2023/24 Desalinated Water Order Advice

Technical Analysis

March 2023

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Purpose

1. This report provides technical analysis supporting the 2023/24 desalinated water order advice.

Context

Background

2. The Melbourne water supply system includes 10 major reservoirs and associated catchments that are used to harvest and store water, a network of pipelines, pump stations, and tanks that are used to supply water to households and businesses across Melbourne and the surrounding region. The total system storage capacity of the 10 major reservoirs is 1,812 gigalitres[1] (GL). The Victorian Desalination Project (VDP), located near Wonthaggi, is connected by an 84 kilometre underground transfer pipeline to Cardinia Reservoir in the Melbourne water supply system. The VDP is operated by AquaSure, and can supply up to 150 GL/year, or around one third of Melbourne's current annual water demand. Bulk Entitlements to water produced by the VDP are held by the metropolitan water businesses (Greater Western Water, South East Water and Yarra Valley Water).

3. Melbourne's water storages supply water to the metropolitan water businesses; the regional water businesses including Barwon Water, Westernport Water, Gippsland Water and South Gippsland Water; for the environment on behalf of the Victorian Environmental Water Holder (VEWH); and Southern Rural Water's irrigation customers.

4. At 1 January 2023, around 64% of the water stored in Melbourne's water supply system was available for greater Melbourne. The rest was held by other water entitlement holders such as regional water businesses, the Victorian Environmental Water Holder (VEWH) and irrigators or is water that is inaccessible under normal operating conditions (refer to *Melbourne's Water Outlook 2023* for further detail).

5. During severe drought years such as 2006/07, storage volumes can decline by as much as 20% of total system storage capacity in a 12-month period. As the annual supply capacity of the VDP can only meet a proportion of water demand, during drought periods water security is dependent on the volume of water already accumulated in water storage at the start of these periods.

6. The aim of water supply system planning and operations with both catchment water sources and the VDP is to build and maintain a buffer of

[1] 1 gigalitre = 1 billion litres (the equivalent of around 400 Olympic swimming pools). In 2020/21, Melburnians (including those in the former Western Water) used 440 GL of water.

water in storage while managing short and long term pricing impacts. A sufficient storage buffer is especially critical during severe drought periods. These periods could last for more than a decade, as experienced in the 1997-2009 Millennium Drought. Thomson Reservoir, which provides around 60% of total system storage capacity, is Melbourne's drought reserve and in 2022 filled for the first time since 1996. Thomson Reservoir is a large reservoir relative to its net inflow and while at capacity it provides reserves for major droughts, it can only fill from natural inflow. Operation of the VDP reduces water transfers from Thomson and other reservoirs and therefore is key to enabling the water supply system to manage water volumes from year to year and over extended time frames.

7. Since the VDP was completed in 2012, desalinated water has been ordered each financial year by the Victorian Government commencing from 2016/17. A total of approximately 455 GL of desalinated water has been delivered from 2017 up to January 2023.

8. For 2022/23, 15 GL was ordered from the VDP, with 4.2 GL delivered. Based on high storage levels, projected weather patterns including a third La Nina summer event, water demand and the resultant risk of potential overflows from storages, the remaining 10.8 GL of the 2022/23 desalination order was cancelled.

