Lower Hunter Water Plan

MERI Evaluation 2018

Version 1.0

Version history

Version	Author(s)	Comments	Date
0.1	Erin Toner		August 2018
0.2	Sogol Ghobad		October 2018
0.3	Erin Toner		January 2019
0.4	Erin Toner	Following Hunter Water and CCC review and comment	February 2019
0.5	Sogol Ghobad	Endorsed by Senior Officers Group. No comments were received.	March 2019
1.0	Erin Toner	Final – endorsed by IWAP with no comments	

Published by NSW Department of Industry

industry.nsw.gov.au

Title: Lower Hunter Water Plan 2018 MERI Evaluation

First published:

Department reference number:

More information

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Acknowledgements

Thanks to Hunter Water and Central Coast Council for their input to the 2018 evaluation process and to this report

Contents

Executive summary

The Lower Hunter Water Plan (LHWP) sets out a mix of supply and demand measures to meet its objectives to:

- provide water security during drought
- ensure reliable water supplies to meet growing demand due to a growing population and increased business and industry activity
- help protect aquatic ecosystems
- maximise net benefits to the community.

A Monitoring, Evaluation, Reporting and Improvement (MERI) Plan guides implementation of the LHWP and sets out a framework to assess performance against its objectives, using an adaptive management approach to incorporate the latest knowledge, experience and technology.

The 2018 annual evaluation report is structured around responding to the four key evaluation questions (KEQ) in the MERI Plan. The findings for each of the KEQ are summarised below.

KEQ 1 How effective has the plan been in achieving its objectives?

Most of the questions under KEQ 1 are only addressed as part of the major MERI evaluation, which was conducted in 2016. For an annual evaluation, only evaluation question (EQ) 1.3 is required: EQ 1.3 asks: Is the forecast supply-demand balance still consistent with the LHWP forecast?

The updated forecast supply and demand balance remains close to the 2014 LHWP forecast, with the intersection of the water supply and demand forecast now expected to occur in 2037/38, two years later than projected in the LHWP.

Above average, hotter and drier conditions in 2016/17 and 2017/18 resulted in demand close to the sensitivity bounds however the longer term forecast is expected to be similar to the 2014 forecast.

Contamination issues at the Williamtown RAAF Base have reduced the availability of water from the Tomago Sandbeds since the LHWP was developed, the system yield remains slightly above the 2014 figure due to compensating improvements in other areas. The estimated impact on yield due to reduced access to water at Tomago is approximately a 1 GL/year reduction. The current estimated system yield, taking into account reduced access to water at Tomago due to water contamination, is around 76 GL/year (1 GL/year above the 2014 figure).

Further changes to groundwater access in the Tomago Tomaree Stockton groundwater sources may also come as a result of future potential regulatory changes to the North Coast Coastal Sands Water Sharing Plan. DoI will convene the Groundwater Working Group in 2019 to assess research into Groundwater Dependent Ecosystems (GDEs) and to identify any additional information needed to assess the broad costs and benefits associated with changes to cease to pump conditions. This will be considered in the context of options investigations for the next LHWP.

Overall the intersection of supply and demand provides adequate time to plan for the next supply.

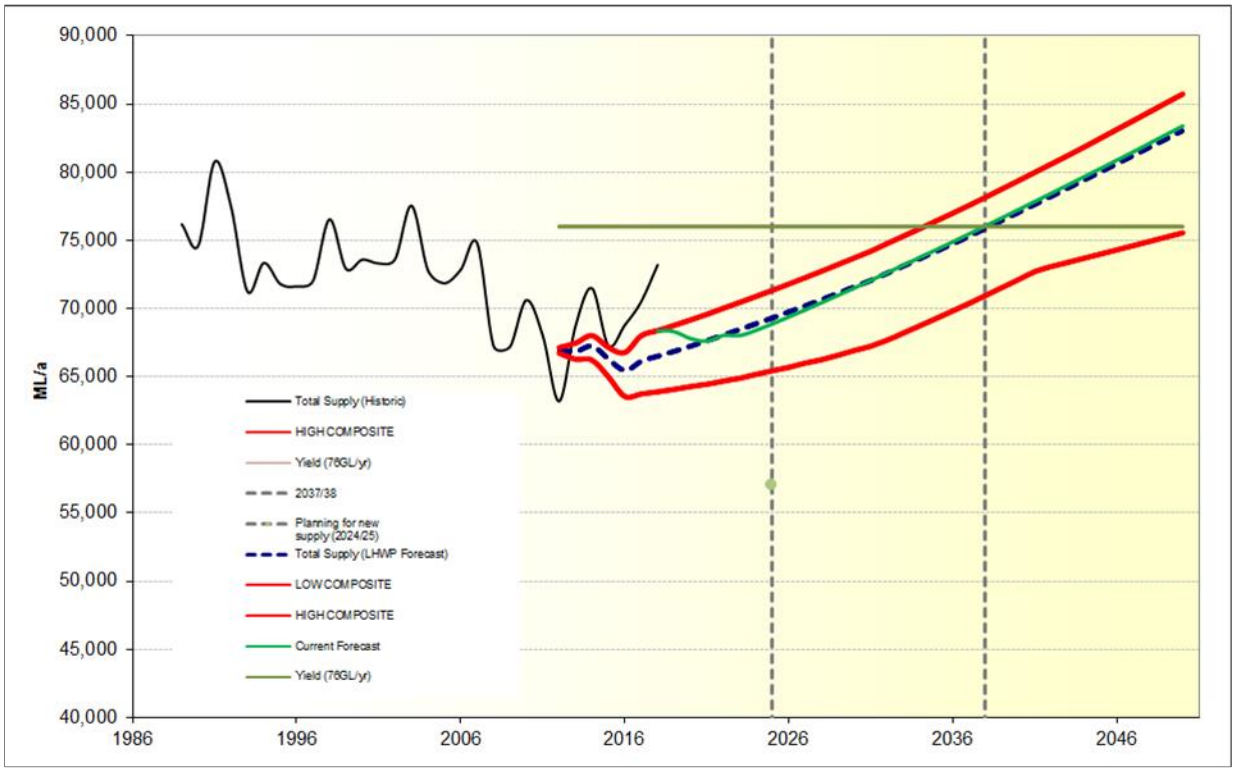


Figure ES.1 Updated supply-demand balance, showing 13-year lead time to provide for future supply augmentation

KEQ 2 How effective are the measures within the plan?

While water storage levels reached the 70% trigger for drought actions to commence in February and March 2018, storages quickly recovered following rainfall. As a result, the drought measures of the LHWP were either not implemented or implemented for a short period of time only, and their performance could not be properly evaluated. The non-drought measures have generally been effective and met expectations for the supply, saving and substitution of water.

The estimated savings achieved from water efficiency measures was higher than forecast, with a significant focus on business customers. Hunter Water has set an internal target to reduce non-revenue water to below 10 GL/year by mid-2019. This initiative has resulted in greater than forecast savings in 2017/18 from loss minimisation programs.

The volume of water recycled through the Kooragang Industrial Water Scheme (KIWS) was slightly lower than the forecast of 3000 ML/year but the highest it has been since the commissioning of the scheme. Overall, total recycled water supplied in 2017/18 was 6,454 ML. Opportunities to increase recycled water as a substitute for potable water will be explored as part of the next LHWP.

KEQ 3 How efficiently has the plan been delivered?

In 2017/18 there was progress against the outstanding implementation actions for the LHWP, though delivery is delayed in in some cases.

Hunter Water engaged SMEC Australia to develop a concept design for a new fishway at Seaham Weir that incorporated the design attributes developed by the Environmental Flows Working Group. While there have been some delays on the project, construction is expected for 2020 to 2021.

DoI has drafted amendments to Hunter Unregulated and Alluvial Water Sources 2009 and will progress with targeted consultation in 2019 to enable increased environmental flows at Chichester Dam.

Hunter Water continues to investigate opportunities for stormwater harvesting identified through the LHWP and now hosts the Water Sensitive Region Interagency Working Group to promote shared understanding of Integrated Water Management with government agencies and local councils.

Investigations in to the Lower Hunter alluvial groundwater source near Maitland yielded water that was determined too saline for potable supply. It was determined that there would be no further investigations into this option and that alternative groundwater sources will be considered as part of the investigations for the next LHWP.

The implementation of readiness activities for the contingency measure of temporary desalination is ongoing, with the concept design and EIS underway for a 15 ML/day facility at Belmont. While delayed by approximately 25 months against the timeline provided in the 2016 MERI, the project has progressed well since the last evaluation. It is estimated that the EIS will be submitted to the Department of Planning and Environment by July 2019 and that readiness activities will be complete by January 2020. Hunter Water advises that based on current storage levels, it could be possible to deliver water in the event of an immediate drought if alternative procurement strategies are applied.

Central Coast Council's construction of the Mardi to Warnervale pipeline to increase inter-regional transfers in a northerly direction to 30 ML/day has been delayed due to changes in the complexity of the project. The project is now estimated for completion in end-2021, pending funding availability. Until works are complete transfers will be limited to 15 ML/day.

KEQ 4 Do the measures within the plan remain appropriate?

Broadly, the measures in the plan remain appropriate, although some issues with delivery timeframes and expected volumes of water supplied and saved have been identified (as discussed above).

There have been several changes to the regulatory and operating environment that did not influence the LHWP in 2017/18 but that will be monitored in 2018/19 and considered in the next planning process, these include:

- IPART review of pricing arrangements for recycled water and related services;
- Infrastructure options identified through the Upper Hunter Regional Strategy;
- Changes to governance arrangements for the Metropolitan Water CEOs committee and the Independent Water Advisory Panel.

1 Introduction

The Lower Hunter Water Plan (LHWP) sets out the NSW Government's water strategy for the region, to deliver a mix of supply and demand measures to meet its objectives to:

- provide water security during drought
- ensure reliable water supplies to meet growing demand due to a growing population and increased business and industry activity
- help protect aquatic ecosystems
- maximise net benefits to the community.

The first LHWP, released in 2014, focussed on responding to drought because supply-demand modelling indicated that Hunter Water's supply system could meet new growth for around 20 years. The LHWP comprises a portfolio of supply and demand measures in the categories of surface water, groundwater, water efficiency, demand management, recycling, stormwater and temporary desalination. A key feature of the plan is that it is flexible to adapt to challenges, such as our highly variable climate patterns and new information and experience gained over time, as well as to changes in behaviour, technology or the regulatory environment that impact the portfolio.

As part of the implementation of the LHWP, a Monitoring, Evaluation, Reporting and Improvement (MERI) Plan sets out a framework to assess performance against the LHWP's objectives and to ensure that it can adapt to incorporate the latest knowledge, experience and technology. Key elements to be monitored include:

- achievement of LHWP objectives
- the validity of the assumptions that underpin the LHWP
- the timely implementation of actions identified in the plan
- relevant developments in research and technology.

Crown Lands and Water division within the Department of Industry (DoI) is the lead agency in implementing the MERI plan and developing future iterations of the LHWP, working in partnership with Hunter Water and Central Coast Council (CCC).

Annual evaluations were undertaken under the MERI framework in 2014, 2015 and 2017. A major evaluation was undertaken in 2016. This report outlines the findings from the 2018 annual evaluation of the performance and implementation of the LHWP

Planning for the next iteration of the LHWP began in 2017/18 and a new plan is estimated for delivery in 2021. This original date for delivery of a new plan was to have been 2020, but a review of current planning methods suggests that a much wider range of issues should be considered to ensure that planning leads to increased resilience, and is capable of dealing with long term trends as well as sudden system shock. As a result, DoI, Hunter Water and CCC have agreed that a longer planning period would result in a more comprehensive and robust plan.

2 The annual evaluation process

The MERI plan includes four key evaluation questions (KEQ) derived from the objectives of the LHWP. The KEQ establish the direction and focus of the evaluation. These are:

KEQ 1	How effective has the plan been in achieving its objectives?
KEQ 2	How effective are the measures within the plan?
KEQ 3	How efficiently has the plan been delivered?
KEQ 4	Do the measures within the plan remain appropriate?

Under these KEQ are two levels of evaluation questions and specific evaluation questions that provide more detailed information needed to answer the four KEQ. This allows us to address the MERI objectives and adapt the LHWP if needed.

Table 2.1 summarises the first two levels of MERI evaluation questions. The lower level 'specific evaluation questions' are covered in the tables in each chapter.

As shown in Table 2.1, only some of the evaluation questions are addressed in the annual evaluation. This is because:

- some actions in the LHWP only occur in the event of a drought
- questions relating to the extent that the LHWP objectives are being met and the contribution of the LHWP to this can only be answered once the plan has been in place for a period of time.

The annual evaluation questions are designed to monitor aspects of the LHWP that can meaningfully be measured each year and provide time series data to evaluate the effectiveness and efficiency of the plan when there is a major evaluation. This evaluation report is structured around responding to the KEQ, with detail on the lower level evaluation questions relevant to the annual reporting.

The steps in the annual evaluation process are illustrated in Figure 2.1. The 2018 annual evaluation began in May 2018. Hunter Water, and CCC submitted their responses to DoI in September 2018. DoI has collated the information from agencies and assessed the results.

The MERI evaluation report will be submitted to the governance groups that oversee metropolitan water planning for the lower Hunter, for their review and endorsement. These governance groups include the Lower Hunter Water Senior Officers' Group (LHWSOG), the Independent Water Advisory Panel (IWAP), and the Lower Hunter Water CEOs (LHWCEOs – formerly the Metropolitan Water CEOs). The final report and a brief on key findings and issues will be submitted to the Minister for Regional Water in early 2019.

In February and March 2018, Hunter Water total water storage levels reached 70%. While this is the trigger to address the drought questions as part of the MERI evaluation, storage levels quickly recovered and remained consistently above 70% until the end of the MERI evaluation period. For the purposes of this evaluation we have not considered the region to have undergone a drought and have not triggered the MERI drought review. However, in preparation for a possible drought, a number of drought actions were implemented by Hunter Water and these are discussed as part of this report in Section 5.

