age related promotional scale adopted for the 2012 valuation (red line).

Graph 9.2: Change in average WTE pay at each age for active population as at 31 March 2016 – Retained Firefighters



Comments on the analysis

- 9.11 The results of this analysis should be treated with some caution as the analysis is affected by the mixture of members at each service length and age. However, the profile analysis in Graph 9.2 shows that experience has been broadly in line with the 2012 assumption for retained members. We therefore propose that the 2012 assumption is maintained for retained members.
- 9.12 For regular members, Graph 9.1 shows that experience has been broadly in line with the 2012 assumption, but the proposed assumption for the England Schemes provides a better fit over years 4 to 12. We therefore propose that the proposed assumption for the England Schemes is adopted for the Schemes at the 2016 valuation.



- 9.13 There is some variation between experience and assumptions at the early years of service and age in both graphs. However, the assumption at these points is less material to the valuation, as members with lower amounts of service have small accrued pensions linked to their final salary. In addition, the majority of these members will now be accruing benefits in the 2015 scheme, for which the assumption about promotional pay increases is much less significant.
- 9.14 We understand that there are proposals relating to the transformation of the Scottish Fire and Rescue Service (SFRS) which may have a significant impact on the active membership. We understand that any changes have not been concluded and therefore no allowance has been made in the valuation assumptions for any impact on assumed future salary growth from these proposals or for any other ad-hoc future increases in pensionable pay.



10 Commutation of pension for cash at retirement

This chapter sets out our recommendation for the assumed level of pension commutation at retirement (where this is not specified in the HM Treasury valuation directions), and summarises the analysis undertaken in order to inform that recommendation.

Proposed assumptions for 2016 valuation

- 10.1 We recommend that members are assumed to commute the following proportions of their pensions for cash. The assumptions are the same for men and women.

Table 10.1: Recommended commutation assumption for the 2016 valuation

Member with service in the following schemes	1992 Scheme only	2006 Scheme only	2006 Scheme (Special Retained Members) only	2015 Scheme only
Scheme pension commuted from	1992	2006	Modified 2006	2015
All members	25%	17.5% ²⁷	25%	17.5% ²⁷

Member with service in the following schemes	Mixed 1992 Scheme and 2015 Scheme		Mixed 2006 Scheme and 2015 Scheme		Mixed 2006 Scheme (Special Retained) and 2015 Scheme	
Scheme pension commuted from	1992	2015	2006	2015	Modified 2006	2015
All members	25%	8.75%	17.5% ²⁷	17.5% ²⁷	25%	8.75%

Use of the assumption

- 10.2 In the 1992 Scheme, members have the option to commute pension for a cash lump sum at retirement. The commutation option terms offered to 1992 Scheme members include the existence of an underpin meaning that the conversion factors will not be lower than those used for the 1992 Scheme in England. The existence of this underpin can mean the value of pension given up is lower than the value of the lump sum paid. An assumption for 1992 Scheme members to exchange pension for cash, allows the cost of this option to be reflected in the valuation results.

²⁷ Specified by HMT Directions



- 10.3 Commutation factors for Special retained members of the 2006 Scheme are fixed and were set to reflect the commutation rates in the 1992 Scheme when the amendment order to introduce the modified scheme was made. These factors are now different to the value of the pension given up and we propose that an assumption is made for Special members to exchange pension for cash so that the cost of this option is reflected in the valuation results.
- 10.4 In the standard 2006 Scheme and the 2015 Scheme, members may commute part of their pension for a lump sum at a rate of £12 for each £1 of pension given up, up to a limit of 25% of their pension. For these members, the assumption regarding the amount of pension commuted is important because the value of the pension given up, as assessed using the actuarial assumptions underlying the valuation is, on average, more than £12 and so commutation has a significant impact on total liabilities and contribution rates.

Previous valuation assumptions

- 10.5 The proposed assumptions have been updated since the previous valuation. At the 2012 valuation, no allowance for commutation of 2015 Scheme pension was made for unprotected members of the 1992 Scheme and the HMT directed assumption for 2006 and 2015 Scheme pension (for members without service in other schemes) was that 15% of pension would be commuted. There were no assumptions for Special retained members as they were not present at the previous valuation.