9. Figure 1 shows historical water storage levels since 2012.

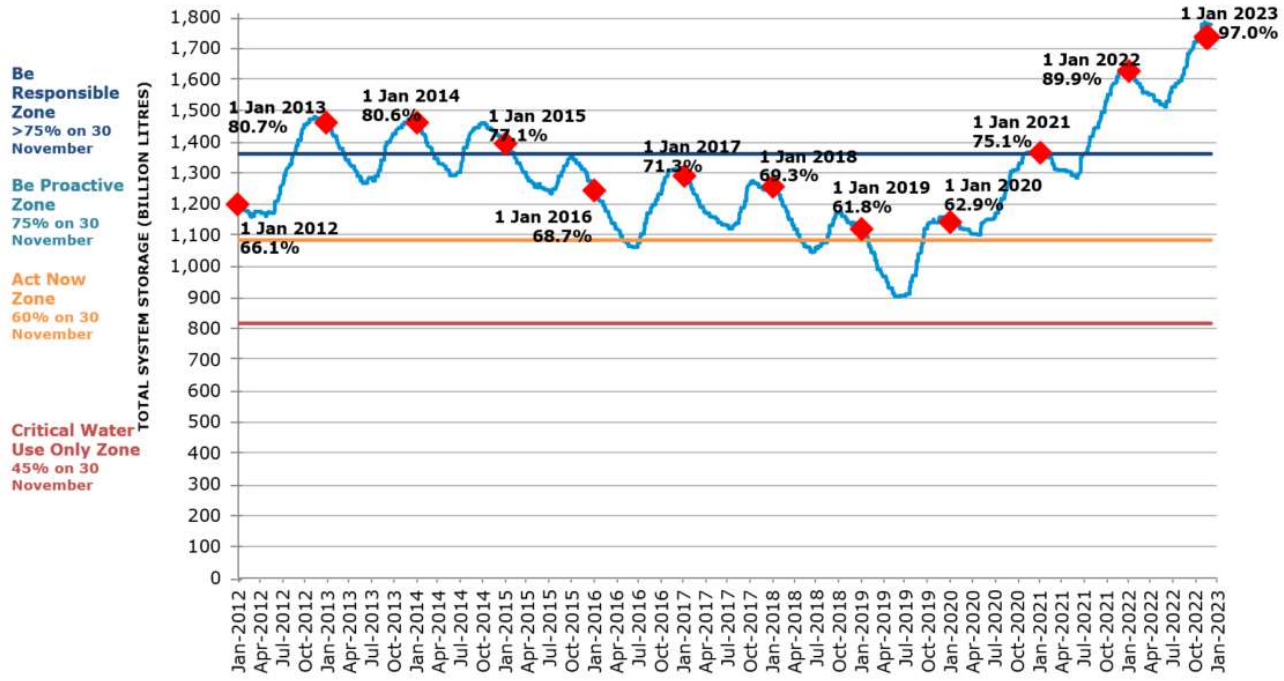

Figure 1: Historical water storage levels

10. As at 1 January 2023, Melbourne's water storages:

    - were approximately 97% full (1,757 GL), 128 GL higher than the same time in the previous year. Thomson Reservoir, Melbourne's drought reserve, held 1,072 GL (100% of its capacity[2]), 97 GL more than on 1 January 2022.
    - were at their highest, for this time of year, due to higher than average rainfall and inflows into storages during 2020, 2021 and 2022, annual desalinated water orders since 2017 and ongoing water efficiency and conservation programs.

11. In 2022, inflows to storages were the highest they have been in the last 48 years and approximately 76% above the last 30-year average. Total inflows received during the three years of 2020-2022 were the 14th higher in the historical record.

12. Prior to this period, water storage volumes and water security for the greater Melbourne area were declining, driven by lower streamflow and increased water demand. Over the past ten years (2013-2022):

    - Average annual streamflow into Melbourne's four major harvesting storages (Thomson, Upper Yarra, O'Shannassy and Maroondah Reservoirs) have been approximately 503 GL/year. By comparison, the 5-year period of largest storage decline (2014-2018), had average annual streamflows of 395 GL/year which was only 5% higher than average annual streamflow during the 1997-2009 Millennium Drought (376 GL/year).
    - Population in Melbourne supplied by the three metropolitan water businesses has grown to a total of approximately 5 million people.
    - Average daily residential water use has increased slightly from 162 litres per person per day in 2012/13 to 164 litres per person per day in 2021/22.
    - Due to population growth and additional supply needs to regional areas, Melbourne's water demand has grown by approximately 9%, from 407 GL/year in 2012/13 to 444 GL/year in 2021/22.

Melbourne's strategic water resource planning

13. In 2017, Melbourne Water published the *Melbourne Water System Strategy*, which presents a system view of water resource management across Melbourne and the surrounding region over the following 50 years. As per Victoria's strategic management framework, Melbourne's long-term water resource planning is currently being updated through the *Greater Melbourne Urban Water and System Strategy*. The draft strategy includes

[2] *Thomson Reservoir was holding more than its full capacity from 29 October 2022 to 19 February 2023 while water flowed over the spillway.*

long-term water supply outlooks for streamflow scenarios described in the Department of Environment, Land, Water, and Planning (DELWP) *Guidelines for Assessing the Impact of Climate Change on Water Availability in Victoria*.

14. These long-term streamflow scenarios under climate change show that the reliable yield of the water supply system throughout an extended drought sequence will continue to decline over time. Although storages are currently at higher levels, the reliable yield of the water supply system from the surface water catchments is expected to fall. The VDP will be increasingly important in providing water security for Melbourne and regional areas for growing population and in managing the impacts of the changing and variable climate. Since the timing and severity of future extended drought sequences is uncertain, it is important to ensure preparedness for such an event by planning and operating the water supply system to maintain the buffer of water in storage that has been established in recent years, subject to pricing impacts.

Desalinated water order advice

15. The State of Victoria is required to place a desalinated water order with AquaSure by 1 April each year under the *Project Deed* between the two parties. Prior to this, the *Water Interface Agreement* between the Minister for Water, Melbourne Water, and the Secretary of the Department of Energy, Environment and Climate Action (DEECA) requires Melbourne Water to provide the State of Victoria (represented by DEECA) with the following desalinated water order advice by 1 March:

    a) Its opinion of the volume of desalinated water required for the next financial year (i.e. 2023/24).

    b) Its opinion of the constrained months[3] (if any) that it considers should be subject to a constrained month cap and the proposed volume of such caps.

    c) A non-binding forecast of the quantity of desalinated water required for the next two financial years (i.e. 2024/25 and 2025/26).

16. Melbourne Water worked with the metropolitan water businesses (Greater Western Water, South East Water and Yarra Valley Water), which hold the Bulk Entitlements to water from the VDP, to coordinate the process of consultation and deliver the modelling and technical analysis required to support the development of the 2023/24 desalinated water order advice. Other water entitlement holders across the water grid were also consulted

[3] Subject to conditions specified in the *Project Deed*, the State may specify the maximum volume of desalinated water which can be delivered (i.e. a constrained month cap) during the months of August, September, October and/or November.

to ensure the advice reflected their forecast demands from the Melbourne system.

Water Outlook zones

17. The desalinated water order advice is a key annual planning activity for supporting the short and long-term water security for Melbourne and the surrounding region. The annual preparation of the advice follows the publication of the *Water Outlook* by Melbourne Water and the metropolitan water businesses on 1 December each year, and is linked to this process through the use of the Water Outlook zones in the preparation of the advice.