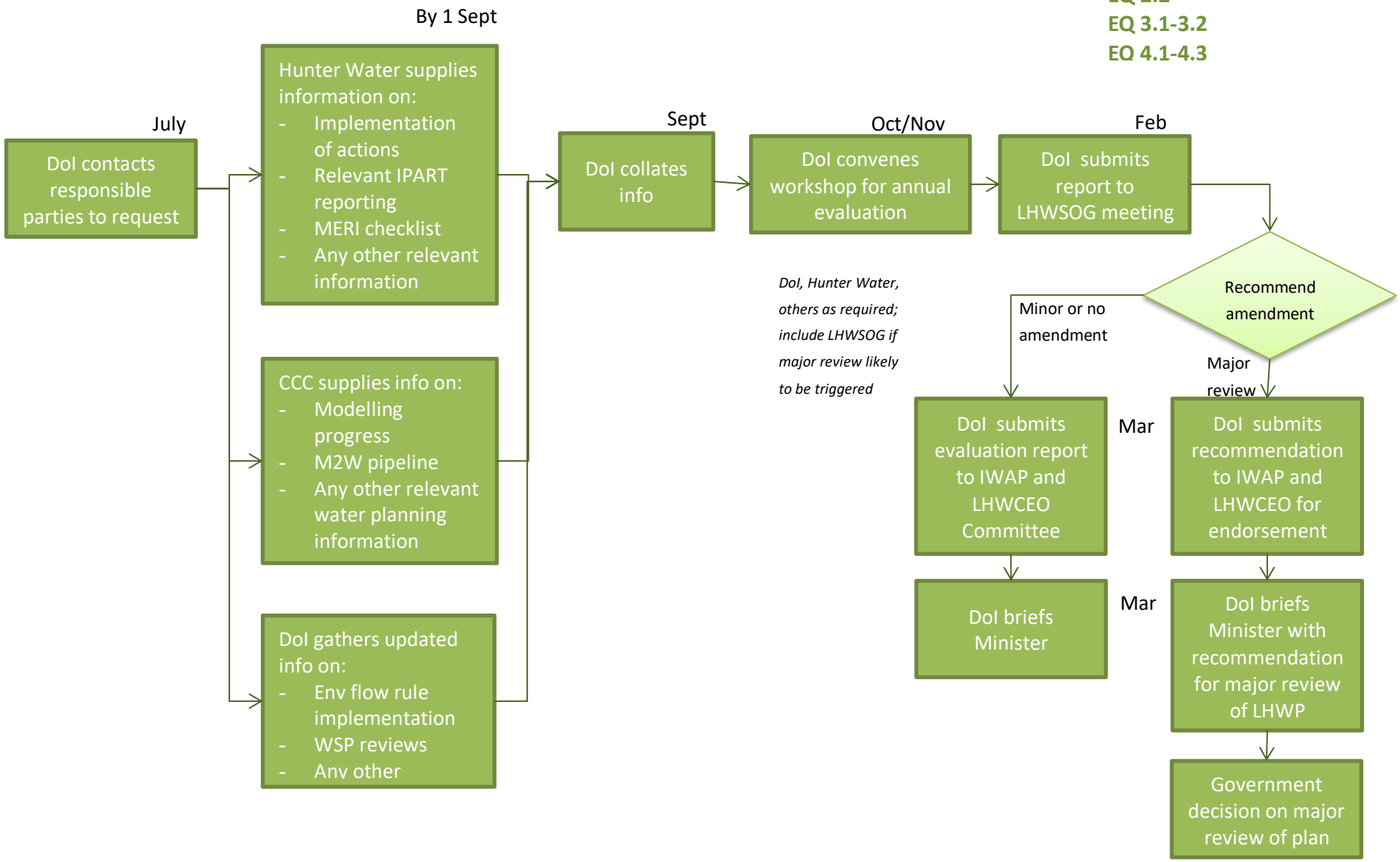
Table 2.1 Summary of MERI evaluation questions and timeframes

Key Evaluation Question	Evaluation Question	Timeframe for monitoring, evaluation and reporting		
		Annual	Intermittent	
			Drought event	Major review
KEQ 1. How effective has the plan been in achieving its objectives?	EQ 1.1 To what extent are the LHWP's objectives being met?			
	EQ 1.2 Have the objectives been achieved as a result of the LHWP implementation?			
	EQ 1.3 The underlying premise of the plan is the supply and demand balance - is the forecast supply and demand balance still consistent with the LHWP's forecast?			
	EQ 1.4 Have there been any unintended outcomes (positive or negative) and how have these impacted on the LHWP's objectives?			
KEQ 2. How effective are the measures within the plan?	EQ 2.1 Do the measures perform as expected under drought conditions? Can any reasons for significant variation be explained?			
	EQ 2.2 Have the non-drought measures (ie, continuing measures) been effective in the supply, saving and substitution of water? Can any reasons for significant variation be explained?			
KEQ 3. How efficiently has the plan been delivered?	EQ 3.1 Have the identified implementation actions been delivered within agreed timeframes or consistent with identified triggers? What are the reasons for any significant variation and how can this understanding improve delivery of the LHWP?			
	EQ 3.2 Are the implementation actions consistent with the LHWP's expectation for deliverables and costs? What are the reasons for any significant variation and how can this understanding improve delivery of the LHWP?			
KEQ 4. Do the measures within the plan remain appropriate?	EQ 4.1 Are the assumptions underpinning the LHWP still appropriate? Do any changes influence the measures and implementation actions in the LHWP?			
	EQ 4.2 Is the regulatory and operating environment still consistent with the LHWP? Do any changes influence the measures and implementation actions in the LHWP?			
	EQ 4.3 Has new technology, information or methods emerged that will influence the measures and their implementation? Do any changes influence the measures and implementation actions in the LHWP?			

Note: Some elements of the MERI plan are specific to drought events and will only be evaluated, when a drought event has occurred. There has not been a drought event in the lower Hunter since the LHWP was released.

Evaluation questions:
EQ 1.3
EQ 2.2
EQ 3.1-3.2
EQ 4.1-4.3

Figure 2.1 Key steps in the annual evaluation process



3 Recommendations from previous MERI evaluations

Two actions from previous evaluations were completed in 2017/18:

- Further investigate the reasons for and response to the increasing trend in 'other' (non-revenue) water supply and the Infrastructure Leakage Index as part of developing the next LHWP.
- Resolve whether or not the lower Hunter alluvial is likely to be a feasible source of supply in drought, so that it can be either included or excluded as an option for developing the next LHWP.

In 2017-18, in addition to progressing the actions set out in the 2014 LHWP work is underway to develop the next LHWP. It is expected that the next LHWP will provide the opportunity to consider and incorporate many of the actions identified through previous MERI evaluations, particularly the 2016 major evaluation. Actions from previous reports which will be considered in the next LHWP are summarised in Table 3.1 below.

Table 3.1 Actions for the next LHWP as identified through previous MERI evaluations

	Action	Lead
1	Frame the objectives to articulate the high-level goals that reflect strategic priorities to be achieved, together with more specific, measurable objectives under these goals. These objectives will also provide a basis for analysing options and portfolios, and will be linked to performance indicators for future evaluations of the performance of the plan.	DoI Hunter Water CCC
2	Consider the capacity to adapt to the potential for significant climate variability in developing the objectives and evaluating measures.	DoI Hunter Water CCC
3	Review the levels of service criteria.	DoI Hunter Water CCC
4	Incorporate the 2016 population projections into the demand model, along with further analysis of underlying trends, as part of the more comprehensive review of the demand forecast.	Hunter Water
5	Follow up any outstanding actions arising from the 2013 peer review of the demand forecast, such as those relating to outdoor water use, correction for weather conditions, demand characteristics of non-residential customer categories, and price elasticity. Incorporate any findings.	Hunter Water
6	Include a climate correction model in the major review of the demand forecast model to better understand the impact of weather on demand and the water savings from WWR, demand management and water efficiency measures	Hunter Water
7	Follow up any outstanding actions arising from the 2013 peer review of the source model, such as those relating to periodic bathymetric surveys of Grahamstown and Chichester dams, optimisation processes, a proofing model, improved modelling of the Tomaree source, synthetic data generation, validation of the Grahamstown Dam model, updating SoMo to reflect any changes in operating strategies/contingency plans, and climate change assessment. Incorporate any findings.	Hunter Water
8	Where appropriate, take findings from paleoclimate research into account in the hydrologic modelling and economic analysis.	Hunter Water
9	Consider the impacts on water supply system yield from any risk mitigation measures for managing impact on Grahamstown Dam from the Campvale catchment.	Hunter Water

10	Examine drivers of increasing residential demand and identify options for cost-effective demand management.	Hunter Water
11	Compare the mine water source with other short-listed sources/sites as part of the temporary desalination readiness investigations, and continue liaising with CSIRO and Centennial Coal on the proposed FO/RO technology trial to understand the feasibility of this source and/or technology. *No further action has proceeded with CSIRO and Centennial Coal as preferable minewater options have been identified for consideration in the next LHWP*	DoI Hunter Water
12	Address the environmental, economic, social and risk implications of changes to groundwater access (cease-to-pump) conditions for the Tomago and Tomaree groundwater sources.	DoI Hunter Water
13	Investigate the potential to increase utilisation of recycled water (as a substitute for potable water).	Hunter Water
14	When developing the MERI Plan, aim to avoid overlap between the evaluation questions and hence reduce duplication in reporting.	DoI
15	Implement a simplified format for evaluation reporting for annual evaluations, and ensure clear communication of needs to all staff contributing to the reporting.	DoI
16	Review the approach to monitoring the implementation of the plan (including, for example, the costs and volumes for water efficiency and demand management programs) to efficiently collect relevant data for future evaluations.	DoI Hunter Water
17	Ensure all assumptions for the plan portfolio and business-as-usual are documented and information is transferred as staff change.	DoI Hunter Water

4 KEQ 1: How effective has the LHWP been in achieving its objectives

Key findings for KEQ 1

- Supply and demand modelling indicates that the region's water supply is secure until 2037/38, two years later than the 2014 LHWP forecast
- Total demand is trending within forecast sensitivity and the current forecast for 2035-36 is slightly lower than the 2014 LHWP forecast
- The current residential demand forecast is above the 2014 LHWP forecast, while the forecasts for non-residential and non-revenue water are below the 2014 LHWP forecast
- The increase in residential water consumption in 2017/18 is likely attributable to weather conditions that were hotter and drier than average
- Hunter Water is developing a water conservation strategy to identify programs that can be implemented in the next 18 months, prior to the next LHWP

Overview

Most of the questions under KEQ 1 are only addressed as part of the major MERI evaluation because they are concerned with whether the LHWP is achieving its objectives and the contribution of the plan to these outcomes.

Evaluation question 1.3.1 asks whether the supply-demand balance is still consistent with the 2014 LHWP forecast. This is evaluated every year to ensure that:

- the demand forecast is tracking within the sensitivity bounds defined for the LHWP
- there have been no major changes to the levels of service or the system yield that would threaten water security
- there is enough time to plan for and implement new options before demand outstrips supply in the future.

The MERI plan establishes that if the supply-demand balance indicates that demand is likely to exceed supply within 13 years, a major review of the LHWP is triggered. This is based on the lead time for a major supply augmentation.

EQ 1.3.1 Is the forecast supply-demand balance still consistent with the LHWP forecast?

Review of demand forecast

Hunter Water updated its demand forecast in September 2018 to incorporate changes over the last 12 months. Table 4.1 illustrates changes in the elements of the 2018 demand forecast compared to the forecast for the 2014 LHWP (termed the 2013 forecast in the figure) for the planning period to 2035/36. This represents the point at which supply intersected demand for the 2014 LHWP forecast and provides a comparison against the most recent forecast.

The forecast demand in 2035/36 is 74.3 GL, a decrease of 0.4 GL compared to the 2014 LHWP forecast of 74.7 GL. The forecast remains within the bounds of the sensitivity envelope.

The updated forecast includes the following changes over the last 12 months:

- Average number of new residential connections per year was extended to include the last eleven years of data, increasing average connections per year from 2,913 to 3,226.

- The number of new residential connections in 2017/18 was 4,048, which is higher than forecast. Hunter Water advised that the majority of extra connections are flats and units, which typically use less water than houses and therefore demand forecasts will not change significantly despite the increase in connections.
- Non-Revenue Water has been updated based on planned and implemented initiatives for water loss programs, unmetered authorised consumption and metering inaccuracies. These programs are expected to reduce non-revenue water by approximately 2.2 GL/year in 2035/36. This is a significant change compared to previous years and reflects the increased strategic importance placed on non-revenue water management by Hunter Water.

Table 4.1 Changes in elements of the demand forecast for 2035/36 compared to the LHWP base forecast

Change	Description	Demand impact 2035/36 (GL/year)
Dwelling and population forecast	Forecast of dwelling connections increased, from 2913 per year to 3226 per year	+0.1
	Higher population forecast due to higher household size forecast by the Department of Planning and Environment	+ 0.3
Residential outdoor water use	LHWP Water Wise rules implemented on 1 July 2014.	- 0.6
	The hot/dry period from 2017/18 has increased the external usage based on the 7-year average	+ 2.2
Water efficiency	New clothes washing machines more efficient than forecast (new data)	- 0.7
	The effectiveness of rainwater tanks has been reduced from 100% to 66% consistent with a recent study by ISF	+ 1.3
Major customer demand	Recycled water supply from Kooragang scheme forecast to be less than capacity of the treatment plant	+ 0.3
	Reduced demand forecast for large users resulting from water efficiency programs and updated historic consumption analysis	
	The growth in provision of potable supply to Network Operators (Huntlee and Cooranbong) have been incorporated in to the forecast	
Inter-regional transfers	Potential supply to Singleton as a bulk water transfer no longer included in the forecast	- 0.2
Dual reticulation recycled water	Reduced extent of recycled water customers compared to LHWP forecast will reduce savings from BASIX	+ 0.3
Non-revenue water	Updated non-revenue water program for water losses, unmetered authorised consumption and metering inaccuracies.	- 2.2
Total	**Combined impact compared to LHWP forecast**	**- 0.4**

Non-residential demand in 2017/18 was 19.3 GL. This was slightly higher than the LHWP demand forecast of 19.1 GL. The non-residential demand is within the sensitivity bounds for large water users as shown in Figure 4.1. Hunter Water reported that this is largely due to the influence of hot/dry climatic conditions during the reporting period.

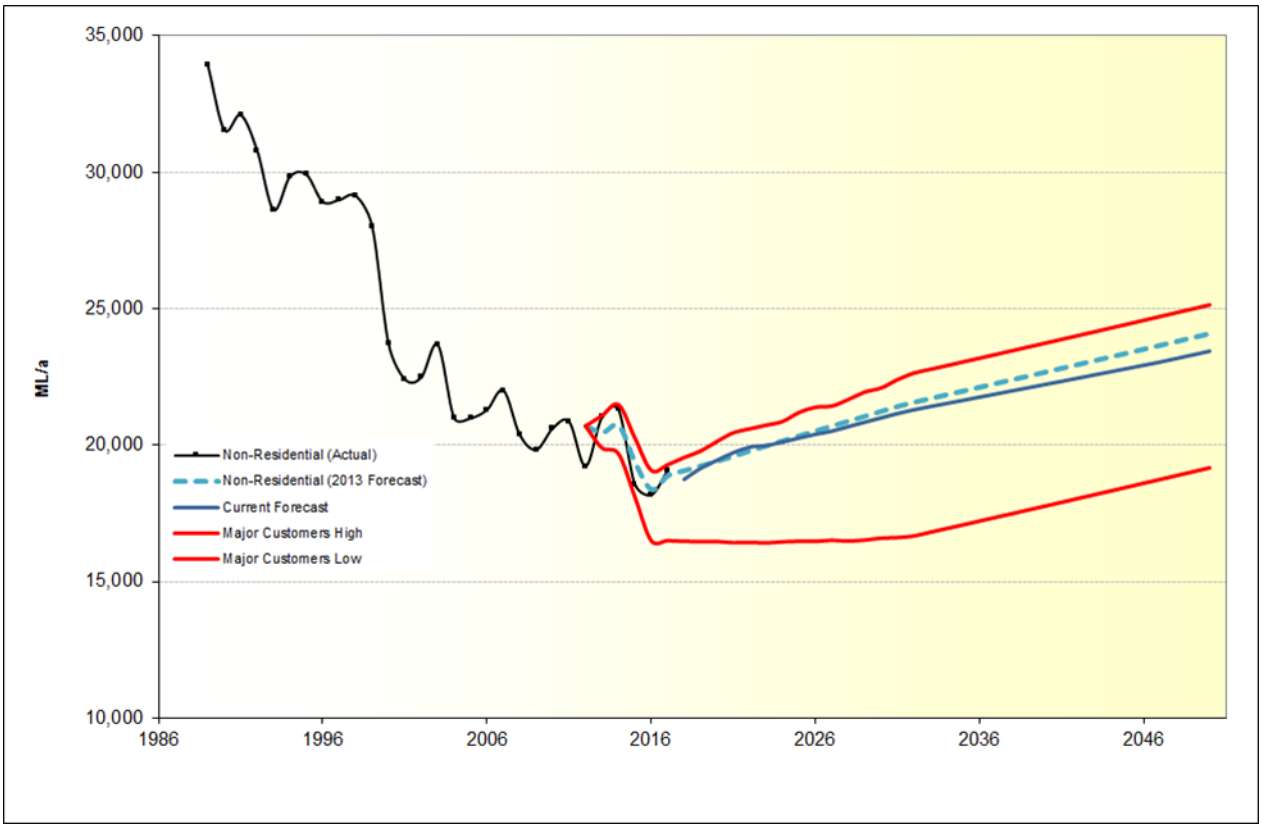


Figure 4.1 Non-residential water demand forecast (updated Sept 2018)

Residential water demand in 2017/18 was 42.7 GL, which was higher than the LHWP forecast of 37.7 GL. The difference between the forecast and actual residential demand was predominately the influence of hot/dry conditions on higher outdoor (garden) water use. Additional influences could be an inaccurate representation of internal demand for the demographics of the lower Hunter, or because of a 'bounce back' in demand after reduced water use in response to the millennium drought.[1] These potential influences and their ongoing impact on demand will be further investigated as part of the major review of the demand forecast to be undertaken in 2019. The residential demand forecasts are shown in Figure 4.2.

Higher population forecasts released by the Department of Planning and Environment (DPE) in 2016 have not yet been included in the demand forecast. DPE has advised that modelling for the greater Newcastle Metropolitan Plan, due for release in early 2018, indicates that population is now expected to be higher than the 2016 forecast. Hunter Water is in the process of conducting a major review of its demand forecast and will take account of projected increases in population and changes in occupancy rates in the new demand forecast.