Derivation of proposed assumptions

- 10.6 After excluding any data that was not credible, analysis of commutation experience of 1992 Scheme members over 2012-16 shows that on average, 1992 Scheme members commuted 24.7% of their pension for a lump sum. As such, we propose to maintain the 2012 assumption for commutation, ie 25% of pension is commuted.
- 10.7 As the factors that apply for Special members of the 2006 Scheme are similar to those that apply for 1992 Scheme members, we expect that most members will elect to exchange the maximum pension for cash, and therefore propose that it is assumed that 25% of pension is commuted.
- 10.8 The assumption for commutation of standard 2006 Scheme and 2015 Scheme pension by members without service in other schemes is directed by HMT.
- 10.9 The recommended assumption for members with mixed 1992 Scheme and 2015 Scheme service is set by considering the potential behaviours of these members and data from any comparable experience, in the absence of any direct commutation experience for these members. 1992 Scheme members are entitled to commute up to a quarter of their pension (in general – alternative limits apply to some members) on actuarially equivalent terms (or better allowing for the underpin).



- 10.10 The terms available in the 1992 Scheme offer a significantly greater lump sum than would be available under the commutation terms of 12:1 offered in the 2015 Scheme. We would expect this to act as a substantial disincentive to commute pension in the 2015 Scheme, especially for those members with significant amounts of service in the 1992 Scheme (where the lump sum available from the 1992 Scheme is large). As such, we do not expect that former 1992 Scheme members will commute significant amounts of pension from the 2015 Scheme.
- 10.11 However, there is some evidence (in respect of firefighters in England) to suggest that a number of members retiring from the 1992 Scheme commute pension above HMRC tax limits. This tax charge can happen because members can commute 25% of pension (generally) and the commutation factors are higher than 20 at some ages. This suggests that members will commute additional pension when the effective terms (after tax) of that additional commutation are much less favourable than for the bulk of the pension that they can commute. Therefore, this situation has similarities with the decision to commute 2015 Scheme pension for unprotected 1992 Scheme members, so can inform the proposed assumption.
- 10.12 We therefore propose that it is assumed that unprotected 1992 Scheme members will commute 8.75% of their 2015 Scheme pension. This is half of the proportion of 17.5% to be assumed for new entrants to the 2015 Scheme. We do not suggest that any averaging with the previous assumption is carried out in setting this assumption for the 2016 valuation, as the proposed assumption is based on new data that is now available, as opposed to a change in observed behaviours. As such, the proposal to use half of the HMT directed assumption of 17.5% is based on the analysis of the new data, with some rounding to reflect the amount of data underlying the analysis.
- 10.13 Likewise, we propose that unprotected Special members will commute 8.75% of their 2015 Scheme pension for the same reasons.



11 Family statistics

This chapter sets out our recommendation for the assumptions for dependants' pensions, and summarises the analysis undertaken in order to inform that recommendation.

Proposed assumptions for 2016 valuation

11.1 We recommend the following assumptions.

Table 11.1: Recommended proportions married/partnered

		1992 Scheme	2006 Scheme and 2015 Scheme
		Proportion married ²⁸	Proportion partnered ²⁸
Current pensioners (sample)	Age		
	50	75%	80%
	60	75%	80%
	70	75%	78%
	80	63%	64%
	90	36%	36%
Future pensioners at retirement		75%	80%

- > Members are assumed to be three years older than their partners.
- > No allowance is made for remarriage on the grounds of materiality.
- > All dependants are assumed to be the opposite sex to the member.

Previous valuation assumptions

11.2 All family statistic assumptions are the same as those adopted for the 2012 valuation.

²⁸ The assumptions are the proportion married/proportion partnered at the valuation date, for current pensioners, or at retirement, for future pensioners.



Use of the assumptions

- 11.3 Dependants' pensions²⁹ are provided to qualifying dependants on the death of a member. In the 1992 Scheme, dependants' pensions are payable to legal spouses and civil partners only. In the 2006 Scheme and 2015 Scheme, dependants' pensions are payable to qualifying partners as well as to legal spouses and civil partners. Assumptions are required for the proportion of members who are married or partnered to determine how many dependants' pensions will be paid. Assumptions are required about age differences between members and their spouses/partners as this affects how long dependants' pensions will be paid for.