18. The metropolitan water businesses' Drought Preparedness Plans were reviewed in 2021 and specify a four-zone adaptive framework for monitoring water security based on the volume of water in Melbourne's storages on 30 November each year, as shown in Figure 2. As illustrated in Figure 1, the end of spring is typically when Melbourne's water storage volumes transition from filling during the cooler, wetter months, to falling during the warmer, drier months. Notable features of the framework are:

    - A Water Outlook is published by 1 December each year by Melbourne Water and the metropolitan water businesses to document and communicate water security status and actions needed in the short to medium term with reference to the four-zone adaptive framework.
    - Storages are managed proactively for possible future drought events when storage levels are in the Be Responsible Zone including ensuring water is used efficiently and drought response measures are identified.
    - When storages are in the Be Proactive and Act Now Zone, actions are taken to ensure supply is available under severe and extended drought conditions for up to five years. Stages 1 and 2 of the metropolitan water businesses' water restrictions by-laws may also be used in these zones, although water restrictions can have significant social and economic impacts, so other approaches (e.g. voluntary water efficiency programs) may be implemented if similar reductions in water use can be achieved.
    - Actions are taken to ensure water storages do not enter the Critical Water Use Only Zone except in extreme circumstances. Stages 3 and 4 of the metropolitan water businesses' water restriction by-laws are available to be used in such a severe event.
    - Varying water ordered from the VDP is considered in all four zones, however the amount taken is determined each year following detailed analysis that considers and balances the five principles and other factors (discussed below), including being in the Be Proactive and Critical Water Use Only Zones in the Drought Preparedness Plans.

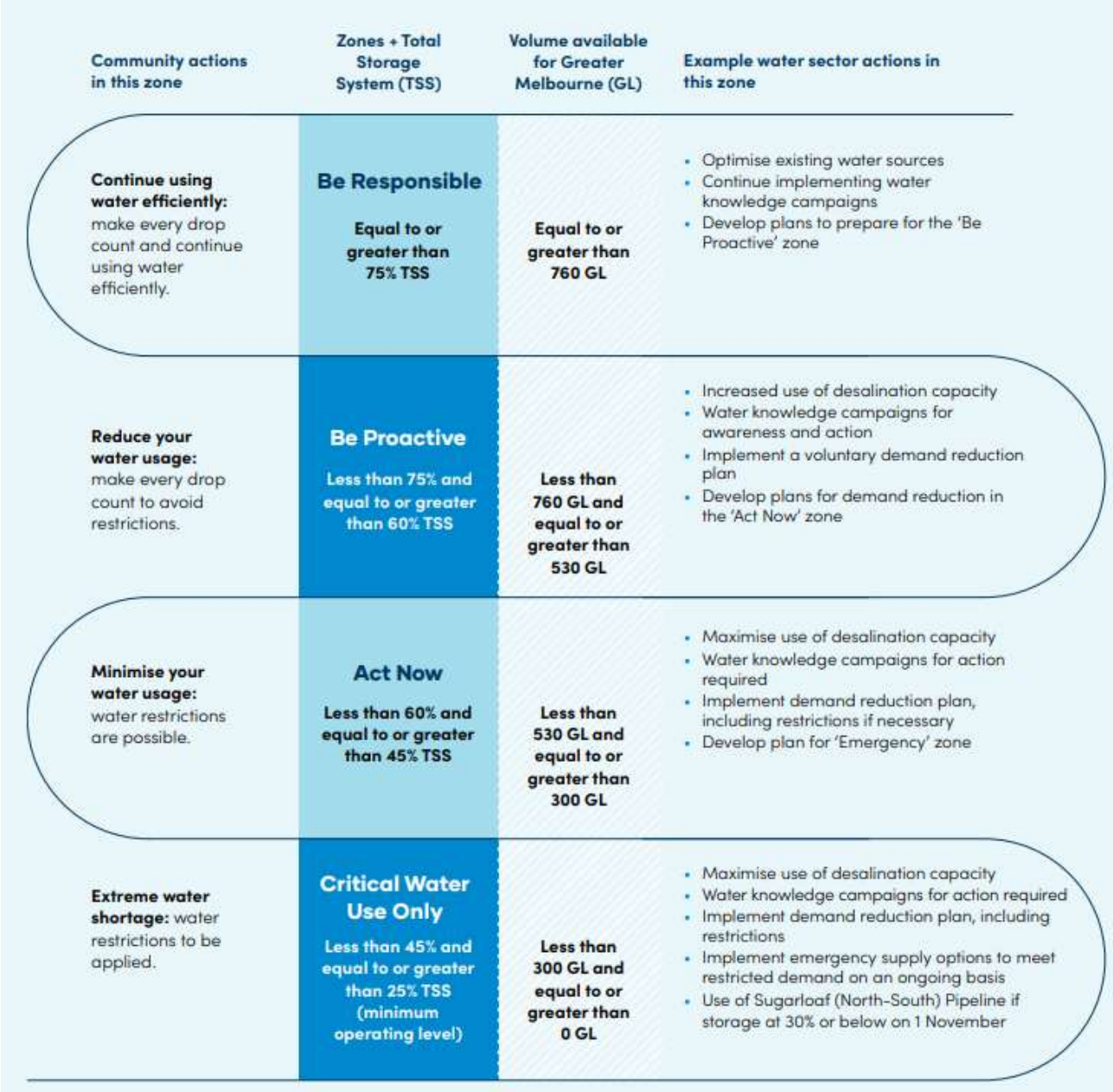

Figure 2: Melbourne's water outlook zones

19. In the development of the desalinated water order advice, the Water Outlook zones are used to measure potential future water security by comparing projections of future water storage levels against the four zones.