Hunter Water has started work on a water conservation strategy as a key input to its IPART pricing submission in mid-2019. This work will build on Hunter Water's existing non-revenue water program (discussed below) and aim to identify water conservation opportunities to reduce residential and non-residential water demand.

[1] Although there were no drought restrictions in the lower Hunter during the Millennium drought, people may have changed their water using behaviours in response to media reports, or restrictions in neighbouring regions.

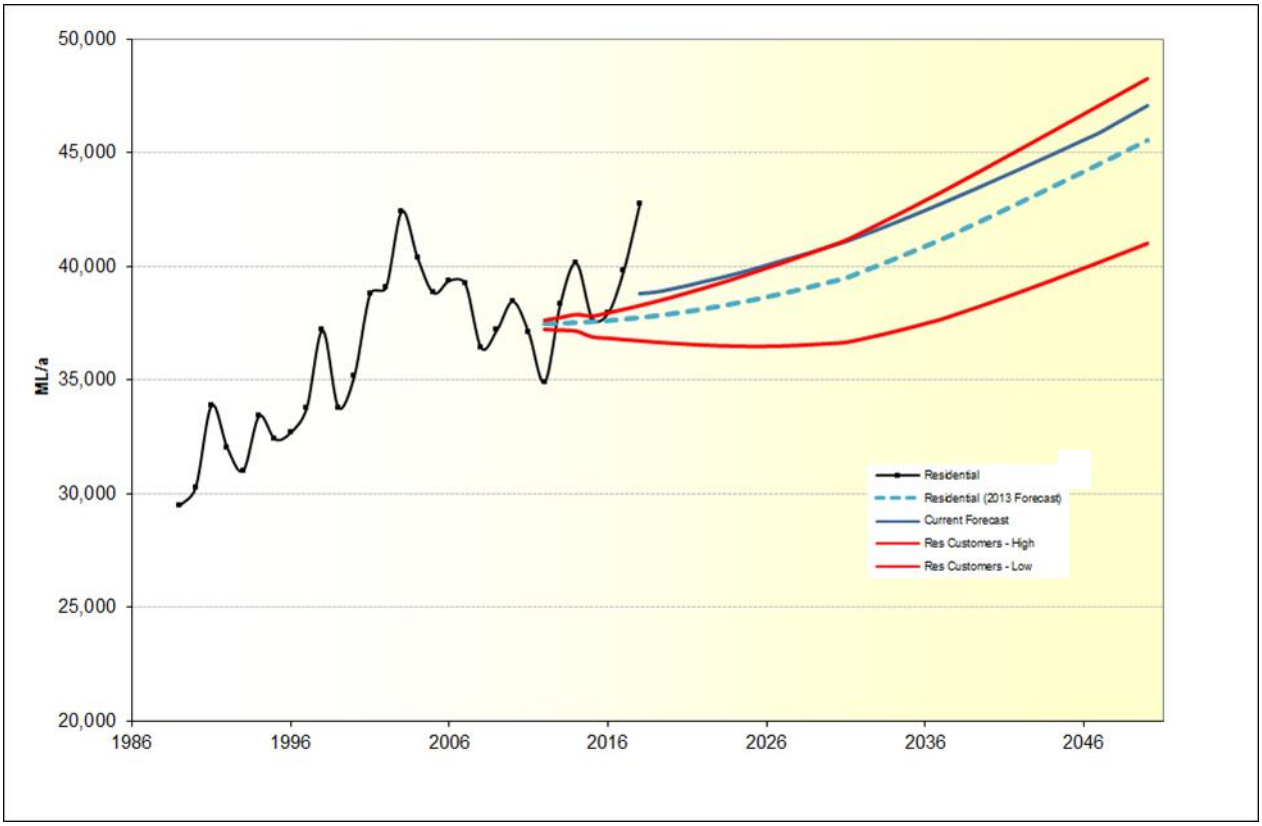


Figure 4.2 Residential water demand forecast (updated Sept 2018)

Non-revenue water (including leakage from the system, firefighting, metering errors and onsite use by Hunter Water) was 10.6 GL in 2017/18, down from 11.1 GL the previous year. This reflects Hunter Water's increased effort to reduce leakage from the system through active leak detection and onsite potable water use at a number of its wastewater treatment plants. Hunter Water has prepared a non-revenue water strategy and the forecast in Figure 4.3 reflects the preferred set of measures within the strategy. High volumes of non-revenue water observed in 2016 are the result of operational issues from losses and repairs due to a major storm event in April 2015 that were reported in the 2016 figures.

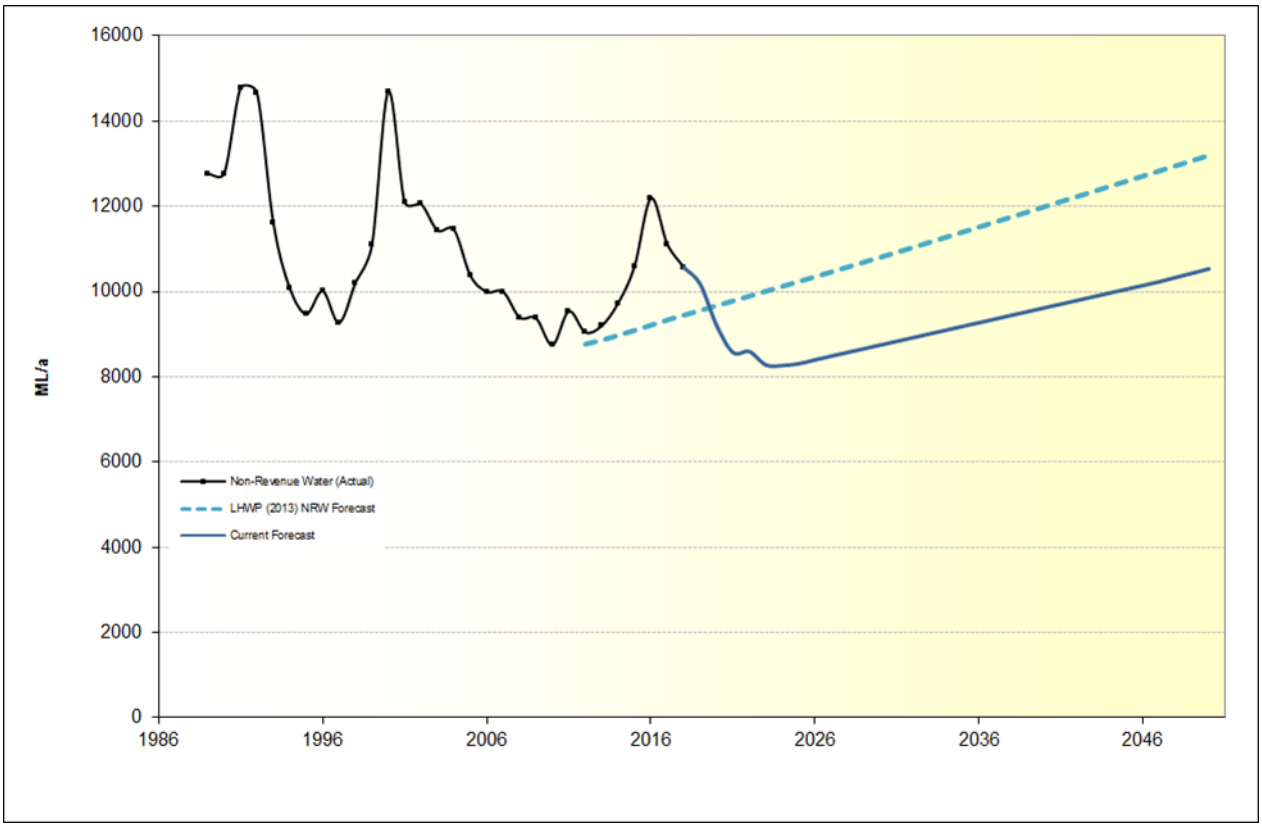


Figure 4.3: Non-revenue water forecast (updated Sept 2018)

Calculation of system yield

Hunter Water's system yield (the volume of water that can be reliably supplied each year over the long term) is currently calculated as 76 GL/year. This number reflects a 1GL/year increase in yield compared with the 2016 estimate due to improved accuracy of modelling inter-regional transfers with the Central Coast and a 1 GL/year reduction due to reduced access to water from the Tomago Sandbeds due to PFAS contamination.

The system yield of 76GL/year is based on the current Central Coast transfer link capacity, prior to its planned increase to 30ML/day to meet the terms of the existing transfer agreement between Hunter Water and CCC.

The impacts of PFAS contamination are discussed further in Section 7.

Hunter Water noted a number of supply side risks that did not impact upon yield in 2017/18 but that could be an issue in the future. These issues will be monitored and considered in the calculation of yield in 2018/19 or for the next LHWP, if required:

- reduced inflow to Grahamstown Dam due to water quality risks such as Campvale canal
- impacts due to asset life of current storages;
- changes due to incorporating pre-instrumental evidence of climate variability from paleo climate records into stochastic modelling (further discussed in Section 7)
- changes to groundwater access conditions in the Water Sharing Plan for the North Coast Coastal Sands Groundwater Source following review of the broad impacts and specifically the interaction between bore operations and groundwater dependent ecosystems

Supply-demand balance

The demand forecast exceeds the yield threshold in 2037/38. This is a two year deferral compared to the 2014 LHWP supply-demand forecast. The supply-demand balance forecast is illustrated in Figure 4.4.

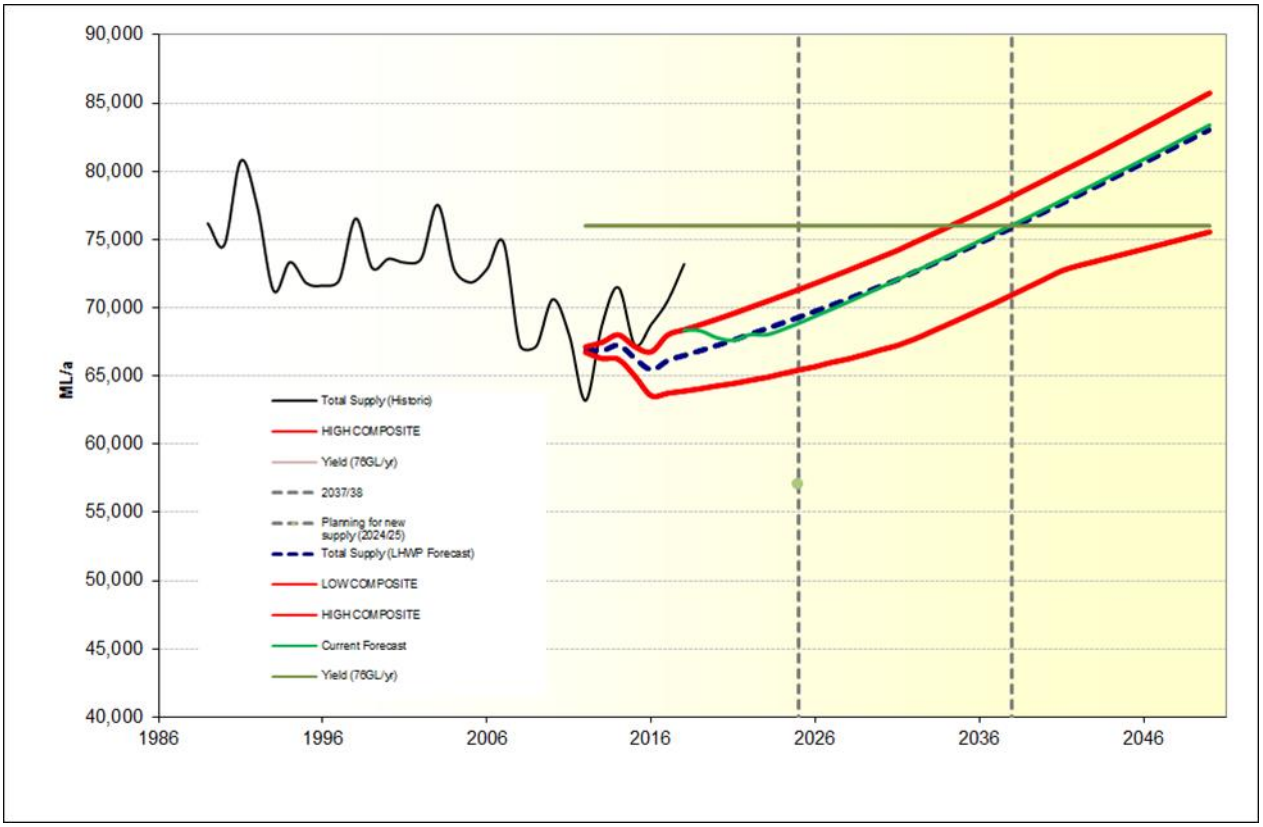


Figure 4.4: Supply-demand balance (updated Sept 2018)

Legend for tables showing MERI findings

Performance (Evaluation Finding Performance)	
	Satisfactory
	Some risks to delivery of LHWP objectives
	Performance is below expectation
	Events have not occurred or actions are not yet due or not assessable due to inadequate information

Table 4.2. Findings for evaluation question EQ 1.3

	Evaluation question	2013/14	2014/15	2015/16 Major Review	2016/17	2017/18	Finding	Comment
EQ 1.3	**The underlying premise of the plan is the supply and demand balance. Is the forecast supply and demand balance still consistent with the LHWP's forecast?**							
1.3.1	Is demand trending within the LHWP forecast sensitivity limits? What is the cause of movement outside of the sensitivity range?	Yes	Yes	Yes	Yes	Yes		Demand in 2017/18 was higher than forecast and

	Evaluation question	2013/14	2014/15	2015/16 Major Review	2016/17	2017/18	Finding	Comment
								close to the LHWP sensitivity, likely due to the hot/dry conditions.
1.3.2	Have the Level of Service criteria changed and what has been the impact (if any) on the supply-demand balance?	No	No	No	No	No		To be reviewed as part of developing next LHWP
1.3.3	Is the yield still as expected (75 GL pa)?	Yes	Yes	Yes	No 76GL	No 76GL		
1.3.4	Is there new information from EQ 4.3 findings that would affect the supply-demand balance?	No	Yes	Yes	Yes	Yes		There are a number of supply side risks that did not impact the supply –demand balance in 2017/18 but will continued to be monitored
1.3.5	Is there new information from the implementation of the actions arising from the peer review of the demand forecast model that would affect the supply-demand balance?	New question added from the mid-term review of the MERI Plan in 2016		No	Yes	N/A This question is not included in annual reviews		
1.3.6	Is there new information from the implementation of the actions arising from the peer review of the source model that would affect the supply-demand balance?	New question added from the mid-term review of the MERI Plan in 2016		No	Yes	N/A This question is not included in annual reviews		

Action summary

No new actions were identified from the 2018 evaluation. Relevant actions to KEQ 1 were identified in previous MERI evaluations and will be considered for the next LHWP. These are summarised in Section 3.

1. Continue to monitor the trend of increasing residential demand to better understand the drivers (climate change, behaviour bounce-back, etc) and how this might inform the major review of the demand forecast for the next LHWP.

5 KEQ 2 How effective are the measures in the plan?

Key findings for KEQ 2

- The Kooragang Industrial Water Scheme supplied 2,495 ML in 2017/18, the highest volume since the scheme was commissioned but slightly below the forecast of 3,000 ML/year.
- Water efficiency programs, primarily aimed at business customers, achieved a savings of 513 ML, exceeding Hunter Water's target of 250 ML/year.
- 2,333 km of active leak detection was undertaken in 2017/18. Accumulated savings from this program over 5 years are estimated to be 1,525 ML at a cost of $790,000.
- Hunter Water reduced their Infrastructure Leakage Index from 1.4 to 1.2.

Overview

KEQ 2 aims to evaluate whether the measures in the LHWP, under drought and non-drought conditions, are delivering the desired outcomes. In February and March 2018 Hunter Water total water storage levels reached 70%. This is the trigger level for convening the Drought Response Implementation Senior Officers' Group and the MERI drought review. A drought meeting was held at officer level between DoI, Hunter Water and CCC to discuss drought planning. However, following this meeting water storage levels quickly recovered. As such, for the purposes of this review we did not report on all the drought questions within the MERI and focussed on answering EQ 2.2.