Analysis and approach to setting the assumptions

- 11.4 The experience of the Schemes is not sufficient in isolation to set robust assumptions and so we have also considered the experience of the England Schemes.
- 11.5 We have no reason to expect that family circumstances in the Scottish Schemes should be substantially different to those in the England Schemes. The assumption used for the 2012 valuations were consistent across the two schemes. We recommend that the family statistics assumptions should remain aligned to those proposed for the 2016 valuation of the England Schemes, where the proposal is to retain the assumptions adopted for the 2012 valuation.

²⁹ Pensions are also payable to dependant children on a member's death but the costs of future children's pensions are not material overall and we therefore do not intend to make any allowance for them in the valuation.



Appendix A: Details of assumptions

This appendix contains details of the recommended assumptions including sample rates and values.

Pensioner mortality

Table A1: Baseline mortality assumptions

Baseline mortality	Standard table ³⁰	Adjustment
Current pensioners in normal health and ill-health	S2NMA	134%
Future pensioners in normal health and ill-health	S2NMA	134%
Dependants	S2DFA	118%

As specified by HM Treasury, future improvements in mortality will be assumed to be in line with those underlying the ONS-2016 projections.

³⁰ From the 'S2' series of standard tables published by the CMI and based on the experience of self-administered pension schemes. Separate tables are available, including those based on experience of members retiring in normal health, ill-health and for dependants.



Age retirement from service

Table A2: Age retirement rates for 1992 scheme full and tapered protection members

<i>Age at joining</i>	<i>18</i>	<i>19</i>	<i>20</i>	<i>21</i>	<i>22</i>	<i>23</i>	<i>24</i>	<i>25</i>	<i>26</i>	<i>27</i>	<i>28</i>	<i>29</i>	<i>30 and over</i>
Age													
50	0.795	0.795	0.795	0.250	0.250	0.250	0.250	0.250	0.000	0.000	0.000	0.000	0.000
51	0.490	0.490	0.490	0.795	0.020	0.020	0.020	0.020	0.050	0.000	0.000	0.000	0.000
52	0.490	0.490	0.490	0.490	0.915	0.020	0.020	0.020	0.020	0.050	0.000	0.000	0.000
53	0.490	0.490	0.490	0.490	0.490	0.975	0.020	0.020	0.020	0.020	0.050	0.000	0.000
54	0.490	0.490	0.490	0.490	0.490	0.490	0.975	0.020	0.020	0.020	0.020	0.050	0.000
55	0.660	0.660	0.660	0.680	0.705	0.725	0.750	0.975	0.410	0.410	0.410	0.410	0.410
56	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.975	0.410	0.410	0.410	0.410
57	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.975	0.410	0.410	0.410
58	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.975	0.410	0.410
59	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.975	0.410
60 and over	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table A3: Age retirement rates for 1992 scheme unprotected members

<i>Age at joining</i>	<i>18</i>	<i>19</i>	<i>20</i>	<i>21</i>	<i>22</i>	<i>23</i>	<i>24</i>	<i>25</i>	<i>26</i>	<i>27</i>	<i>28</i>	<i>29</i>	<i>30 and over</i>
Age													
50	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
51	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
52	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
53	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
54	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
55	0.995	0.995	0.995	0.993	0.995	0.997	0.996	0.983	0.472	0.462	0.451	0.440	0.410
56	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.975	0.410	0.410	0.410	0.410
57	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.975	0.410	0.410	0.410
58	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.975	0.410	0.410
59	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.655	0.975	0.410
60 and over	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000



Table A4: Age retirement rates for 2006 Scheme members and new entrants to the 2015 Scheme

Retirement Age	2006 Scheme – Standard (protected and unprotected)	2006 Scheme – Special (protected and unprotected)	2015 Scheme
55	-	1.00	0.25
56	-	-	-
57	-	-	-
58	-	-	-
59	-	-	-
60	1.00	-	1.00

III-health retirement from service

Table A5: III-health retirement rates for all members

Age	III-health retirement rate
20	0.00008
25	0.00016
30	0.00031
35	0.00063
40	0.00128
45	0.00260
50	0.00526
55*	0.01023
59*	0.01139

*rates are zero if above the retirement age of the relevant scheme.