20. The 2023 Water Outlook for Melbourne, published on 1 December 2022, noted that storages were in the Be Responsible Zone (98.2%) and secure for the coming year.

Principles

21. Consistent with the approach established by the water businesses and used in previous years, the 2023/24 desalinated water order advice is based around five principles. These were developed and assessed by the water businesses to balance the benefits of using the VDP in maintaining the short and long-term security of supply to customers against the costs of placing an order and the potential for foregone water harvest[4]. Short-term water security is maintained by avoiding going into the Critical Water Use Only Zone, and minimising the risk of going into the Be Proactive Zone, while long-term water security is achieved by building storage recovery over a number of years when there is sufficient capacity available in the reservoirs and maintaining higher storage volumes, when storages volumes are high. The advice is based on the water businesses assessing an appropriate balance across these principles. The advice is prepared recognising that while the first year order is contractually binding for the financial year, there is the opportunity to revisit the volume required in each of the second and third years, as part of the annual planning and ordering cycle. This allows adaptation based on the storage levels and outlooks at the time. The technical assessments of different potential desalinated water order volumes for 2023/24 described later in this document take this ability to adapt subsequent order volumes into account.

22. The intent of the principles is to provide for water security for Melbourne and surrounding regions supplied from the system by avoiding both storages falling to low levels, and the potential for foregoing harvest of lower cost water from within the system in wetter years (although this can potentially provide environmental benefits for downstream waterways). In satisfying these at times competing objectives, customer impacts should be minimised. The principles are:

    - **Principle 1: Chance of storage volume falling into the Critical Water Use Only Zone**
      Storages should remain above the Critical Water Use Only Zone described in the metropolitan water businesses' Drought Preparedness Plans on 30 November 2023, 30 November 2024 and 30 November 2025 under a severe drought sequence, which is defined as the driest sequence among the modelled streamflow sequences.
    - **Principle 2: Chance of storage volume falling into the Be Proactive Zone**
      Storages should remain above the Be Proactive Zone described in the metropolitan water businesses' Drought Preparedness Plans on 30

[4] 'Foregone harvest' is defined as the modelled additional flow over dam spillways from the Melbourne water supply system and/or reduced harvest into Sugarloaf Reservoir for each modelled streamflow sequence due to the desalinated water order volumes supplied.

November 2023, 30 November 2024 and 30 November 2025 under 90 per cent of modelled streamflow sequences.

- **Principle 3: Storage Recovery**
  Storages should display a recovery trend such that the median (50th percentile) modelled total system storage levels across the modelled streamflow sequences increase in 2023/24, 2024/25 and 2025/26.
- **Principle 4: Risk of desalinated water causing avoidable foregone harvest**
  Foregone water harvest should be less than 12.5 GL/year for at least 50% of modelled streamflow sequences, and less than 25 GL/year for at least 90% of modelled streamflow sequences in 2023/24, 2024/25 and 2025/26. 'Foregone water harvest' is defined as the modelled additional flow over dam spillways from the Melbourne water supply reservoirs and/or reduced harvest into Sugarloaf Reservoir for each modelled streamflow sequence due to the desalinated water order volumes supplied. All water may not be harvested from smaller storages and weirs in wetter years.
- **Principle 5: Customer impacts**
  The impacts on the metropolitan water businesses' customers' bills should be minimised while providing an acceptable security of supply.

23. Potential desalinated water order pathways were assessed against the five principles using detailed technical analysis described later in this report.

Technical analysis inputs and assumptions

Initial water storage levels

24. Water resource modelling for the 2023/24 advice examines possible future water storage levels for different desalinated water order volumes and operational conditions based on storage volumes observed on 30 November 2022 (1,775 GL or 97.9%). Approximately 155 GL of the water in storage on 1 December 2022 was allocated to entitlement holders other than the metropolitan water businesses, including the regional water businesses, the Victorian Environmental Water Holder, and Southern Rural Water. The distribution of water across the 10 major storage reservoirs in the Melbourne water supply system on 30th November 2022 is shown in Table 1. Water resource modelling supporting the desalinated water order advice considers the range of possible streamflow conditions into the reservoirs and the expected demands associated with all entitlement holders in the Melbourne system for the desalinated water order advice period.

Table 1: Distribution of water across the 10 major storage reservoirs in the Melbourne water supply system on 30th November 2022

Reservoir	Capacity at full supply (ML)	Volume (ML)	% Full
Thomson	1,068,000	1,078,466[5]	100%
Upper Yarra	200,579	185,439	92.5%
O'Shannassy	3,123	3,253[5]	100%
Maroondah	22,179	22,399[5]	100%
Sugarloaf	96,253	92,644	96.3%
Yan Yean	30,266	30,317[5]	100%
Greenvale	26,839	24,570	91.5%
Silvan	40,445	35,953	88.9%
Cardinia	286,911	263,545	91.9%
Tarago	37,580	38,082[5]	100%
Total	**1,812,175**	**1,773,660**	**97.9%**

[5] Reservoir was above capacity while water was flowing over the spillway.

Streamflow scenario

25. This technical analysis report was based on modelling with the 'Post-1997 step climate change' streamflow scenario described in the *2020 Guidelines for Assessing the Impact of Climate Change on Water Availability in Victoria*. The use of the 'Post-1997 step climate change' streamflow scenario is representative of streamflow conditions observed in recent history and therefore appropriate for developing the three year desalinated water order advice. The methodology used to establish this streamflow scenario results in consideration of some potential drought sequences more severe than those that have occurred historically.