Evidence to answer the evaluation questions was sourced from annual reporting spreadsheets documenting the supply, saving and substitution of water, together with Hunter Water's annual Compliance and Performance Reports required under its operating licence.

EQ 2.2 Have the non-drought measures (i.e. continuing measures) been effective in the supply, saving and substitution of water?

This section discusses how effective the non-drought (i.e. continuing) measures in the LHWP have been in the supply, saving, and substitution of water.

Water supply

Hunter Water supplied sufficient water to meet customer demands from its three main water sources in 2017/18. The lower Hunter's main sources of water supply continue to be surface water from Chichester Dam and Grahamstown Dam (average since 2013-14 is 93% of supply, although this can vary from year to year), and groundwater from the Tomago and Tomaree sandbeds (around 7% of supply). Some water is also sourced from the Paterson River and the Allyn River to supply the township of Gresford.

In 2017/18 only 5% of water supplied in the lower Hunter was sourced from the sandbeds, because under Hunter Water's optimised operating rules, the surface water sources are used first if water is available. Figure 5.1 shows the supply from surface water and groundwater sources since 2006/07.

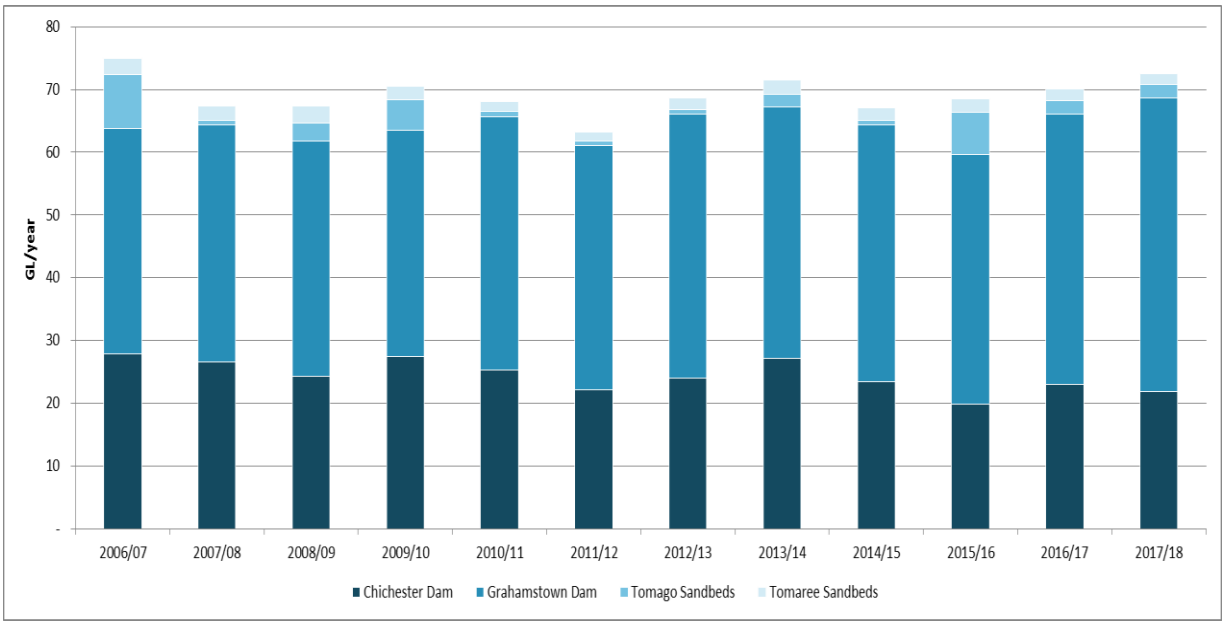


Figure 5.1 Supply from surface water and groundwater sources[2]

Water savings

Water use by sector

The LHWP forecasts reductions in water demand from Hunter Water's existing water efficiency and loss minimisation programs. This section compares forecast and actual savings from water efficiency programs. Water conservation from Water Wise Rules is discussed under EQ 4.1.

Figure 5.2 shows the volume of water supplied for each sector (residential, non-residential and non-revenue water) since 2008/09. This shows that:

- residential water use varies with wet and dry years, but has remained between around 35 and 40 GL/year. Residential water use in 2017/18 was consistent with 2016/17 but higher than in 2015/16, most likely due to hot/dry weather.
- non-residential use dropped in 2014/15, as the Kooragang Recycled Water Scheme (KRWS) started to supply water. Non-residential demand has increased slightly in 2017/18, again most likely due to hot/dry weather.
- 'other' (non-revenue water) has had an increasing trend over the period, however recent efforts by Hunter Water have reduced losses from the system in 2016/17 and 2017/18.

[2] Data source for Figure 4.1: Hunter Water *Compliance and Performance Reports* for 2013-14, 2014-15 and 2015/16, section 6

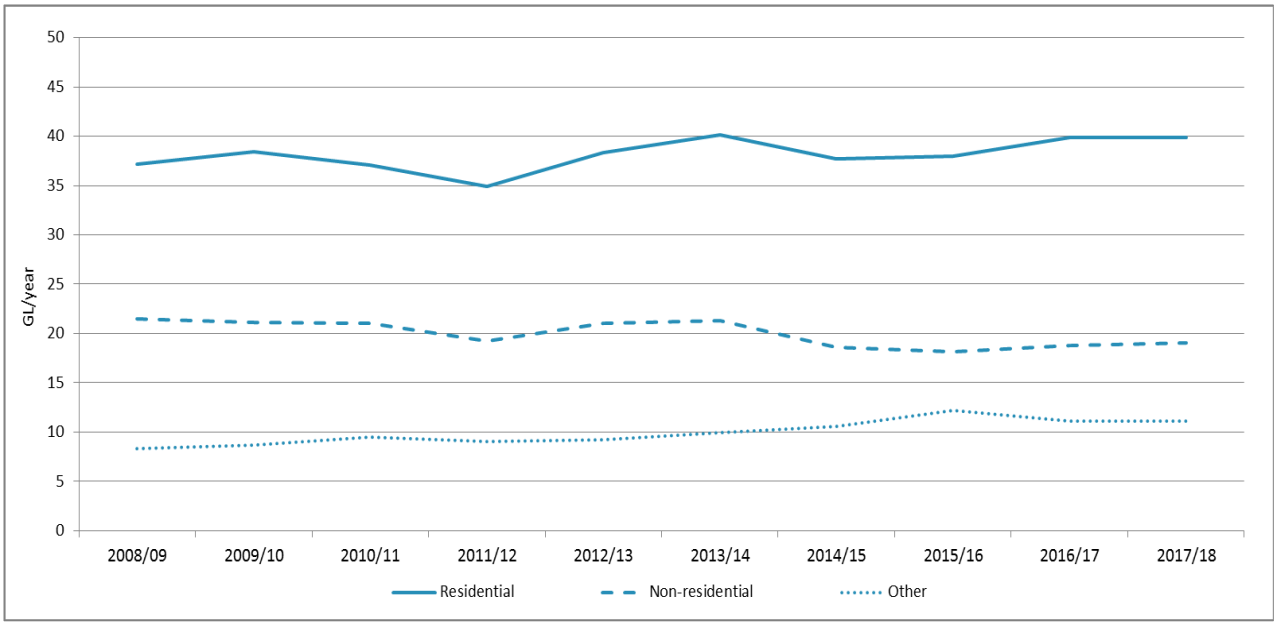


Figure 5.2 Volume of water use by sector[3]

Water efficiency programs

Hunter Water's compliance and performance report sets a target of 250 ML/year reduction in potable water use through water efficiency programs. Water efficiency savings in 2017/18 were 513 ML, therefore exceeding the target and offsetting the reduced savings from 2016/17 that fell slightly below the target.

Cumulative water savings from Hunter Water's water efficiency programs since 2007/08 compared with the LHWP forecast are shown in Figure 5.3. The forecast developed at the time of the 2014 LHWP was not extended beyond 2016/17.

In 2017/18, Hunter Water focused the majority of its efforts in water efficiency programs in the areas of non-residential and non-revenue water. These projects identified a total of 513 ML of savings. This work included:

- 28 Water Efficiency Management Plans completed for major customers
- detailed large customer audits completed at Newcastle Jockey Club, Centennial Coal Mandalong and Centennial Coal Cooranbong, identifying savings of 237 ML.
- installation of 52 data loggers identified 19 leaks, totalling 276 ML of savings. Of these, 16 leaks were repaired, saving a total of 208 ML. These savings consist of 99 ML from schools, 65 ML from commercial leaks, 55 ML from council leaks and 57 ML from Dora Creek WWTW potable make-up overflow.

[3] Data source for Figure 4.3: *Compliance and Performance Report*, Hunter Water 2012-2017

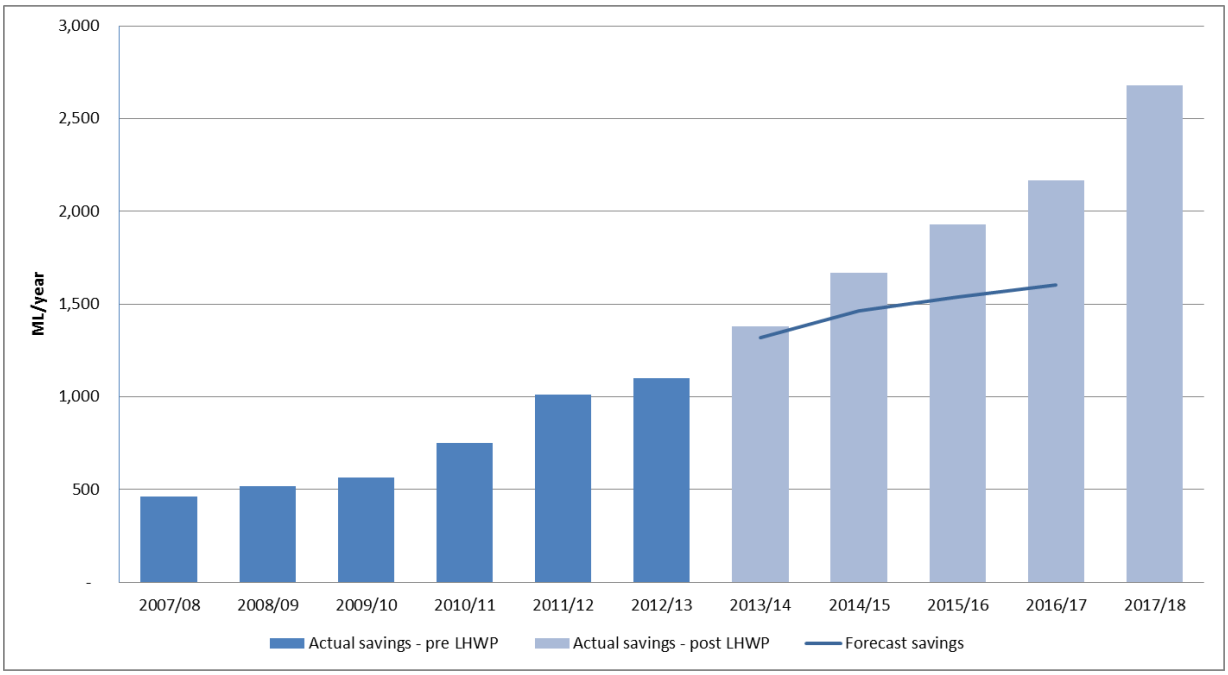


Figure 5.3 Estimated cumulative water savings from water efficiency programs[4]

Water efficiency savings – loss minimisation programs

The main focus of activities to minimise losses from the water supply system involve:

- active leak detection and repair (where water loss minimisation is the primary benefit)
- reducing pressure in selected zones with higher pressure (where loss minimisation is a secondary benefit, with the main drivers being related to asset maintenance, asset life, and customer impacts)

Water loss minimisation programs in 2017/18 under the water main/water service replacement, pressure management, active leak detection and point source reduction programs have achieved approximately 894 ML of water loss abatement.

[4] Data source for Figure 4.4: 2014 LHWP (graph page 33) and this report, Table 5.1

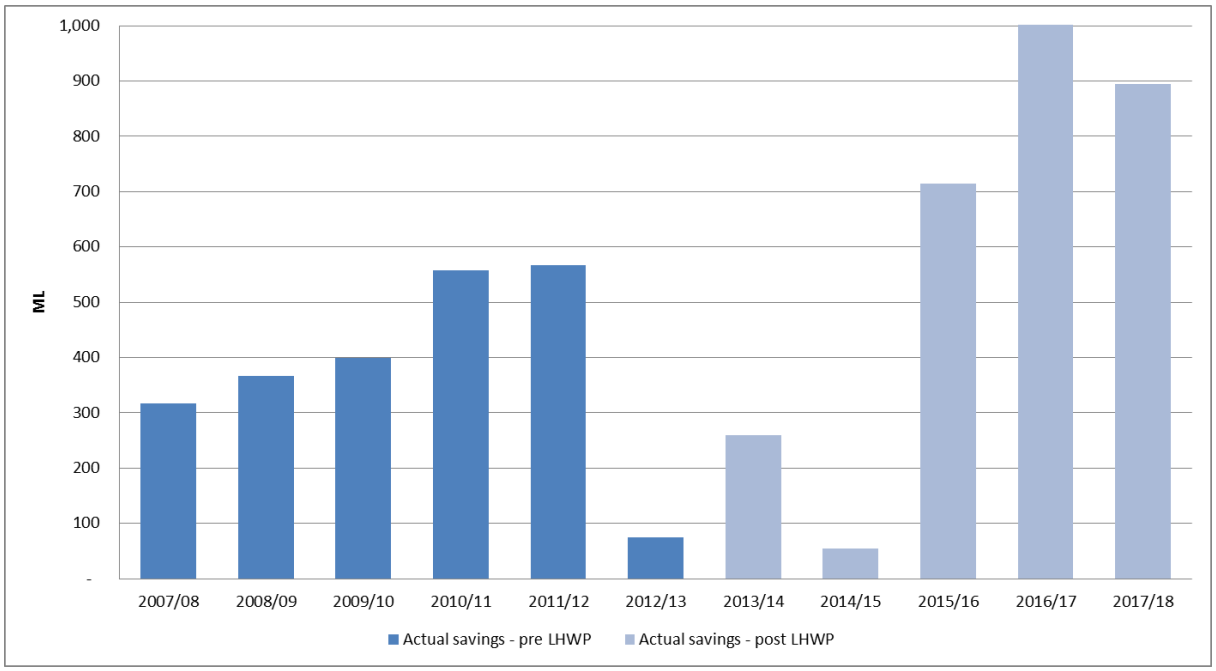


Figure 5.4 Estimated water savings from loss minimisation programs (active leak detection and pressure management)

Active leak detection

The LHWP MERI plan establishes a target of surveying 20% of Hunter Water's water mains for leaks each year under its active leak detection program and implementing pressure management zones in three network areas that receive particularly high operating pressures.

The estimated and actual savings for these programs for each year since 2007/08 are shown in Figure 5.4. The estimated water savings from leak reduction was below forecast for each year from 2012/13 to 2015/16, primarily due to delays in implementation of the active leak detection program. The forecast assumed that the delays would be caught up in 2013/14, but the program did not start until 2015/16. Since this time there has been significant work in the area of leak reduction. In 2017/18, 2,333 km of active leak detection was undertaken, representing approximately 46% of the network. Overall, Hunter Water has met the target of 20% of the network surveyed per year since 2014, see Table 5.1 and Figure 5.5. Total water loss identified by active leak detection over 5 years is estimated to exceed 1,525 ML.

Figures reported in 2016/17 and 2017/18 are derived from a new reporting process that is more accurate, estimating water loss volumes from the leaks identified. The previous reporting methodology used to record volumes was based on an estimate from survey leakage data and survey length. The methodology was also inconsistent with the data used to develop the forecast used in the 2014 LHWP.

The 2017 MERI evaluation reported that two pressure reduction zones (Charlestown and Edgeworth) were not completed in 2015/16 as planned. In the pressure management program for 2017/18 these two pressure management zones were completed, therefore meeting the target of three. In addition to the three pressure management programs outlined in the 2014 LHWP, significant work has also been achieved in loss minimisation through the repair of Black Hill #1 (Stoney Pinch) Reservoir.