Voluntary withdrawal from service

Table A6: Withdrawal rates for all members

Age	Withdrawal rate		
	1992 scheme	2006 Scheme and 2015 Scheme - Regular and Special Retained	2006 Scheme and 2015 Scheme - Standard Retained
20	0.0106	0.0106	0.0954
25	0.0106	0.0106	0.0954
30	0.0106	0.0106	0.0954
35	0.0098	0.0098	0.0882
40	0.0061	0.0061	0.0549
45	0.0034	0.0034	0.0306
50	0.0019*	0.0019	0.0171
55	0.0000	0.0000	0.0000

* Rates are zero at age 50 if the member is eligible to retire on an unreduced pension

Death before retirement

Table A7: Death before retirement rates for all members

Age	Death before retirement
20	0.00014
25	0.00015
30	0.00021
35	0.00028
40	0.00038
45	0.00054
50	0.00079
55	0.00128
60	0.00196
65	0.00308



Promotional pay increases

Table A8: Promotional salary scales for Regular firefighter members

The proposed salary scale shows assumed pay progression in excess of general wage inflation in comparison to an index base of 100 at entry.

Service (years)	Promotional Pay for Regular Firefighters
0	100.0
5	140.4
10	145.4
15	152.2
20	161.6
25	171.1
30	183.6
35	190.1
40	190.1

Table A9: Promotional salary scales for Retained firefighter members (Standard and Special)

The proposed salary scale shows assumed pay progression in excess of general wage inflation with an index base of 100 at age 18.

Age	Promotional Pay for Retained Firefighters
20	102.2
25	107.7
30	113.2
35	118.7
40	124.2
45	129.7
50	135.2
55	137.7
60	140.2
65	142.7



Commutation of pension for cash at retirement

Table A10: Recommended commutation assumptions for the 2016 valuation

Members are assumed to commute the following proportions of their pensions for cash

Member with service in the following schemes	1992 Scheme only	2006 Scheme only	2006 Scheme (Special Retained Members) only	2015 Scheme only
Scheme pension commuted from	1992	2006	Modified 2006	2015
All members	25%	17.5%	25%	17.5%

Member with service in the following schemes	Mixed 1992 Scheme and 2015 Scheme		Mixed 2006 Scheme and 2015 Scheme		Mixed 2006 Scheme (Special Retained) and 2015 Scheme	
Scheme pension commuted from	1992	2015	2006	2015	Modified 2006	2015
All members	25%	8.75%	17.5%	17.5%	25%	8.75%

Family statistics

Table A11: Recommended proportion married or partnered at retirement for future pensioners

Proportion married	Proportion married or partnered
75%	80%

Table A12: Recommended proportion married or partnered for current pensioners (at the valuation date)

Age	Proportion married	Proportion married or partnered
50	75%	80%
60	75%	80%
70	75%	78%
80	63%	64%
90	36%	36%

Males are assumed to be three years older than their female partners.



Appendix B: Modelling approach and minor assumptions

Active membership projections

- B.1 Direction 11³¹ requires the actuary to use the 'projected unit methodology' to calculate the valuation results. The valuation results require the calculation of the cost of benefit accrual over periods after the effective date (31 March 2016). The expected cost of benefits provided to members remaining in the 1992 Scheme and 2006 Scheme under the provisions of transitional protection differs from the expected cost of providing members with benefits in the 2015 Scheme. Further, the expected cost of providing benefits varies for members in the 1992 Scheme and 2006 Scheme. This implicitly requires the actuary to estimate the membership at future dates in order to determine the valuation results.
- B.2 Since the majority of members (around 60%) were accruing benefits in the 2015 Scheme at the effective date, and further, given that the remaining members continuing to accrue benefits in the pre-2015 schemes are expected to rapidly decline to close to nil over the future periods being considered in this valuation, a pragmatic approach to estimating the future membership of each section/scheme over the relevant future periods is suitable.
- B.3 The expected cost of accruing benefits over periods after effective date have been determined by assuming an overall stable population (age and pay profile) to end of implementation period. In particular:
- > Allow for the protected population to reduce over the projection period (ie to 2023) with a corresponding increase in those accruing benefits in the 2015 Scheme to maintain the stable population. SPA in the projected populations is determined by implied dates of birth and so the SPA mix changes over time despite the assumed stable population.
 - > Mortality is projected forward to the relevant year of use in all cases.
 - > The run off of the protected population is broadly linear from the relevant calculation date to the average age at which members of each identified group (eg 1992 Scheme, Standard 2006 Scheme, Special 2006 Scheme) are expected to retire.
- B.4 The expected cost of accruing benefits over periods after the effective date for calculating the employer contribution correction cost has been determined by assuming:
- > The aggregate membership has the same age/pay profile over all projection periods (i.e. to 2023) (and assuming all in the 2015 Scheme).