26. The 'Post-1997 step climate change' streamflow scenario uses the observed streamflow for the period July 1997 to December 2022, with the observed streamflow from January 1913 to June 1997 scaled to match the statistical properties of the period July 1997 to December 2022. The 2022 streamflow at Melbourne's four major harvesting reservoirs (847 GL) was the highest in any calendar year for the post-1997 period and the highest in the last 48 years. The addition of this year to the data set has resulted in an increase of the average annual streamflow for the post-1997 period and adjustment of almost 21 GL/year to the scaled streamflow from January 1913 to June 1997 used as the baseline for assessment purposes. The difference between the observed historical streamflow (grey bars) and the adjusted streamflow (orange bars) are illustrated in Figure 3. In the water resource modelling, the 110 years of streamflow data, with the adjusted streamflow from 1913 to 1997, are used to create 110 streamflow replicates (also referred to as streamflow sequences), that are used to assess the performance of potential desalinated water order pathways against a range of potential streamflow conditions.

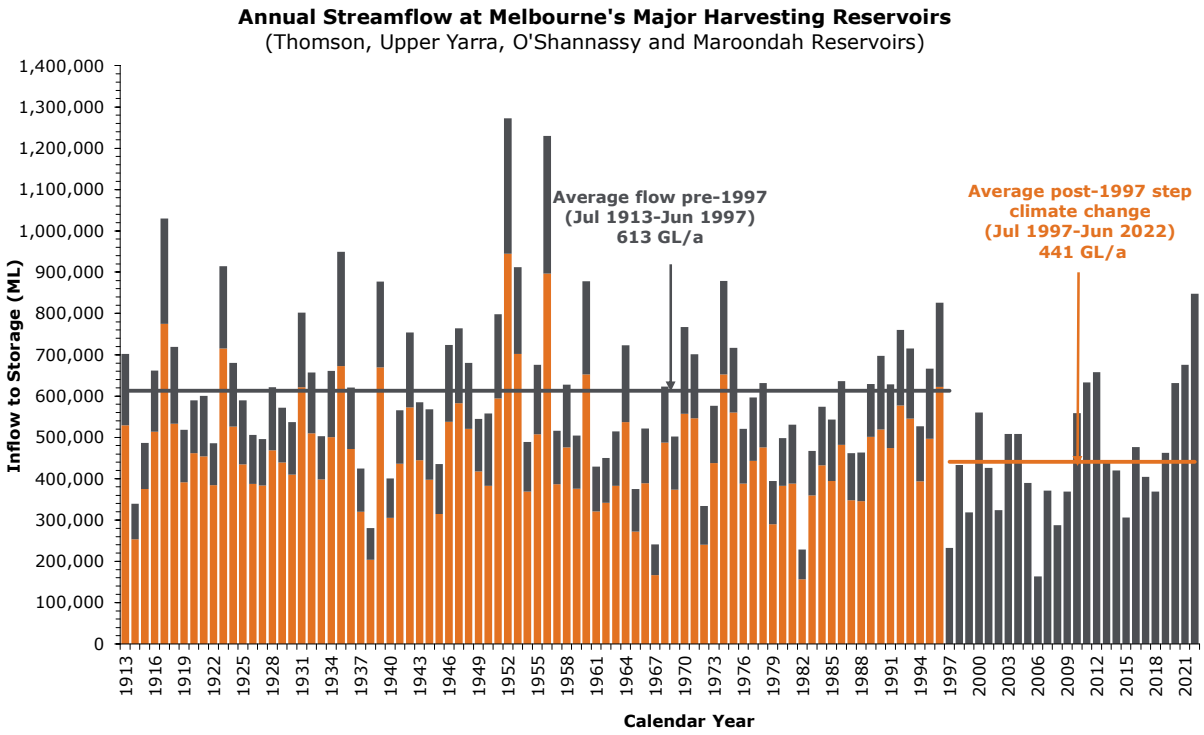

Figure 3: 'Post-1997 step climate change' streamflow scenario

Demand forecasts

27. To support the desalinated water order advice development process, the metropolitan and regional water businesses provided demand forecasts for the next 15 years. Focusing on the first three years covered by the advice, the demand forecasts are outlined in Table 2. These demand forecasts include expected water savings from the Target 155 program and Permanent Water Use Rules. In the water resources modelling, the metropolitan demand forecasts are adjusted in each modelled year using a climate index algorithm to reflect the variability in demand typically observed in warmer and drier, cooler and wetter years and seasonal variability in demand during the year. The average annual demand forecasts for the metropolitan water businesses outlined in Table 2 reflect the impact of recent and forecast growth in Melbourne's population.

Table 2: Demand forecasts provided by the metropolitan and regional water businesses

Year	Metropolitan water businesses (GL)	Regional water businesses (GL)	Total (GL)
2023/24	438	19	458
2024/25	442	19	461
2025/26	446	20	466

28. The water demand forecasts in Table 2 do not include environmental water releases from water entitlements held by the Victorian Environmental Water Holder for the Yarra, Tarago and Thomson basins. For modelling purposes, it was assumed that the Victorian Environmental Water Holder will use 2022/23 planned releases and the annual allocation each year thereafter. The environmental allocations for key modelled river systems include:

    - Yarra River system: 17 GL/year
    - Thomson River system: 10 GL/year plus 3.9% of inflows to Thomson Reservoir (under the 'Post-1997 step climate change' streamflow scenario, 3.9% of inflows to Thomson Reservoir is approximately 7 GL/year on average).
    - Tarago River system: 10.3% of inflows to Tarago Reservoir

29. The water demand forecasts in Table 2 also do not include rural irrigation water releases from water entitlements held by Southern Rural Water. For modelling purposes, it is assumed that Southern Rural Water uses their annual allocation of 6% of inflows to Thomson Reservoir each year (under the 'Post-1997 step climate change' streamflow scenario, 6% of inflows to Thomson Reservoir is approximately 11 GL/year on average).