Total water loss identified by active leak detection over 5 years is estimated to exceed 1,525 ML at a cost of $1,004,522. On average, costs for active leak detection were $10-50 per kilometre less than assumed in the modelling for the 2014 LHWP.

The estimated savings achieved from the three PRV zones commissioned over 5 years is 18 ML/year at a cost of approximately $1.4M. While the cost per ML of savings is significantly greater for pressure management programs as opposed to active leak detection there are ongoing benefits to the Hunter Water system, including reduced maintenance costs and extended asset life that are of significant value.

The cost effectiveness of both programs will be considered in the analysis of options for the next plan.

Table 5.1 Summary of savings from loss abatement
*** actual savings calculated using new methodology**

Year	Savings from water loss abatement (ALD & PM)	Length of water main surveyed through Active Leak Detection			Other works / comments
	Actual (ML)	Actual (km)	Actual (%)	Target (%)	
2012/13	-	146	3%	20%	Contract delayed
2013/14	259	1,236	25%	20%	
2014/15	55	1,076	22%	20%	Low savings in 2014/15 due to water main repairs occurring in 2015/16. One pressure reduction zone completed (Argenton).
2015/16	714	2,057	41%	20%	Lined part of Black Hill No 1 (Stoney Pinch) Reservoir.
2016/17	1019*	1902	35%	20%	
2017/18	894*	2,333	46	20%	Two pressure reduction zones completed (Charlestown and Edgeworth)

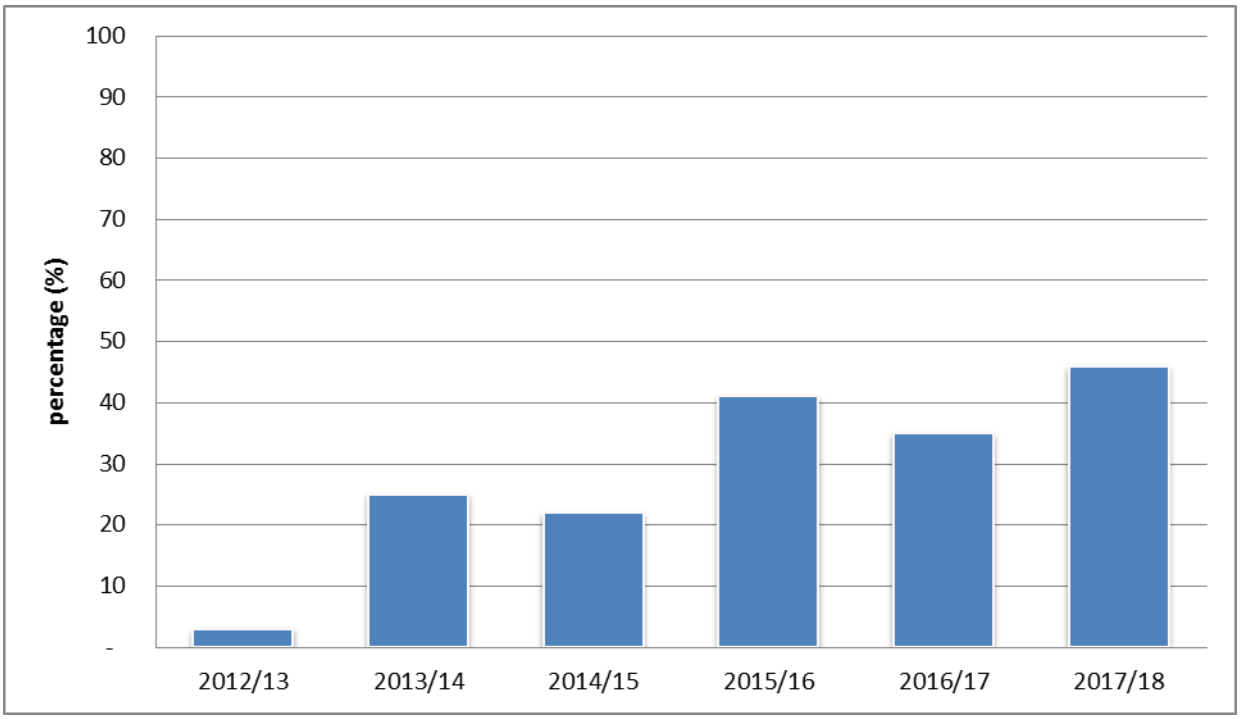


Figure 5.5 Percentage of the network surveyed each year under the active leak detection program

The following leakage reduction projects and programs are planned for implementation in 2018/19:

- Ongoing leak detection survey of the water distribution network covering east and west Lake Macquarie and to be extended into other areas with a high rate of leak occurrence. The total length proposed for the program is approximately 4700 km.
- Lining and repair of Toronto, Four Mile Creek and Bellbird Heights 2 Reservoirs and further work on Black Hill Reservoir.
- Ongoing use of temporary data loggers to assist customers with the identification of large internal leaks with a particular focus on schools. Of these, 16 leaks have already been repaired, leading to 208 ML of water saved.
- Expansion of the intelligent water network monitoring trial to cover approximately 25% of the distribution system. Hunter Water also commenced a trial of an intelligent water network monitoring system that uses existing operational data and applies advanced algorithms to detect, accurately identify and report network events such as leaks, bursts and other anomalies. These kinds of monitoring systems can support a more proactive and targeted approach to network leak management.

Water asset masterplan

A water asset resource plan is currently being developed by Hunter Water aimed at reducing water main breaks. This plan will be completed during 2018/19 and the actions will begin to be implemented.

Reductions in non-revenue water

The Infrastructure Leakage Index (ILI) is an internationally-used performance indicator of real (physical) water loss from a water supply network, and is defined as the ratio of current annual real losses to unavoidable annual real losses[6]. The ILI for Hunter Water's network is shown in Figure 5.5. Hunter Water has made significant efforts to improve its ILI in recent years, reducing the ILI from 1.4 to 1.2 and real losses from 4.3 to 3.9 kL/day/kilometre of watermain.

During 2017-18, non-revenue water was reduced to 10.6 GL, an improvement of 0.5 GL on the previous year.

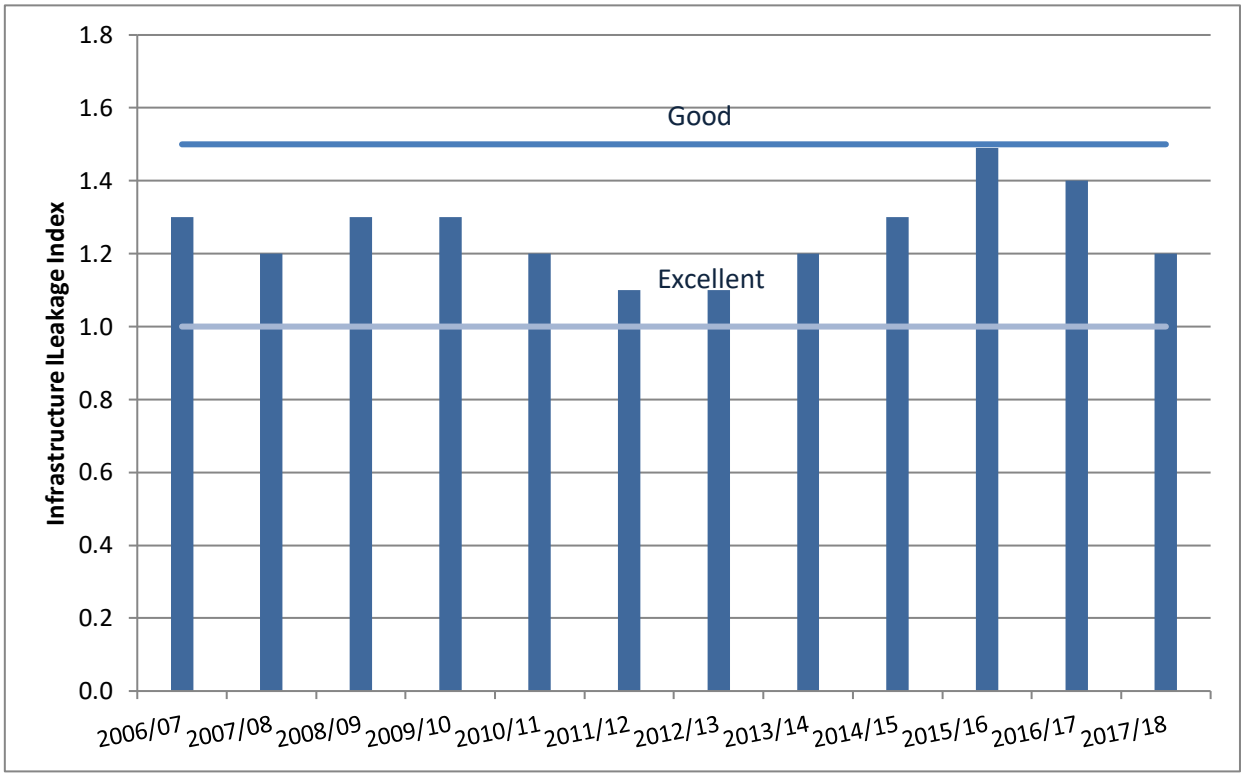


Figure 5.6 Infrastructure leakage index (ILI)[5]

In addition, the current operating licence (2017-22) requires Hunter Water to develop a methodology for calculating the Economic Level of Water Conservation (ELWC) with respect to leakage reduction, water efficiency and recycled water. Hunter Water will submit a final ELWC methodology to IPART for approval in November 2018. Moving forward, they will use this tool to assist in determining which water saving projects are economically viable. Further information on the proposed methodology will be reported on in next year's MERI report.

Hunter Water also undertakes a number of community outreach and education initiatives that support its water conservation message. These are summarised in Table 5.1.

Table 5.1 Water conservation community engagement programs and partnerships in 2017/18

Love Water campaign	Love Water is a water conservation campaign primarily focused on residential consumers. The campaign encourages water wise behaviour, but rather than communicating the Water Wise Rules it aims to engage more deeply with the community to encourage behaviour change. The campaign was first launched in late December 2017 on social media platforms and rolled out to other channels using interactive content, sparking curiosity and getting people talking about water and its value.
School and Community Group Incursions and Excursions	There were 38 school incursions and tours of the Hunter Water Centre for Education during the year. Our education programs have been designed to meet Science-based elements of the school curriculum for Stage 2 (Years 3 and 4) and Stage 4 (Years 7 and 8) students. Programs have also been developed for community groups. These programs aim to inform students and the community of the ways Hunter Water operations benefit customers and the environment as well as teaching students about their role in caring for and sustaining water resources.
Bubbles and Supa Squirt	Bubbles and Supa Squirt is a school water education show that incorporates tips on using less water. More than 80 performances were held at local primary schools, preschools and in the community in 2017/18.

[5] Data source for Figure 5.5: Hunter Water Compliance and Performance Reports

Hunter Water Website	The Hunter Water website includes a dedicated 'Save Water' section that provides information on how to be water efficient in the home and garden with new information added to compliment the Love Water objectives. In 2017/18, the Water Usage Calculator received 241,814 visits.
Community Events	Hunter Water had an active presence at 18 community events attended by more than 185,000 people including V8 Supercars, Surfest, Port to Port, Living Smart Festival and Light Up Newcastle.
Media – Awareness Raising	Hunter Water regularly emphasised the need for residents to be water efficient in media messaging over the year. This was specifically linked to dam level stories during the warmer months. When supplies replenished, the message remained that by continuing to be water conscious through winter, water storages are in better shape for summer. This ties into a wider campaign to build awareness of the vulnerability of Hunter Water's storages and therefore the need to work together to ensure water security into the future.
Learning with Schools	The Learning with Schools Program partners with local primary and secondary schools to empower students to plan and take action to improve water resilience in and beyond the Hunter community. It involves students designing and leading their own learning journeys to help shape the environmental health and wellbeing of their community. We partner to share knowledge, resources and expertise.
Community Funding Program	In 2017/18, we supported 20 key community impact programs to help raise awareness of water conservation. Partnerships included working collaboratively with local conservation organisations such as Port Stephens Koalas to educate the community on the importance of the environment and the impact that community behaviour has.
Support of WELS	We continued to support the Water Efficiency Labelling Scheme (WELS) for household appliances by including information on WELS under the 'Save Water' section of the Hunter Water website. In addition, Hunter Water attended several community events to promote and encourage householder uptake of water efficient products.
Smart Water Advice	Hunter Water have signed an agreement to participate in the Smart Water Advice program. This is a national, not for profit water efficiency membership program for water utilities and councils. It allows for economies of scale to be leveraged for the development and distribution of online water saving information for the home, garden and business sectors, educational interactive resources, a video library, posters and factsheets. All materials are regionalised and branded for its members.

Water substitution – recycled water

Total recycled water supplied in Hunter Water's area of operations since 2006/07 is shown in Figure 5.6. Total recycled water use in 2017/18 was 6,454 ML.

A large component of potable water substitution in the LHWP was recycled water from the Kooragang Industrial Water Scheme (KIWS). Modelling for the LHWP assumed that the plant would supply 9 ML/day of recycled water to Orica, equating to an average annual substitution of around 3000 ML. In 2017/18, 2,495 ML of potable water was offset, just below the assumed 3,000 ML/year. Since it was commissioned in 2014 the plant has supplied an average of 1,825 ML/year.

On 27 November 2017 the Mayfield West Advanced Water Treatment Plant (part of the KIWS) was sold to Water Utilities Australia. The treatment plant is now being operated by Suez (under contract to Water Utilities Australia). Preliminary meetings have been held between Hunter Water and Water Utilities Australia to discuss future expansion opportunities.

Programs to develop dual reticulation schemes at Chisholm and Gillieston Heights were developed as part of the LHWP. Detailed design and construction of the recycled water treatment plant for these schemes commenced in July 2017. Detailed design and construction of Gillieston Heights dual reticulation pipelines commenced in April 2018 and will produce Commissioning of the Chisholm scheme is due in March 2019 and will produce 90 kL/day while the scheme at Gillieston Heights is due in May 2019 and will produce 150 kL/day.

Hunter Water has reported that it will develop an internal recycled water strategy in 2018 to explore best practice and identify potentially viable recycled water opportunities. This will help inform options development for the next LHWP.

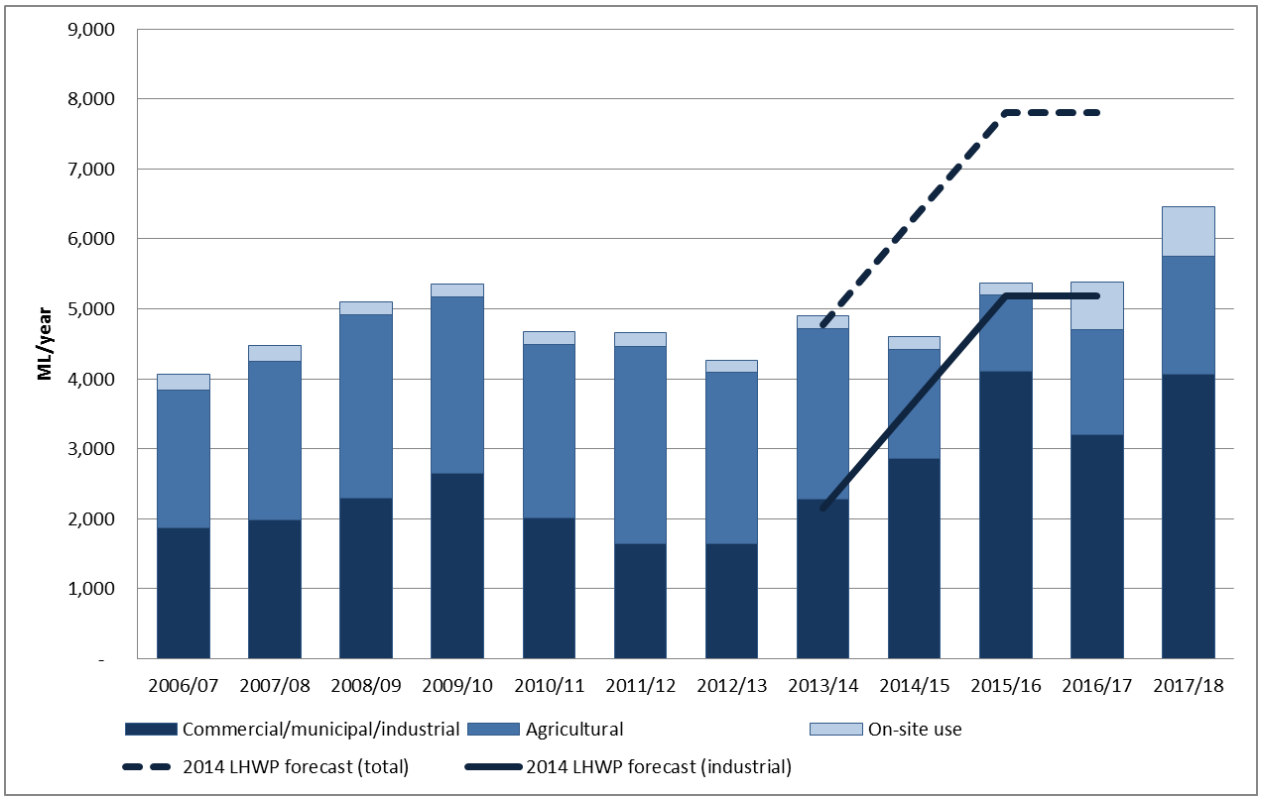


Figure 5.7 Recycled water supplied in Hunter Water's area of operations [6]

Drought initiatives

In February 2018, in response to dropping water storages, Hunter Water initiated a number of water conservation initiatives aimed at reducing non-residential customer demand. These included investigating opportunities for recycled water substitution, stormwater harvesting schemes and improving water efficiency.