³¹ The Public Service Pensions (Valuations and Employer Cost Cap) Directions 2014 (as amended).



- > Allow for the actual membership (assumed) accruing benefits in the 2015 Scheme to change over the projection period (i.e. to 2023). SPA in the projected populations is determined by implied dates of birth and so the SPA mix changes over time despite the assumed stable population.
- > Mortality is projected forward to the relevant year of use in all cases.

Grouping of individual active member records

- B.5 Individual active members have been grouped together for the purposes of calculating liabilities. This grouping is necessary to accommodate the volume of data within our valuation system. The approach taken to grouping the data has been tested to ensure it does not result in any distortion of the valuation results. The groupings are made for protection status (ie protected, tapered or unprotected), section/scheme (ie 1992 Scheme, 2006 Scheme, 2015 Scheme and Modified 2006 Scheme), age, State Pension age and service.

Accrual cost methodology

- B.6 See B.3 and B.4. The cost over each relevant period has been taken as the average of the cost at the start and end of each period.
- B.7 Direction 11 requires use of the projected unit methodology to determine the valuation results. Directions 14, 16 and 17 specify some modifications to the financial assumptions in the short term. An implication of the short term modifications is that the projected unit methodology is expected to result in an increasing standard contribution rate over successive periods. For example the cost of accrual over the period 2015 - 2019 is lower than that over the period 2019 - 2023 (ignoring any redistribution of members into the 2015 Scheme). This effect is not immaterial for final salary benefits, but has no effect on the cost cap future service cost calculation since short term assumptions are explicitly disregarded for this purpose in Direction 40.
- B.8 Non-accruing benefits such as lump sums payable on death in service have been recognised only when a benefit payment is expected.
- B.9 Members accruing or expecting to accrue benefits at double rate (in the 1992 Scheme) are treated as though the overall expected benefit accrues uniformly over all service.

Guaranteed Minimum Pensions (GMPs)

- B.10 A global adjustment was applied to reduce the past service liability in respect of estimated GMP entitlements for which provision of post SPA pension increases is not the responsibility of the scheme. The reduction is equivalent to a reduction in the contribution rate of around 0.4% of pensionable pay over the 15 year period from the implementation date. This estimation has no impact on the calculation of the employer contribution correction cost.



Public Service Transfer Club (PSTC)

- B.11 Allowance has been made for the potential additional liabilities arising from inward transfers on PSTC terms (because the transfer value is usually less than the cost of providing the service credit granted). If volumes of transfers continue at historic levels the financial impact is expected to be equivalent to an employer contribution cost of 0.3% of pensionable pay.

General pay increases

- B.12 Direction 17 sets out the general pay increases that are to be assumed for valuation purposes.

Final pensionable pay

- B.13 All liabilities have been based on pensionable pay at the effective date as provided by administrators. No explicit allowance has been made for the impact of prior years' earnings resulting in higher final pensionable pay for particular members since this effect is not expected to impact a material number of members.

Dependants' pensions

- B.14 No allowance has been taken for short term dependant pensions or children's pensions (other than those already in payment), on ground of immateriality.

Expenses

- B.15 No allowance has been made for expenses. Expenses are outside the valuation framework.

Early retirement factors

- B.16 When modelling retirement from the 2015 Scheme before Normal Pension Age where an actuarial reduction would be applied early retirement factors have been set equal to those which would apply using the long term assumptions under the Directions (applied for the appropriate period before the normal pension age).
- B.17 There is no option to retire from active service with actuarially reduced benefits in the 1992 Scheme.



Re-entry of members

- B.18 Re-entry of members to pensionable service has been modelled by the use of a 'net' withdrawal assumption for active members. This explicitly allows for a proportion of those leaving active service to return. No explicit allowance has been made in the valuation for a proportion of those deferred at the effective date to subsequently rejoin. However the analysis undertaken for active members, and the resultant 'net' withdrawal rates include those rejoining from deferred status and hence the valuation of active members implicitly includes some provision for deferred members to return.

Added Years

- B.19 In certain limited circumstances firefighters can purchase additional service. The added years data supplied to GAD could not be easily associated with the main pension data for firefighters who had purchased this option. However, added years were deemed not to have a material impact on the valuation results and therefore no adjustment has been applied to the liabilities to allow for these.