Operational considerations

30. The technical analysis supporting the 2023/24 desalinated water order advice also takes into account planned asset and operational factors including:

    - **Cardinia Reservoir:** The modelling includes a maximum operating volume of 265 GL (full supply level approximately 287 GL), consistent with dam management operating conditions and also includes assumptions for temporary drawdown to 230 GL to support future capital works currently planned to commence in November 2024. Cardinia Reservoir is required to store desalinated water delivered as well as wet season streamflow from the upper Yarra River tributaries.
    - **Upper Yarra Reservoir:** The modelling includes a maximum operating volume of 185 GL (full supply level approximately 200 GL), consistent with system management rules.
    - **Yan Yean Reservoir:** Modelling takes account of the expected timing for completion of the Yan Yean Reservoir water treatment plant upgrades in August 2023.

    Other key modelling assumptions related to water supply system operations are similar to those used in previous years, including:

    - **Winneke** and **Tarago water treatment plants:** The modelling includes planned operating capacity for 2023/24, and up to full operational

capacity for subsequent years (130 GL/year and 16 GL/year respectively), with output depending on water availability at these sites and others.

31. Desalinated water is assumed to be delivered from 1 July at its maximum capacity until the order has been completed. For larger orders, a reduced output is assumed in February as part of regular operational practice.

Cost information

32. To support water resource modelling and price modelling, DEECA provided estimates of costs associated with each of the desalinated water order volume options based on the best available information.

Technical analysis results

33. Water resource modelling was undertaken to support the 2023/24 desalinated water order advice, which provides an outlook from 1 December 2022 to 30 June 2026, covering the three financial years for which advice is required under the *Water Interface Agreement*. This modelling process considers all possible desalinated water orders that could be placed under the *Project Deed* during this three year period (including 0 GL), and identifies the desalinated water orders most likely to lead to outcomes consistent with the principles described in paragraph 22.

34. The water resources modelling separately considers each of the seven possible orders from 0 to 150 GL in the first year of the three-year desalinated water order advice. For each of these seven possible first year (2023/24) orders, Melbourne's water supply system is modelled over the next three and a half years under 110 different streamflow sequences. For each streamflow sequence, the model selects the second (2024/25) and third year (2025/26) desalinated water orders that best meet the five principles under that particular sequence.

35. The water resources modelling results are summarised in Table 3. These results reflect, for a given 2023/24 desalinated water order volume, the remaining risks after taking into account the potential to increase or decrease desalinated water orders in 2024/25 and 2025/26 in response to observed conditions.

Table 3: Summary of assessment against the five principles for all potential 2023/24 desalinated water order volumes

2023/24 desalinated water order volume (GL)	Principle 1			Principle 2			Principle 4						Principle 3			Principle 5			
	Percentage of streamflow replicates that fall into the Critical Water Use Only Zone (below 45% on 30 November)			Percentage of streamflow replicates that fall into the Be Proactive Zone (below 75% on 30 November)			10th percentile foregone harvest (90% of streamflow replicates have foregone harvest less than this volume) (GL)			50th percentile (median) foregone harvest (50% of streamflow replicates have foregone harvest less than this volume) (GL)			50th percentile (median) storage recovery (50% of streamflow replicates have greater storage recovery than this volume) (GL)			Average discounted cost of producing desalinated water over the three year outlook period ($M)	Average order volume across all streamflow replicates (GL)		Average change in order volume between years across all streamflow replicates
	Principle target: 0%			Principle target: Less than 10%			Principle target: Less than 25 GL			Principle target: Less than 12.5 GL			Principle target: More than 0 GL			Principle target: Minimise impacts (magnitude and variability) on customer bills in all three years			
	Year 1	Year 2	Year 3	Year 1	Year 2	Year 3	Year 1	Year 2	Year 3	Year 1	Year 2	Year 3	Year 1	Year 2	Year 3	All three years	Year 2	Year 3	All three years
0 GL	0	0	0	2	6	5	0	9	11	0	0	5	-71	-21	20	100	51	82	41
15 GL	0	0	0	1	5	5	16	10	11	5	0	2	-63	-28	-2	80	41	53	27
50 GL	0	0	0	0	3	5	46	17	11	27	3	0	-46	-43	-17	74	28	35	38
75 GL	0	0	0	0	3	5	56	32	13	37	7	1	-29	-53	-20	83	25	29	50
100 GL	0	0	0	0	3	4	60	53	23	39	10	2	-7	-71	-21	95	22	27	65
125 GL	0	0	0	0	1	2	61	73	31	39	19	3	16	-85	-24	109	21	26	79
150 GL	0	0	0	0	1	2	67	98	33	39	31	3	40	-103	-40	120	18	20	95