These initiatives were set out as part of the LHWP and assumptions were made in the planning process around the expected volumes of water savings that could be achieved and the timeline for programs to be implemented. Water savings achieved from the development of Water Efficiency Management Plans, data-logging and water efficiency measures are reported in earlier in this section of the report.

Overall, challenges were encountered with the implementation of some of the initiatives due to their reliance on third parties to engage with the programs, thereby increasing the timeframes.

The next LHWP should continue to explore similar programs, considering how best to address the uncertainty and challenges around uptake and the implications for timelines and expected water savings.

[6] Data source for Figure 4.9: 2014 LHWP (graph page 45) and *Compliance and Performance Report 2015/16* (Hunter Water, Sept 2016), Table 8.2, NPR indicators W20-W24

Table 5.2 Findings for evaluation question EQ 2.2

	Evaluation question	2013/14	2014/15	2015/16	2016/17	2017/18	Finding	Comment
EQ 2.2	**Have the non-drought measures (i.e., continuing measures) been effective in the supply, saving and substitution of water?**	Yes	Yes	Yes	Yes	Yes		Savings from water efficiency and loss minimisation exceeded forecast. Substitution: Total recycled water use of 6,454 ML was achieved in 2017/18

KEQ 2 Action summary

Recommended actions from the evaluation findings for KEQ 2 are summarised below

2. In developing the next LHWP, ensure that water efficiency and recycled water scheme options that rely on third parties appropriately account for uncertainties in expected water savings

3. Ensure the economic level of water conservation (ELWC) methodology takes into account potential societal and environmental costs and benefits to ensure efficient investment in loss minimisation, water efficiency and recycled water and is consistent with the approach used for the LHWP analysis

6 KEQ 3: How efficiently has the plan been delivered – timing, delivery and cost?

Key findings for KEQ 3

- Hunter Water and CCC have developed a joint WATHNET model to further explore the potential water security benefits to both regions of water transfers and other supply and demand options.
- CCC has experienced unavoidable delays in constructing transfer infrastructure. This has had implications for the volume of water that can be transferred between the regions and has increased costs to CCC.
- Hunter Water has progressed infrastructure to release improved environmental flows at Seaham Weir and is planning to commence construction in on the new fishway and control gates by 2020/21.
- DoI has experienced delays in finalising amendments to the Hunter Unregulated and Alluvial Water Sources WSP.
- Investigations of the Lower Hunter alluvial groundwater source near Maitland yielded water that was too saline for potable use and it was determined that there would be no further investigation of the option as a source of supply.
- Readiness activities for temporary desalination are underway, but have been delayed by approximately 25 months against the 2016 MERI timeline. As current storage levels are high, it is likely that water would be available in a severe drought.

Overview

KEQ 3 evaluates the implementation actions established in the LHWP[7] and whether they have been delivered within agreed timeframes or triggers and consistent with expected costs. The two evaluation questions under KEQ 3 are:

- EQ 3.1 – Have the identified implementation actions been delivered within agreed timeframes or consistent with identified triggers?
- EQ 3.2 – Are the implementation actions consistent with the LHWP's expectations for deliverables and cost?

A number of implementation actions set out in the LHWP have experienced delays including:

- inter-regional transfers between the lower Hunter and Central Coast
- implementation of new environmental flow rules for Chichester Dam and Seaham Weir
- readiness activities for temporary desalination.

Progress against implementation actions in 2017/18 is discussed below. For ease of reading, responses to both EQ 3.1 and EQ 3.2 are reported under each of the actions. A full update on delivery and timing of the implementation actions is provided in Table 6.2.

There were two implementation actions set out in the LHWP as watching briefs. These actions were not progressed in 2017/18 but will be considered in the context of options investigations for the next LHWP. The two actions are:

- a watching brief on potential use of water from underground coal mines on the western side of Lake Macquarie
- a watching brief on pricing structures

[7] *MERI Plan for the Lower Hunter Water Plan* (v2.0, Sept 2016), Tables 32 and 33, p117-119

Modelling of inter-regional transfers between the lower Hunter and the Central Coast

In 2017/18 Hunter Water and CCC developed a joint WATHNET model that includes both water supply systems. Work is currently underway to expand on the modelling work to include paleo-informed stochastic data for the two regions. The model will be subject to a peer review in 2019 as part of the development of the next LHWP.

In addition, Hunter Water, CCC and DoI will consider including economic capability to the model which would allow it to be used for hydro-economic modelling for the next LHWP. This would allow for more accurate modelling of yield impacts of inter-regional transfers as well as other supply and demand options that could provide mutual benefit to both regions.

Infrastructure to increase inter-regional transfers with the Central Coast

Transferring water from the Central Coast is a key drought response in the LHWP. Hunter Water and CCC are responsible for constructing infrastructure to enable more water to be transferred from the Central Coast to the lower Hunter as per the 2006 agreement for inter-regional transfers. These transfers are a key drought response in the LHWP.

Hunter Water has progressed infrastructure work on their area of operations, with infrastructure capable of receiving up to 30 ML/day expected to be complete by the end of November 2018. This is slightly behind the mid-2018 delivery date reported in last year's MERI. Completion of this infrastructure work will increase the northerly transfers from 13 ML/day (current) to 15 ML/day. Flows of up to 20 ML/day may be possible, but there is a risk of excessive pressure (with water hammer as the pumps cut in) at these higher rates.

The delivery of the Mardi-Warnervale pipeline by CCC, required to meet 30ML/day northbound transfer, has been further delayed from the estimate of end-2019 reported in the 2017 MERI. The most recent estimate for delivery of this infrastructure is the end-2021. Changes to the complexity of the project have increased the associated costs. Due to the significant increase, CCC is waiting to recoup funding through the 2018/19 IPART review, thereby delaying the upgrade works. CCC has reported that detailed design is almost complete and the Review of Environmental Factors is finalised.

Further delays to the pipeline capacity upgrade increase the risk to Hunter Water during drought. In effect, the pipeline allows Hunter Water to improve water storages on the Central Coast when Hunter Water storages are healthy, but limits return flows from the Central Coast when Hunter Water storages fall. Following completion of the upgrade works, the reliable yield of Hunter Water's system will increase by around 1 GL/year to 77 GL/year.

Modelling currently assumes Mangrove Creek Dam at 80% capacity due to safety issues. However, upgrades to restore design capacity to 100% would provide additional yield benefits estimated at 1-2GL per year and will be considered in the development of the next LHWP.

The expenditure in 2017/18 and total project estimates are shown in Table 6.1.

The costs of re-routing the Mardi to Warnervale pipeline will significantly increase CCC's project cost. As the infrastructure was part of the pre-existing transfer agreement between Hunter Water and CCC the additional costs are not attributable to the LHWP. This is also the case for Hunter Water's infrastructure related costs for this measure.

Table 6.1 Costs of infrastructure to increase transfers from the Central Coast

	Total expenditure to 30 June 2018	LHWP estimated cost	Estimated total project cost (2018)	Comment
Hunter Water	$7.0M	$242,680 $2.0M	$8.5M	Revised project total cost estimate increased from $7.6M in 2017
CCC	-	n/a	$61M	Revised project total increased from $24M in 2017

Environmental flows

Chichester Dam

DoI has drafted amendments to the Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2009 to implement the environmental flow release rules from Chichester Dam. In order to protect the releases for the environment DoI is recommending slight changes to the cease to pump rules for users downstream of the confluence of Chichester River and Williams River. Modelling results suggest these changes should not impact users however DoI will be conducting targeted consultation in 2019 to confirm that there are no unintended impacts. The amendments are expected to be gazetted in 2019.

Hunter Water has completed minor works at Chichester Dam to enable release of environmental flows agreed during development of the LHWP. Hunter Water remains ready to implement the new releases at Chichester Dam as soon as the required changes are made to the Water Sharing Plan by DoI

Seaham Weir

Hunter Water is progressing delivery of infrastructure to release environmental flows from Seaham Weir, as agreed during development of the LHWP.

As an interim arrangement, Hunter Water implemented new control systems at Balickera pumping station and Seaham Weir gates in September 2016 to ensure that a specified proportion of river flow is released at Seaham Weir. This strategy is an interim measure, and relies on releases being made through the existing gates at Seaham Weir.

In 2017/18, SMEC Australia developed a concept design for the fishway that incorporated design attributes developed by the Environmental Flows Working Group. Investigations by SMEC and engagement with key project stakeholders identified the following:

- Two structure locations were investigated: a wet build with short channel linking the weir pool to the Hunter Estuary and a dry build with longer linking channel. The dry build was identified as preferred based on construction complexity and cost.
- Three gates types were investigated: a single leaf vertical slide, a double leaf vertical slide and a tilting weir. The single leaf vertical slide type was preferred based on cost, maintainability, fish passage and other factors.
- Six different gate number /size options were investigated: 2m-5m-5m option and 3m-3m-3m-3m option were progressed for physical modelling. The 3m-3m-3m-3m option was determined to provide the best fish passage performance across a range of flows and to provide good ease of operation, reliability and cost.

There have been some delays on this project due to greater than anticipated geotechnical complexity and issues that arose during the physical modelling phase. Construction is expected in 2020 to 2021. Once complete, the new integrated low to medium flow gate and fishway structure that will allow much better control of the way that water is released into the estuary for releases up to around 500 ML/day. This structure will also enable the release rate to be monitored and provide improved fish passage across Seaham Weir.

Table 6.2 Costs of environmental flows

	Total expenditure to 30 June 2018	LHWP estimated cost	Comment
Chichester Dam	$50,000	n/a	Completed in 2016
Seaham Weir	$658,715	$5,700,000	

Lower Hunter alluvial groundwater source

The LHWP initiated studies into a potential groundwater source near the junction of the Hunter and Paterson Rivers – the lower Hunter alluvial aquifer.

In September 2017, after determining the suitability of the technique, Hunter Water completed a gravity survey of the Hunter Alluvial investigation area. A "passive seismic" geophysical survey was completed simultaneously to enable gravity survey data to be calibrated against existing borehole logs. Survey results are shown in Figure 6.1.

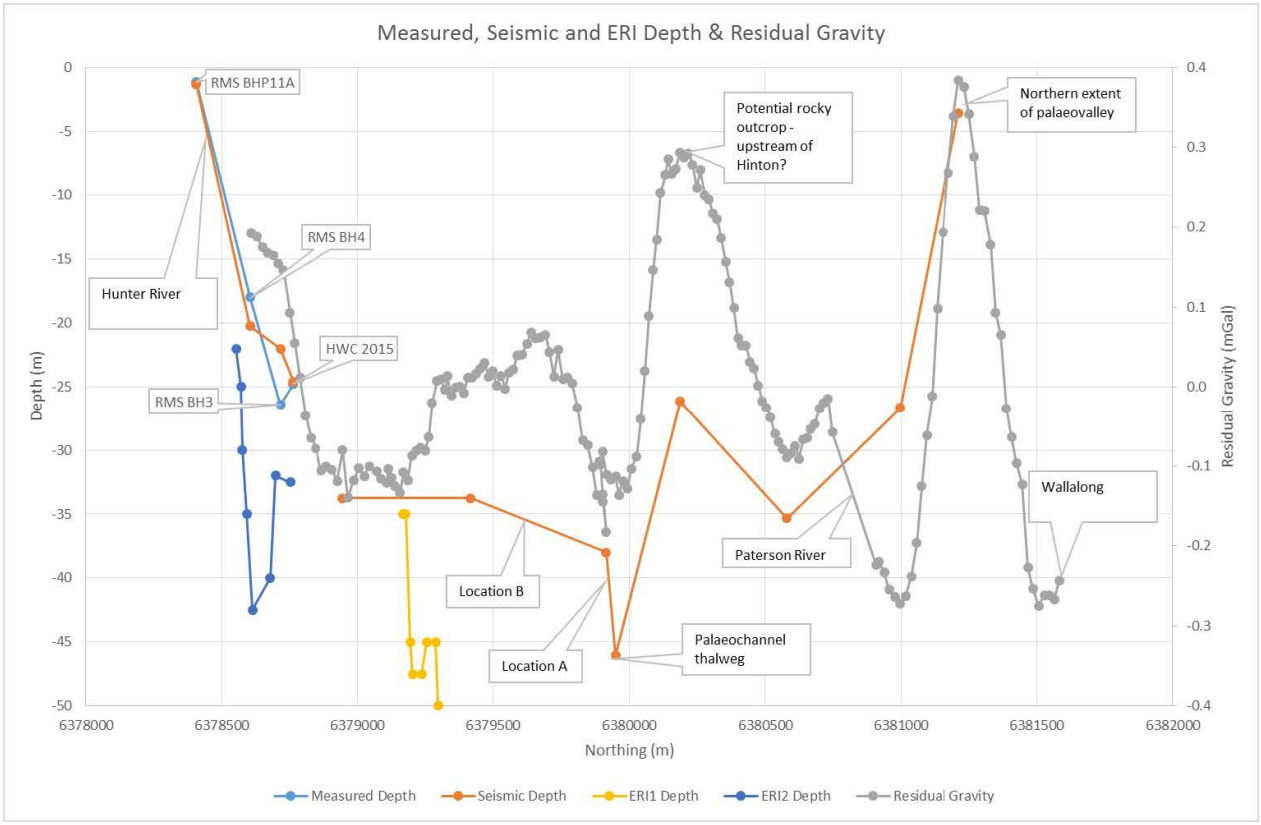


Figure 6.1 Measured, seismic and ERI depth and residual gravity of suspected Lower Hunter Alluvial Aquifer

The survey results were used to identify two drilling locations where the deepest section of the palaeochannel was likely to be encountered.

A contract was awarded to undertake geotechnical works at these two locations in April 2018, with preliminary testing of subsurface conditions to bedrock (known as Cone Penetrometer Testing) completed in May 2018, and drilling through the soil strata completed in June 2018. A map of the two locations is Figure 6.2.