Member contribution yield over implementation period

- B.20 The average member contribution yield expected over the implementation period is estimated to be 13.0% of pensionable pay. This calculation uses the employee contribution rates for each scheme, as set out in scheme regulations. This compares to an average member contribution yield of 13.2% of pensionable pay that was expected over the period from April 2015 to March 2019.

Treatment of Special retained members of the 2006 Scheme

- B.21 Special retained members of the 2006 Scheme generally took up their options to purchase past service during the year 2015/16. For the purposes of the calculation of the prior value of the cost cap fund at 31 March 2015, having taken instruction from SPPA, the following approach has been taken.
- > All Special members are treated as being in pensionable service at 31 March 2015 and therefore part of the scheme membership at that date; and
 - > Liabilities of Special members at 31 March 2015 include all Special service that Special members have elected to purchase, net of the present value of any future employee contributions that are payable towards that service.
- B.22 The calculation of past service liabilities at 31 March 2016 for Special members paying by periodic contributions allows for their full past service to be recognised, net of the present value of any outstanding employee contributions at that date.



Other Direction interpretations

Directions 27 and 28 (contribution rates)

- B.23 27(1)(a) and 27(1)(c): For the purposes of spreading any past service surplus or deficit, the payroll at the effective date has been projected forward assuming a stable workforce size and in line with valuation earnings assumptions.
- B.24 27(1)(c)(ii) and 28: Member contributions since the effective date based on actual (or expected) yield for past periods and periods up to 31 March 2019. Set equal to expected contribution yield from April 2019 based on current member contribution rates set out in scheme regulations. See B.19.
- B.25 27(1)(b) and 27(1)(d): See B.3 and B.4.

Directions 28, 31, 32(1), 33(2)(a) (and related) – member contribution yields

- B.26 See paragraph B.23.

Direction 30 – Prior value of the cost cap fund

- B.27 Liabilities in respect of past service for Special members of the 2006 Scheme is included in the liabilities as at 31 March 2015, as described in paragraph B.20.

Direction 32(1) – expected cost of benefits for past periods (for cost cap purposes)

- B.28 The contribution rate required to cover cost of benefits over 2015-16 is calculated by considering the membership over the period 2015-16.

Directions 32(1) and 40(1) – expected cost of benefits for future periods (for cost cap purposes)

- B.29 See B.4.

Direction 34 – benefits paid from 2015 Scheme during 2015-2016

- B.30 Estimated where data unavailable.



Appendix C: Assumptions made for data uncertainties

Summary

- C.1 Whilst comprehensive data was received from SPPA for the 2016 valuation, some aspects of the data were incomplete and/or unreliable for certain elements of our valuation calculations.
- C.2 It has not been possible to fully resolve these data issues in the timescale required for the valuation. Therefore to calculate results for the 2016 valuation of the Schemes, assumptions are required in respect of incomplete and/or unreliable individual member records and movements data. The latter is used for setting assumptions and in the calculation of the cost cap net leavers liability.
- C.3 Scheme specific assumptions are determined by the “responsible authority”, which is the Scottish Ministers in the case of the Scheme, and must be set as best estimate assumptions and not include margins for prudence or optimism.

Individual member records

- C.4 Membership data is provided by SPPA for the purpose of the 2016 valuation and we apply checks to these membership records to ensure all key data items are provided and reliable for valuation purposes. Following these checks, it was identified that individual member records at the relevant dates as required for valuation purposes were not fully complete and reliable. We worked with SPPA to address some of these issues. However, where critical data items were missing from member records the general approach taken was to exclude that record for calculation purposes with calculations based on the remaining dataset being rated up to incorporate an allowance for the excluded records.
- C.5 Uprating factors were determined for each membership category equal to the ratio of known valid records and the number of records with adequate data. Implicitly this uprating approach assumes that the records with omissions or errors have the same average profile (age, sex, pay, service) as fully complete records. Some 7% of records were excluded from the 2016 valuation data and around 30% of records provided for the purposes of setting the initial cost cap fund. Many of the excluded records relate to retained firefighters who have small amounts of pension, so the impact on the valuation is expected to be low.
- C.6 As noted, the approach taken to data omissions is to assume each record with missing data has the same average profile as the complete records and therefore there is a risk that this assumption is not appropriate. The table below indicates the extent to which the valuation results might be incorrect if the approach in fact under/overstates the liability for the omitted members by 10%, which we believe to be a reasonable level to consider.