36. Table 3 suggests that:

- **Principle 1 - Avoid being in the Critical Water Use Only Zone:** For all water order options in 2023/24, including a zero order, the assessed risk of storages falling into the Critical Water Use Only Zone on 30 November is 0% in all three years of the advice period.
- **Principle 2 – Minimise risk of being in the Be Proactive Zone:** For all water order options in 2023/24, including a zero order, the assessed risk of storages falling into the Be Proactive Zone on 30 November is below 10% in all three years of the advice period.
- **Principle 3 – Maximise storage recovery:** At least 125 GL is required in 2023/24 to almost enable a 50% chance of storages being maintained in 2023/24.
- **Principle 4 – Minimise foregone harvest:** An order of 0 GL will maintain foregone harvest within benchmarks in all three years of the advice period. An order of 15 GL does not exceed the foregone harvest benchmark under 10% of streamflow sequences, however there is a risk of foregoing more catchment harvest than the order volume. Orders of 50 GL and above provide unacceptable foregone harvest risk well above the principle criteria.
- **Principle 5 – Minimise customers' bill impacts:** A 0 GL has no impact to customer bills while a 15 GL order has a slight increase, primarily due to inflation. With lower water orders in 2023/24 and the anticipated higher orders associated with the forecast non-binding advice of 50 GL and 75 GL, customer bills may be affected in subsequent years.

37. Figure 4 illustrates projected water storage levels over the next three financial years for the 110 streamflow sequences associated with the 'Post-1997 step climate change' streamflow scenario. Figure 4 assumes that 0 GL is ordered in 2023/4, followed by orders in 2024/25 and 2025/26 adapted for each streamflow sequence as needed to deliver outcomes consistent with the principles.

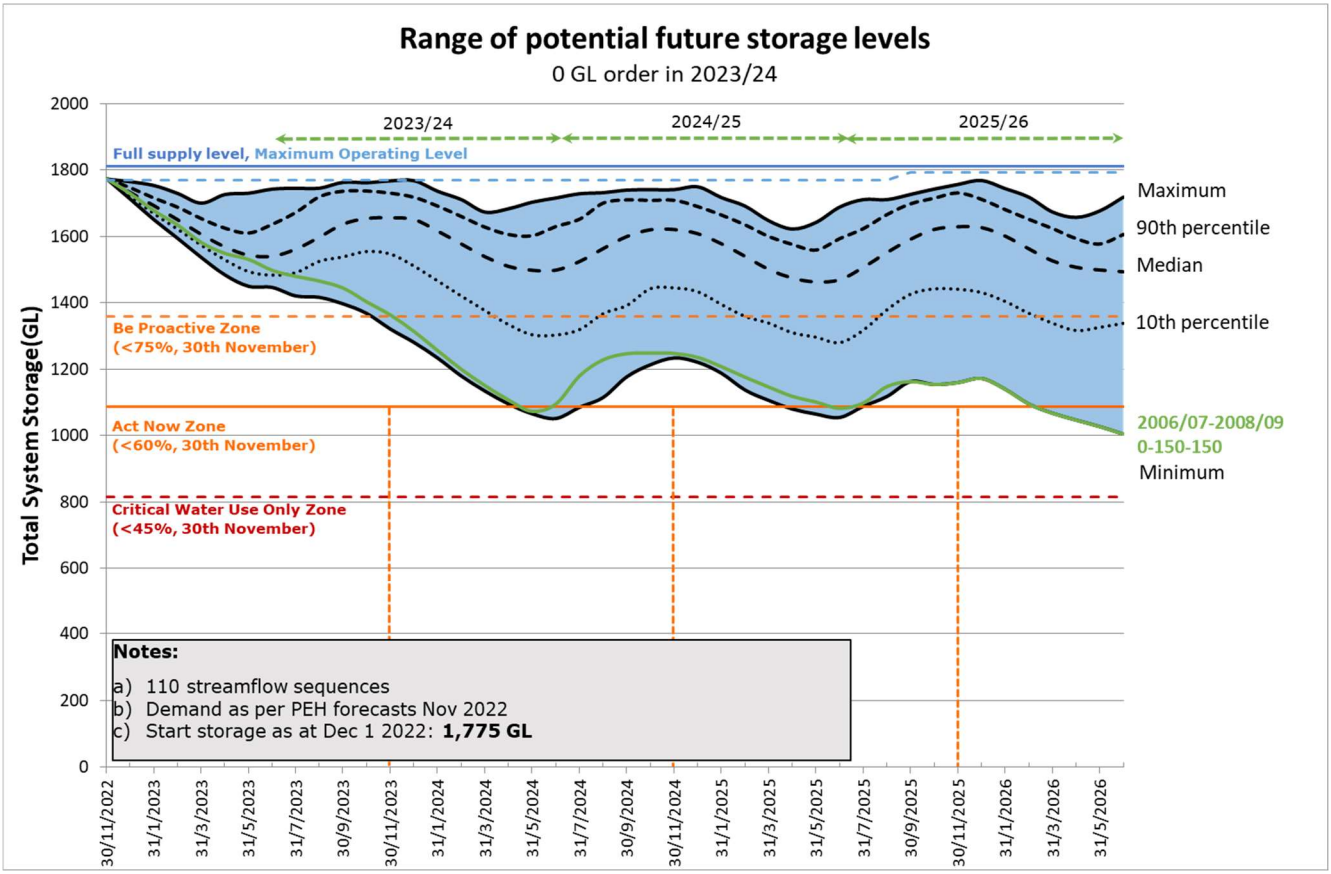

Figure 4: Modelled projection of potential future water storage levels assuming a 0 GL order in 2023/24

38. Figure 4, the projected water storage levels if streamflow similar to those observed in 2006/07, 2007/08 and 2008/09 (a particularly dry sequence within the Millennium Drought period) were to be repeated are shown in green. For this particular streamflow sequence, the modelling suggests that it could be appropriate to order 150 GL in both 2024/25 and 2025/26 to respond to falling water storage levels resulting from severe dry conditions.