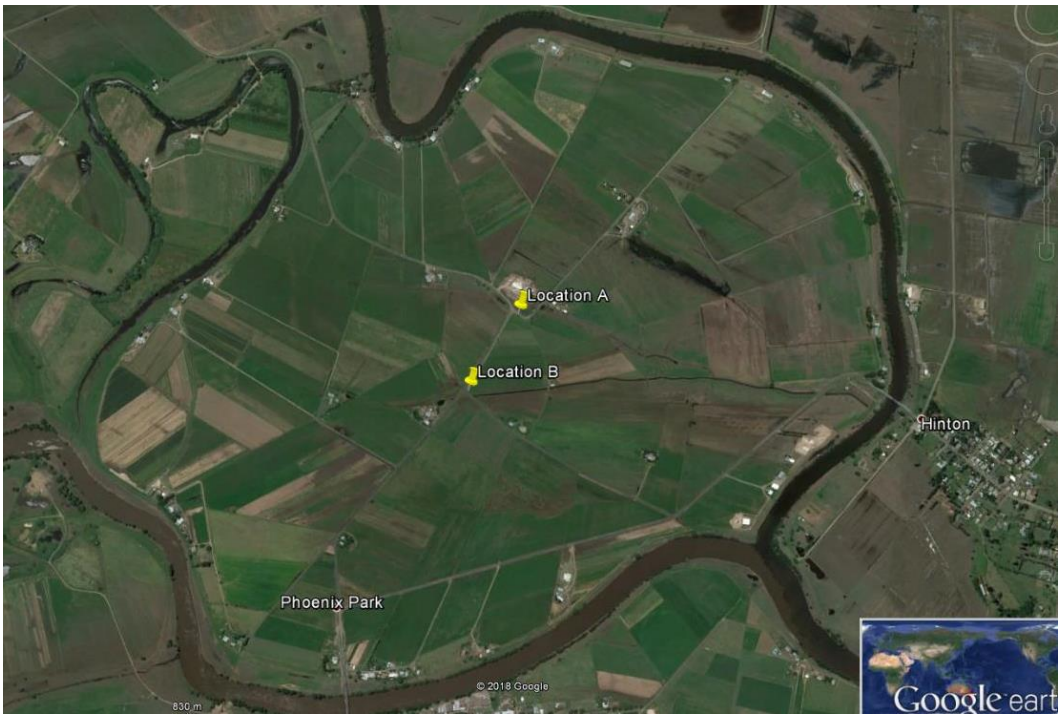


Figure 6.2 Map of drilling locations

The palaeochannel was encountered during the drilling works with fluvial sand deposits detected above bedrock at a depth of 35 and 40m. Monitoring bores were subsequently installed at both locations. Groundwater from the deep aquifer was observed in both wells.

Bore development and water quality sampling was completed in July 2018, and the analysis results showed high levels of total dissolved solids up to 28,000 mg/L. The results have confirmed the groundwater is highly saline and unsuitable for drinking without substantial treatment (desalination).

In 2017/18, Conjoint Associate Professor Ron Boyd provided a review of the geophysical survey report and provided technical advice during the geotechnical works.

The survey results and findings of the survey work were also reviewed by groundwater scientists in DoI. The only recommendation from this review was to consider a second water quality sample to assure against any accuracy issues, however it was noted that this would be unlikely to produce a different salinity result.

In accordance to the strategy agreed for the 2014 LHWP (Figure 6.3 below), Hunter Water and DoI have determined that since the water identified was not of a suitable salinity level for drinking water use, there will be no further work to locate the aquifer and this action of the LHWP will be considered complete.

The costs assumed for these investigations in the 2014 LHWP was $75,000. The actual expenditure to date and forecast expenditure are summarised below.

The potential for the paleochannel to be utilised for Managed Aquifer Recharge may be investigated as an option for the next LHWP.

Table 6.3 Costs associated with Lower Hunter alluvial groundwater source investigations

	Total project expenditure
Field investigations	$201,300
Hunter Water internal costs	$96,400

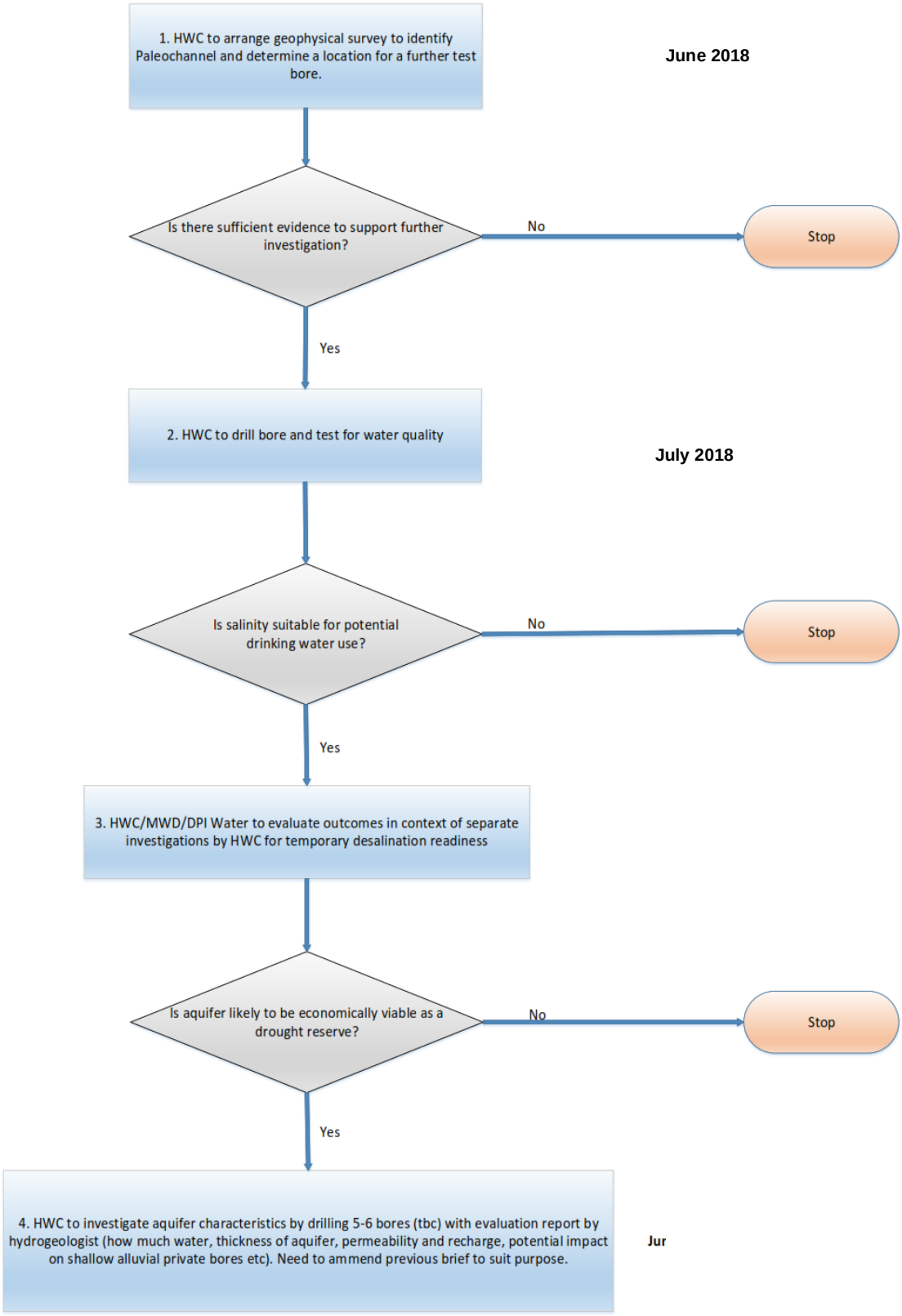


Figure 6.3 Strategy for investigations into the Lower Hunter alluvial groundwater source

Rain water and stormwater use

During 2017/18, Hunter Water continued to host the Water Sensitive Region Interagency Working Group, which includes councils and government agencies. The working group meets quarterly to promote a shared understanding of Integrated Water Management and explore opportunities to improve the liveability of the lower Hunter.

A Stormwater Harvesting Framework is being developed, in conjunction with Lake Macquarie City Council, to identify and guide decision-making on potential stormwater harvesting schemes.

Decentralised water sources such as stormwater harvesting opportunities are being investigated as part of the next LHWP.

Temporary desalination

The 2016 MERI major evaluation discussed in detail how changes in the scope of temporary desalination readiness had impacted upon the expected costs and timing of deliverables. Hunter Water proposed a revised program for delivering temporary desalination, which was approved by the LHWP governance groups and signed off by the Minister as part of the 2016 MERI evaluation report.

In 2017-18, a number of activities commenced for readiness for a 15ML/day facility at Belmont.

The request for Secretary's Environmental Assessment Requirements (SEARs) was submitted to Department of Planning & Environment (DPE) in November 2017. A planning focus meeting was held in December 2017, and the SEARs were finalised by DPE in January 2018.

Collection of oceanographic data (temperature and current) to support the brine dispersion modelling commenced in February 2018 as an extension to an existing Hunter Water engagement and will continue until September 2018. The concept design and environmental impact assessment (EIA) consultancy tender was finalised in February 2018, incorporating a peer review by Public Works Advisory. The consultancy was tendered in March and April 2018, and tender evaluation was completed in May 2018. Hunter Water engaged GHD for the temporary desalination plant concept design and EIA in June 2018.

Geotechnical and groundwater investigations, a key task for the concept design and EIA, are due to commence in August 2018. Under the current program, submission of the EIA to DPE should occur in mid-2019.

Community consultation for the temporary desalination plant commenced in January 2018 and will continue in parallel with the EIA and concept design.

Water quality monitoring will commence in August 2018 following the geotechnical investigation, as part of the EIS and concept design work.

The updated timeline for the temporary desalination project is shown in Figure 6.4. Based on the new timeline, readiness activities for the temporary desalination plant are expected to be finalised in around January 2020. This is approximately 4 months later than the timeline set out in the 2017 MERI and 25 months later than the timeline agreed in 2016.

Under the current timeline, some modification to a sequential Concept Design – Detailed Design procurement approach would be required to enable delivery of water from temporary desalination if there were an extreme drought in the immediate future. However, assuming there is average rainfall through to April 2019, Hunter Water advises that Concept Design could be completed and Detailed Design could follow sequentially if triggered and that parallel procurement of these two elements would not be required.

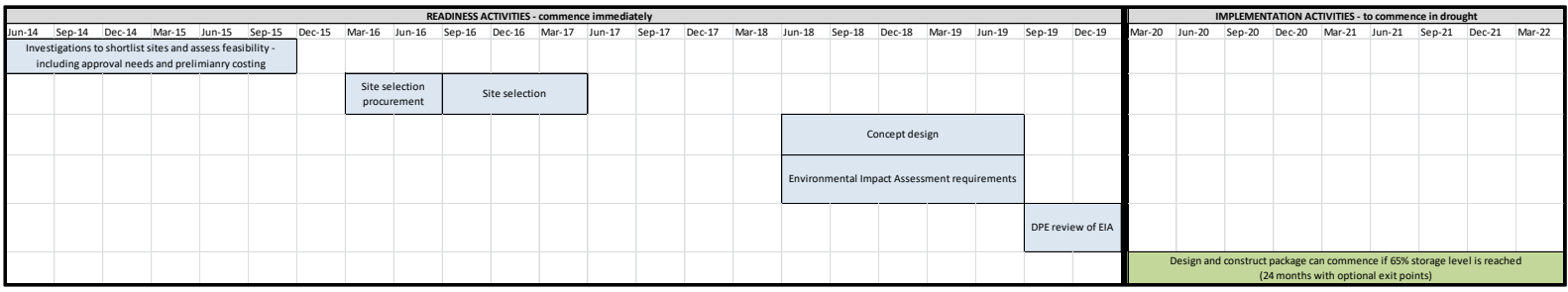


Figure 6.4 Updated timeline for delivery of temporary desalination readiness (2018)

Readiness for temporary desalination will continue while planning for the next iteration of the LHWP proceeds. The proposed facility will be considered as part of the new planning process.

The expected costs for implementing the temporary desalination measure have increased significantly since the analysis was undertaken for the LHWP. As reported in the 2016 major evaluation, this cost increase has been driven by the change in scale of the plant from 9 ML/day to 15 ML/day, as well as the requirement to undertake a full Environmental Impact Study (EIS) . Increased costs are associated with the need for permanent infrastructure including power, water intake and brine disposal infrastructure. In 2016, Hunter Water modelled the LHWP portfolio with the higher costs included for the 15 ML/day facility and found that it was still the preferred portfolio for the LHWP. This is likely to be because the probability of triggering construction (the highest cost component) is so low that the average expected present value cost remains low when it is calculated over a large number of replicates (possible climate scenarios) in the hydro-economic model.

Expected costs of construction estimated by AECOM as part of the Preliminary Environmental Assessment are higher than the estimate in 2016.

Table 6.3 summarises the costs for each stage of temporary desalination based on the original LHWP estimate and the most recent estimate in 2018.

Table 6.3 Comparison of cost estimates for temporary desalination

Stage	LHWP assumed cost for 9ML/d plant	Estimated cost for 15ML/d plant (2016)	Revised cost for 15ML/d plant (2017)	Revised cost for 15ML/d plant (2018)
Readiness	n/a	$2,000,000	$1,700,000	$1,940,000
Trigger 1	$23,000	$3,000,000	$4,900,000	$4,900,000
Trigger 2	$23,000,000	$59,400,000	$84,100,000	$84,100,000
Total	**$25,500,000**	**$64,400,000**	**$90,700,000**	**$90,940,000**

Table 6.4 Summary of findings for EQ 3.1

EQ 3.1	Have the identified implementation actions been delivered within agreed timeframes or consistent with identified triggers? What are the reasons for any significant variation and how can this understanding improve delivery of the plan?						
Category	**Implementation action / deliverable**	**Who**	**LHWP timing**	**Actual/ Expected**	**Status**	**Finding**	**Comments**
Surface water	Construct infrastructure to transfer more water from the Central Coast to the lower Hunter as per existing agreement	HW	2017	end 2018	Delayed		Hunter Water is expected to complete construction by the end of November 2018. Completed works will increase the water capacity received from CCC to 15 ML/day. The delivery of the Mardi-Warnervale pipeline by CCC, required to meet 30ML/d northbound transfer, has been delayed to the end of 2021 due to factors beyond CCC's control.
		CCC	2017	end 2021	Delayed		
	Develop an improved model for inter-regional transfers with the Central Coast	HW, CCC	Oct 2015	May 2016	Complete		
	Investigate options to optimise water transfers with a view to enhancing existing transfer agreement if required/ appropriate	HW, CCC, DoI	Oct 2016	Oct 2016	Complete		Options for alternative water transfer arrangements have been investigated, and will be available for consideration during development of the next LHWP
	Implement new environmental flow rules for Chichester Dam	DoI, HW	Not specified	To be progressed in 2019 and to be complete no later than 2022	Delayed		DoI has drafted amendments to the Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2009 to implement the environmental flow release rules from Chichester Dam. Hunter Water is ready to implement the new releases at Chichester Dam when the required changes are made to the WSP.

EQ 3.1	Have the identified implementation actions been delivered within agreed timeframes or consistent with identified triggers? What are the reasons for any significant variation and how can this understanding improve delivery of the plan?						
Category	**Implementation action / deliverable**	**Who**	**LHWP timing**	**Actual/ Expected**	**Status**	**Finding**	**Comments**
	Implement new environmental flow rules for Seaham Weir	DoI, Hunter Water	Not specified	2021	On track		New fishway and gates are expected for construction in 2020-2021.
Groundwater	Consider any implications for the LHWP arising from review of the Water Sharing Plan for the Tomago Tomaree Stockton groundwater sources	DoI	July 2014	Apr 2015	Completed		The Groundwater Working Group will be convened to consider the implications of groundwater extraction on GDEs and considerations for access conditions in the Tomago and Tomaree water sources as part of the process of developing the next LHWP.
	Investigate feasibility of Lower Hunter Alluvial for drought supply	Hunter Water	Not specified	June 2016	Completed		After completion of drilling works and water sampling Hunter Water and DoI determined that the salinity level was not appropriate for potable use and further investigations will not proceed on the option as a water supply.
	Watching brief on use of water from underground mines	DoI	Not specified	Ongoing	Ongoing		As part of the development of the next LHWP options under consideration will include extracting water from disused mines and storage and extraction of water from disused mines.
Water efficiency	Continue existing water efficiency programs	Hunter Water	Ongoing	Ongoing	Ongoing		See EQ 2.2
Demand management	Introduce Water Wise Rules	Hunter Water	July 2014	Ongoing	On track		WWR were implemented in 2014. In 2018 Hunter Water launched the Love Water campaign which aims to engage more deeply with the community to encourage lasting behaviour change rather than communicating the rules.