	Impact of error in assumption for missing data (as % of pay)	
	Uncorrected employer contribution rate	Employer contribution correction cost
Actives (uprating applied: 1.11 for 2016 data, 1.41 for 2015 data)	0.1%	0.1%
Deferreds (uprating applied: 1.25)	0.1%	nil
Pensioners (uprating applied: 1.00)	Not material	nil

- C.7 The table above illustrates the potential impact if known data omissions are subsequently found to have been handled incorrectly. Since it is not possible to undertake independent checks for all categories of members and a full reconciliation has not been achieved against all prior datasets there is the potential for currently unidentified problems with the data to emerge in future. For example a group of deferred members could be identified where no liability has previously been determined. The impact of such unknowns emerging at subsequent valuations could be considerably more than the sensitivity indicated above.

Movements data

Setting assumptions

- C.8 SPPA supplied data on the experience of the Scheme's membership over the four-year period to 31 March 2016. Fully complete and comprehensive data about members moving status between certain dates (eg leaving active status due to death or retirement) was not able to be provided. Analysis of member movements is needed to inform scheme specific demographic assumptions as scheme-specific experience, both recent and longer term, generally provides the most reliable evidence when considering best estimates of future experience.
- C.9 Assumption setting relies on analysis of movements data in consideration with such other relevant information which is available. The setting of demographic assumptions is to some extent subjective and a matter of interpretation. Changes in assumptions may be expected at successive valuations as circumstances change even with full data. Thus the absence of fully complete movements data does not necessarily introduce uncertainty into the valuation results provided there is other relevant information available to inform those assumptions. It is to be expected that there is some volatility in the experience arising from an analysis of movements data. As assumptions are intended to reflect long term expectations it is reasonable to seek to smooth out the impact of these short term effects. A number of the recommendations we make for scheme-specific valuation assumptions smooth out the short term effects by taking only a proportion of the difference in experience since the 2012 valuation, for example in recommending the assumption for baseline pensioner mortality.
- C.10 It should however be recognised that should movements data become available for future valuations it could result in recommendations regarding appropriate



assumptions which lead to greater changes in valuation results than otherwise. It is difficult to quantify the potential scale of this discontinuity but it could be over +/-1% of pensionable pay on the employer contribution rates. For example, if the number of pensioner deaths was overstated or understated in the data available for setting assumptions for the 2016 valuation but correctly stated at a subsequent valuation, this would have an impact on the mortality assumptions adopted and potentially lead to a large change in the assumption at future valuations and hence a corresponding change in liability and employer cost.

Cost cap net leavers liability (CCNLL)

- C.11 The initial cost cap fund is set equal to the liability for actives members at 31 March 2015. The cost cap mechanism is intended to manage the costs of the reformed scheme and recognise any unexpected experience relating to pre-reformed entitlements of members in service at 1 April 2015, but only to the point at which they leave active service. CCNLL is a quantification of the amount of pre-reformed liabilities which fall out of the cost cap fund at a valuation owing to members which have left service since the previous valuation (or since the initial cost cap fund was set in the case of the 2016 valuation), net of the additional liabilities in respect of members with pre-reformed service who rejoined active membership during 2015-16.
- C.12 To accurately calculate CCNLL in accordance with the directions requires full movement data for all members who were active in 2015 and are no longer active at the 2016 valuation. The data available was not suitable for calculating the CCNLL and it was not possible to make assumptions to adjust the data available to provide for a reasonable estimate of CCNLL to be calculated. The data available for the CCNLL calculation was particularly complex to use due to the adjustment for members re-joining the Schemes and the significant number of members with multiple data records in both the 2015 and 2016 data sets.
- C.13 For the purposes of determining the 2016 valuation results, we have adopted an approach which implicitly makes an assumption that there is no unidentified experience gain or loss arising over the period 2015 to 2016. A risk of this approach is that any upward or downward cost pressure that has occurred over the period but has not been explicitly identified will not be reflected in the 2016 valuation results.
- C.14 We expect that the uncertainty introduced by the approach above is not more than ½% of pensionable pay.
- C.15 We would not expect significant unidentified experience gains or losses to arise over the one year period 2015 to 2016, although some uncertainty remains. In addition, we have reconciled the surplus or deficit arising over the period 2012-16 with a small unattributed item.
- C.16 For the 2016 valuation, the CCNLL calculation period is only one year, rather than a full four-year valuation. Given the short period over which any gain or loss may have arisen it might reasonably be concluded that the lack of data for the CCNLL calculation is not critical for this valuation although it would become so in future valuations when a longer period is considered.