Other considerations

Value of Water in Storage

39. While the consecutive La Niña years of 2020, 2021 and 2022 saw higher inflow conditions, in the medium to long term, yield is projected to decrease as a result of changing climate conditions while demand is projected to continue to increase. As a result:

- Water storage levels will, on average, show a decreasing trend without regular water volumes provided by the VDP.
- Desalinated water order volumes will therefore be necessary in order to maintain or recover storage levels. Depending on the sequencing of future wet and dry years, average orders will reflect an increasing use of the VDP.

- Prior to the VDP's capacity being required to supply growing base demand in future, larger orders when there is storage capacity can be used to build a storage level buffer for drought resilience.
- Maintaining high storage volumes increases the Melbourne region's resilience to extreme climate events such as droughts and assist in delaying the need for augmentation. This was highlighted in a 2018 Melbourne University study on the '*The economic value of water in storage'* that found that:
  - Storing additional water can have important economic value as it can reduce or defer the need to augment the water supply system.
  - Additional water in storage can reduce the severity and impact of water restrictions, and the resulting economic and social costs.
- Augmentation to the water supply system will become necessary as the difference between water demand and yield diminishes and water security cannot be maintained.

Reservoir spillway flows

40. Given current high water storage volumes and the distribution of water across the major water storages, Principle 4, the risk of desalinated water causing avoidable foregone harvest and reservoir spills, was a key consideration in the technical analysis. In most years, some spillway flows occur from the smaller reservoirs in the system regardless of any desalinated water orders.
41. The 2023/24 order advice gave detailed consideration to order volumes that balanced maintaining drought reserves in Thomson Reservoir while managing the possible risk of the reservoir reaching full capacity and spilling again in 2023/24. Analysis highlighted that there is potential of spillway flows from Thomson Reservoir in 2023/24; placing any desalinated water order in 2023/24 increases this possibility.

Climate outlooks

42. The desalinated water order advice was informed by the Bureau of Meteorology's seasonal streamflow forecasts and ENSO Wrap-up issued during January and February 2023.
    - The Climate Drive Update (issued 31 January 2023) indicated that:
      - 'La Niña continues in the tropical Pacific, but oceanic indicators have weakened since their peak during spring 2022. While ocean temperatures have eased from La Niña thresholds, the atmosphere has yet to respond, and remains La Niña-like. La Niña typically increases the chance of above-average rainfall for northern and eastern Australia during summer.'
      - 'All models anticipate SSTs (i.e. Sea Surface Temperatures) in the central Pacific will return to neutral ENSO levels during February, with

neutral conditions (neither La Niña nor El Niño) anticipated until at least mid-autumn.'

- 'The Southern Annular Mode is currently strongly positive, but is anticipated to ease over the coming fortnight and then remain neutral over the remainder of February. During summer, positive SAM is typically associated with an increased chance of above average rainfall for eastern New South Wales, eastern Victoria, and north-east Tasmania, and below average rainfall for western Tasmania.'
- 'The Indian Ocean Dipole (IOD) is neutral and has little influence on Australian climate while the monsoon trough is in the southern hemisphere (typically December to April).'

- The seasonal streamflow forecasts for Melbourne's four major harvesting storages (issued mid-January 2023 and illustrated in Table 4) generally favoured high flow for the period January to March 2023.

Table 4: Seasonal streamflow forecast for Melbourne's four major harvesting storages for January to March 2023 (Source: Australian Government Bureau of Meteorology)

4 major harvesting reservoirs	Jan – Mar 2023 (based on 'unpublished new' forecast provided by BoM)
Thomson	High flow
Upper Yarra	High flow
O'Shannassy	High flow
Maroondah (Watts River & Graceburn Creek)	High flow

43. More generally, the Bureau of Meteorology climate outlooks issued on 9 February 2023 indicated for the period March to May 2023 approximately:
    - 60-70% chance of exceeding median rainfall.
    - 50-60% chance of exceeding median maximum temperature.
44. These outlooks do not extend over the three years of the desalinated water order advice period, but indicate relatively short term conditions. While a La Niña event remains active, the streamflow and rainfall forecasts show mixed signals and as such have not influenced the advice for 2023/24.

Technical outcomes

45. Order volumes of 0 GL and 15 GL were considered for the 2023/24 desalinated water order advice. These options provided water security by

managing the Critical Water Use Only and Be Proactive Zone risks, minimised foregone harvest and major reservoirs reaching capacity and maintains a buffer against the impacts of future drought. These two potential order volumes meet most of the desalinated water order advice principles in 2023/24.

46. A 0 GL order does not impact customer bills while a 15 GL order results in small customer bill increases from 2022/23 to 2023/24.

47. To best balance the need to manage the risk of foregone harvest while maintaining a storage buffer and minimising customer bill impacts, desalinated water order advice of 0 GL for 2023/24 is most aligned with the desalination order advice principles. Thereafter, non-binding forecasts of 50 GL in 2024/25 and 75 GL in 2025/26 are recommended.

Conclusion

48. Consistent with the requirements of the *Water Interface Agreement* described in paragraph 15, the following desalinated water order advice has been provided by Melbourne Water to the Victorian Government:

    a. The required annual water volume for the 2023/24 supply period should be 0 GL.

    b. There are no constrained months in the 2023/24 supply period.

    c. Non-binding forecasts of 50 GL in 2024/25 and 75 GL in 2025/26 supply periods are appropriate.