Appendix D: Sensitivity of valuation results to assumptions set by Scottish Ministers

D.1 The table below provides an indication of the sensitivity of the valuation results to the particular assumptions under consideration. The figures shown here are also provided in section 4 of the formal valuation report.

Table D1: Sensitivity of valuation results to assumptions set by Scottish Ministers

	Addition to uncorrected employer contribution rate	Addition to employer contribution correction cost
Membership profile: 2 years older on average over implementation period	0.2%	0.2%
Mortality rates: 5%* heavier rates of pensioner mortality	(1.5)%	(0.7)%
Age retirement rates: All new entrants to the 2015 Scheme retire at age 55	0.0%	0.0%
Commutation (other than as directed) all unprotected members of the 1992 Scheme commute 17.5% of 2015 Scheme pension	(0.6)%	(0.3)%
Ill-health retirement: 5%* increase to assumed rates	0.1%	0.1%
Ill-health retirement: 5%* increase in proportion assumed to receive higher tier benefits	0.0%	0.0%
Proportions partnered: 5%* more members assumed to have qualifying partners at death	0.9%	0.4%
Resignations and opt outs: 5%* higher numbers assumed to leave voluntarily before retirement (net of rejoiners)	(0.1)%	(0.0)%
Promotional pay increases: 0.5% higher promotional pay increases than assumed	2.1%	2.0%

* All these represent multiplicative increases to rates, i.e. 5% means rates 1.05 times higher.

Note: Opposite changes in the assumptions will produce approximately equal and opposite changes in the valuation results.

D.2 In each variant of Table D1 the sensitivity shown is in relation only to the change in the assumption described. The impact of a combination of assumption changes will not necessarily equate to the sum of the relevant rows above.



Appendix E: Assumptions for Special members at 31 March 2015

E.1 Advice on assumptions for Special members of the 2006 Scheme for use in the 2016 valuation is provided in the main body of this report.

E.2 Assumptions for Special members are also required in order to calculate the prior value of the cost cap fund as at 31 March 2015. The Directions require that the assumptions used for this purpose are the assumptions adopted at the 2012 valuation. As the Special members were not present at the 2012 valuation, there are no existing assumptions for them.

E.3 We propose that the assumptions adopted for this purpose are as set out below.

- > Age retirement from service: Assume all retire at age 55.

For the 2016 valuation, it has been assumed that all Special members (including unprotected and taper protected Special members) will retire at age 55. There is no reason to believe that we would have come to a different conclusion if we had advised on this assumption at the 2012 valuation. Therefore, we propose that all Special members are assumed to retire at age 55.

- > Voluntary withdrawal from service: Use the same assumption as per members of the 1992 Scheme.

For the 2016 valuation, it has been assumed that Special members will withdraw from service in line with the assumption for members of the 1992 Scheme. There is no reason to believe that we would have come to a different conclusion if we had advised on this assumption at the 2012 valuation. Therefore, we propose that Special members withdraw in line with the assumption for 1992 Scheme members from the 2012 valuation (which remained unchanged at the 2016 valuation).

- > Commutation of pension for cash at retirement: Use the same assumption as per members of the 1992 Scheme.

For the 2016 valuation, it has been assumed that Special members will commute in line with members of the 1992 Scheme. There is no reason to believe we would have come to a different conclusion if we had advised on this assumption at the 2012 valuation. Therefore, we propose that Special members commute pension in line with the assumption used for 1992 Scheme members at the 2012 valuation (which is different from the assumption for 1992 Scheme members at the 2016 valuation).

- > Other assumptions: Use the same assumptions as per standard retained members.

For the 2016 valuation, all other assumptions for Special members have been set to be the same as for standard retained members. There is no reason to believe we would have come to a different conclusion if we had advised on these assumptions at the 2012 valuation. Therefore, we propose all other assumptions are set to be those used for standard retained members at the 2012 valuation.