EQ 3.1	Have the identified implementation actions been delivered within agreed timeframes or consistent with identified triggers? What are the reasons for any significant variation and how can this understanding improve delivery of the plan?						
Category	**Implementation action / deliverable**	**Who**	**LHWP timing**	**Actual/ Expected**	**Status**	**Finding**	**Comments**
	Watching brief on pricing issues	DoI	Ongoing	Ongoing	Ongoing		As part of the development of the next LHWP options under consideration will include block tariffs, scarcity pricing and voluntary curtailment.
Recycled water	Dual reticulation schemes at Chisholm and Gillieston Heights as development proceeds	Hunter Water	Not specified	2018 / 2019	Delayed		Detailed design and construction of the recycled water treatment plant commenced in July 2017. Commissioning of the Chisholm and Gillieston Heights recycled water schemes are due December 2018 and March 2019, respectively.
	Complete the Kooragang Recycled Water Scheme	Hunter Water	Dec 2014	Ongoing	Complete		
	Assess future expansion opportunities	Hunter Water	Ongoing	Ongoing	Ongoing		To be considered as part of developing the next LHWP
	Watching brief on private sector involvement in providing water supply and/or wastewater services	DoI	Ongoing	Ongoing	Ongoing		Opportunities for private sector involvement will be further considered as part of developing the next LHWP.
Rainwater and stormwater use	Trial with Lake Macquarie Council to better understand rainwater tank failures and educate participants	Hunter Water	June 2014	July 2015	Complete		
	Liaise with Councils to encourage potential stormwater harvesting schemes	Hunter Water, DoI	Ongoing	Ongoing	Ongoing		Hunter Water continues to host the Water Sensitive Region Interagency Working Group, which includes councils and Government agencies. Investigation of potential stormwater harvesting schemes in conjunction with Lake Macquarie City Council is currently being undertaken.

EQ 3.1	Have the identified implementation actions been delivered within agreed timeframes or consistent with identified triggers? What are the reasons for any significant variation and how can this understanding improve delivery of the plan?						
Category	**Implementation action / deliverable**	**Who**	**LHWP timing**	**Actual/ Expected**	**Status**	**Finding**	**Comments**
	Consider stormwater harvesting as part of large customer water efficiency initiatives	Hunter Water	Ongoing	Ongoing	Ongoing		Stormwater harvesting opportunities to be investigation as part of the major review of the LHWP.
Temporary desalination	Readiness activities - site selection, technical and environmental investigations and review of procurement options	Hunter Water	Dec 2015	EIS to be submitted to DPE for approval in mid-2019 Time for approval has been estimated at 6 months but is subject to DPE	Delayed		The request for SEARs was submitted to DPE and finalised in January 2018. Community consultation for the temporary desalination plant commenced in January 2018. Collection of oceanographic data commenced in February 2018 Hunter Water engaged GHD for the temporary desalination plant concept design and EIA in June 2018. Geotechnical and groundwater investigations due to commence in August 2018.
	Water quality monitoring program for preferred sites	Hunter Water	tbc	End 2018	Delayed		See above
	Watching brief on improvements in desalination technology	Hunter Water	Ongoing	Ongoing	Ongoing		For consideration in the desalination investigations for the next LHWP
	Liaison with CCC regarding desalination as a contingency drought measure	DoI	Ongoing	Ongoing	Ongoing		The potential for shared water security measures between the lower Hunter and Central Coast will be considered as part of developing the next LHWP and the Central Coast Integrated Water Resources Plan.

KEQ 3 Action Summary

Recommended actions from the evaluation findings for KEQ 3 are summarised below:

4. CCC to progress construction of infrastructure to increase inter-regional transfers between Central Coast and Hunter Water by the revised timing of end-2012
5. DoI to progress amendments to the Hunter Unregulated and Alluvial Water Sharing Plan to facilitate environmental flows for Chichester Dam
6. DoI to convene the Groundwater Working Group for an update on research into groundwater dependent ecosystems at Tomago and Tomaree and agree a way forward for assessing impacts of groundwater extraction into the analysis for the next LHWP
7. Hunter Water to progress readiness activities for desalination including water quality monitoring and preparation and submission of EIS
8. Hunter Water to continue to engage with businesses and locals councils on integrated water management, including stormwater harvesting opportunities

7 KEQ 4: Do the measures in the plan remain appropriate? Assumptions and new information

Key findings for KEQ 4

- Hunter Water is collaborating with the University of Newcastle to generate paleoclimate informed stochastic rainfall and streamflow data. The data will be used as an input to the hydrologic models to better account for climate variability over thousands of years (before instrumental climate records).
- A major review of the demand forecast model will include climate correction and will provide insight about the impact of Water Wise Rules on residential demand. This is will be undertaken as part of the next LHWP.
- A review of the governance structure for the LHWP and terms of reference for the governance groups is underway as part of the development of the next LHWP
- The IPART review of recycled water and the completion of the Hunter Regional Strategy did not impact significantly on the actions in the LHWP in 2017/18 but will continue to influence the plan and be considered in future MERI evaluations and in the development of the next LHWP.

Overview

This section considers whether the measures in the plan are affected by new information, changes in the regulatory and operating regime, or other developments such as new technology or information. If new information about water volumes, lead times or costs would substantially change the assumptions used in the portfolio analysis, it may be necessary to re-model the portfolios to test whether the measures remain optimal. The MERI plan establishes that if modelling indicates that the portfolio is no longer preferred, a major LHWP review will be triggered.

EQ 4.1 Are the assumptions underpinning the LHWP still appropriate?

Most of the assumptions underpinning the LHWP remain appropriate. Only the assumptions that indicate a risk to delivery of LHWP objectives, or have consistently performed below expectations are discussed below.

Assumptions about groundwater sources

SEQ 4.1.3 Does the accessible storage level of Tomago Sandbeds remain at least 60,000 ML?

Following the implementation of the Tomago PFAS operating strategy in April 2018, the estimated accessible storage volume of the Tomago Sandbeds has been reduced from 60,000 ML to 54,000 ML. The PFAS contamination issue and PFAS operating strategy are discussed further at 4.1.6.

SEQ 4.1.5 Can 90% of pumpable water from Williams River be transferred?

Water transfers have been challenged on two occasions during the year due to high volumes of weed overwhelming the weed screen system at Balickera WPS. Hunter Water is investigating methods to address the problem.

During the year Water NSW gauged the flow of water through Balickera WPS against Hunter Water's flow calculation formula. They found that Hunter Water was over-estimating extraction by around 15% for the old pumps, and measurement of extraction through the new pumps was accurate. Under the interim access rules this over-estimation meant that Hunter Water did not take as much water as it should have accessed prior to the gauging being done. The problem

has been addressed by adding a calibration factor to the flow estimation. There is no suggestion that the pumps are under-performing, but rather that there is a suspected error in the estimated elevation of instruments that feed into the calculation. Alternative flow measuring methods are also being investigated in line with NSW water access reforms flagged for 2018/19.

These problems are not expected to cause a long term impact on the ability to take 90% of pumpable flow on average.

SEQ 4.1.6 Does the current source strategy for Tomago continue to apply / operate?

Tomago operation is impacted by PFAS contamination that originated from RAAF Williamtown. During the past year, Hunter Water developed a PFAS management strategy in collaboration with the NSW Government PFAS Taskforce. This strategy was ultimately endorsed by the PFAS Taskforce in April 2018. In terms of the MERI review, the impact of the PFAS strategy on the operation of the Tomago Borefield is that Stations 7 and 9 are no longer accessible to Hunter Water and there have been changes to the Tomago operating rules. The PFAS strategy also includes numerous other requirements, such as increased water quality monitoring, that do not impact the MERI review.

The 2014 LHWP operating assumptions for the Tomago Borefield were:

Rule 1

When the storage in Tomago Sandbeds (in % terms) exceeds the storage in Grahamstown Dam by more than 5%, Tomago is operated at 45ML/day.

Rule 2

When overall system storage is between 40% and 70%, Tomago Sandbeds is operated at 75ML/day unless it runs out of water.

Rule 3

When overall system storage is below 40%, Tomago Sandbeds is operated at 45ML/day whenever water is available in Tomago Sandbeds.

Following the PFAS strategy, Rule 1 has been removed, and Rules 2 and 3 have been retained. It was found that Rule 1 could be removed without measurable impact on yield, but with a substantial impact on the frequency of operating the borefield. The rule was removed as an initiative to 'minimise' use of the borefield from the perspective of minimising the use of water that contains trace levels of PFAS, albeit below the Australian Drinking Water Quality guideline limits. Removal of this rule resulted in a decision not to operate the borefield in 2018/19 when operation would otherwise have been triggered.

The loss of access to Stations 7 and 9 effectively reduces the area of the Tomago Sandbeds that can be accessed, thereby reducing the accessible water storage volume. This change is reflected in 4.1.3.

SEQ 4.1.8 Is the assumption that Tomaree aquifer can deliver a constant sustainable supply of 7 ML/day still valid?

A model of the Tomaree Sandbeds has now been developed and an assumption of the available volume is no longer required. In preparation for modelling for the next LHWP, DoI will work with Hunter Water to define a rule-based approach to water access from the Tomaree sandbeds and the modelling will be updated accordingly.

Assumptions about future climate

SEQ 4.1.7 Is future climate represented by historical climate records as of 2012? How do changes impact on supply (yield) modelling?

Hunter Water has engaged the University of Newcastle to develop a palaeo-informed synthetic data set for rainfall and streamflow. This data will better account for climate variability over thousands of years (before instrumental records) and will be applied to hydrological modelling and economic analysis.

Hunter Water's major review of the demand forecast model will also consider climate correction and provide an indication of whether recent increases in residential demand are likely to be the result of hot, dry weather conditions or due to other behavioural changes (e.g. bounce-back from water savings behaviours of the Millennium drought).

Assumptions about recycled water

SEQ 4.1.11 Has Kooragang Recycled Water Scheme offset 3 GL per annum of potable water use from December 2014

In 2017/18, the scheme offset 2,495 ML. This is the highest volume since the plant was commissioned. Since 2014 the plant has supplied an average of 1,825 ML/year. This is further discussed in Section 5.

Assumptions about environmental flow rules

SEQ 4.1.12 Have the revised environmental flow rules for Chichester Dam and Seaham Weir been implemented?

The new rules have been partially implemented at Seaham Weir, and Hunter Water is ready to implement them at Chichester Dam. The changes at Chichester Dam will be made when DoI revises the Hunter Unregulated and Alluvial WSP. Hunter Water is on track for final implementation at Seaham Weir when new gates and fishway are constructed (estimated for 2020 to 2021). This is further discussed in Section 6.

Assumptions about Central Coast transfers

SEQ 4.1.23 Can Central Coast transfers supply an average of 30ML/day northbound by 2017?

Due to delays in construction of infrastructure, at the current time transfers northbound of 30 ML/day are not possible. It is not expected that transfers of this volume will not be available until 2022. Transfers are currently limited to 15 ML/day in a northerly direction. This is discussed further in Section 6.

Assumptions about Water Wise Rules

SEQ 4.1.24 Does the application of Water Wise Rules result in a demand reduction of 2.5% of residential water demand?

The 2016 MERI evaluation discussed that while there had been a downward trend in residential water use since WWR were implemented, it was not possible to distinguish how much of this reduction in use could be attributed to WWR, compared with savings from improvements in household water efficiency and variability due to weather conditions.

As part of the major review of its demand forecast Hunter Water will develop a methodology for climate correction that will provide improved understanding of demand trends since the introduction of Water Wise Rules in 2014. This will also provide a better understanding around the assumptions for water restrictions that will be considered for the next LHWP.

SEQ 4.1.25 Are the Water Wise Rules cost assumptions still valid?

In 2017/18 Hunter Water moved away from advertising Water Wise Rules and instead implemented the "Love Water" campaign with a focus on a softer approach to water conservation messaging. A total of $340,000 was spent on this campaign in 2017/18, exceeding the $120,000/year forecast for Water Wise Rules assumed in the LHWP.

EQ 4.2 Is the regulatory and operating environment still consistent with the LHWP?

Regulatory and operating

While there have been changes to the DoI governance structure and the creation of the Natural Resource Access Regulator, the underlying Water Sharing Plans that govern Hunter Water's water access are still fundamentally the same as they were during development of the 2014 plan.

The North Coast Coastal Sands WSP has been drafted with an amendment that allows changes to rules for major utility access licences in the Tomago and Tomaree Groundwater Sources after Year 5 of the WSP. The Groundwater Working Group will be convened to consider the implications of groundwater extraction on GDEs as part of the process of developing the next LHWP and this may result in operational changes for Hunter Water. However, in 2017/18 complications arose related to the research on GDEs in this area and at the present time the status of the research is unclear.

Operational changes for the Tomago source, in response to groundwater contamination from the Williamtown RAAF Base have been implemented by Hunter Water. Changes to operational rules are discussed under EQ 4.1.

In 2018 IPART began a review of pricing arrangement for recycled water and related services for Hunter Water, CCC, Sydney Water and Essential Energy. The outcomes of this review will be reported in the next MERI evaluation.

The Upper Hunter Regional Strategy (being developed by DoI) has identified a number of infrastructure options for further investigation, including a two-way pipeline between Lostock Dam and Glennies Creek Dam and construction of a potable pipeline from Hunter Water infrastructure to Singleton. These options will be considered as part of the development of the next LHWP.

Sydney Water and Hunter Water (also to include CCC) have developed a Memorandum of Understanding (MOU) around water conservation. The objectives of the MOU are to explore opportunities to coordinate water conservation initiatives, ensure consistent messaging with communities, identify efficiencies in measures and initiatives and identify opportunities for co-resourcing and co-funding. The intention of the initiative is to recognise the importance of implementing effective conservation strategies throughout NSW and to provide benefits to the community through collaboration and effective working relationships. The goals of the MOU are consistent with the water conservation actions and commitment to inter-agency collaboration that are part of the LHWP.

Governance

Throughout 2018/19 DoI continued to address the implications of the 2017 Machinery of Government changes. The changes resulted in the movement of responsibility for the delivery of the Metropolitan Water Plan to DPE, complicating the governance arrangements for the Independent Water Advisory Panel (IWAP) and the Metropolitan Water CEOs committee (MWCEOs), both of which oversaw the delivery of both the Sydney and Lower Hunter water plans. The MWCEOs is no longer active and DoI have progressed with the formation of a Lower Hunter Water CEOs consisting of representatives from DoI, Hunter Water and CCC to provide high level oversight to the LHWP process.

DoI has coordinated with the project team at DPE to continue to convene the experts of the IWAP in accordance with their existing terms of reference.

EQ 4.3 Has new technology, information or methods emerged that will influence the measures and their implementation?

Population information

The NSW Department of Planning and Environment released updated population projections and occupancy rates in 2016 indicating that population is now expected to be higher than previously forecast.

The projected increases and changes in occupancy rates will be accounted for as part of Hunter Water's major review of the demand forecast for the next LHWP.

Table 7.1 Summary of findings for KEQ 4

EQ 4.1 Are the assumptions underpinning the LHWP still appropriate								
	Question	**2013/14**	**2014/15**	**2015/16**	**2016/17**	**2017/18**	**Finding**	**Comment**
	Are the assumptions underpinning the LHWP still appropriate? **Do any changes influence the measures and implementation actions in the LHWP?**							
4.1.1	Does the accessible storage at Chichester Dam remain at least 18,357 ML?	Yes	Yes	Yes	Yes	Yes		
4.1.2	Does the accessible storage at Grahamstown Dam remain at least 182,400 ML?	Yes	Yes	Yes	Yes	Yes		
4.1.3	Does the accessible storage level of Tomago Sandbeds remain at least 60,000ML?	?	?	?	Yes	No		The estimated access to water at Tomago has been revised down by 10% to 54,000 ML following implementation of a PFAS Management Strategy in April 2018.
4.1.4	Is the surrogate method of modelling transfers representative of Central Coast transfers under the existing agreement? OR If new inter-regional modelling capacity is developed, do the inter-regional models accurately represent transfers under the existing agreement?	Yes	Yes	Yes	Yes	N/A Yes		
4.1.5	Can 90% of pumpable water from Williams River be transferred?	Yes	Yes	Yes	Yes	Yes		Water transfers have been challenged on two occasions during the year due to weeds overwhelming the screen system at Balickera WPS. Hunter Water is investigating methods to address the problem and it is not expected to have a long-term impact.
4.1.6	Does the current source strategy for Tomago continue to apply / operate? *Rule 1* *When the storage in Tomago Sandbeds (in % terms) exceeds the storage in Grahamstown Dam by more than 5%, Tomago is operated at 45ML/day.* *Rule 2* *When overall system storage is between 40% and 70%, Tomago Sandbeds is operated*	Yes	Yes	Yes	Yes	No		Rules altered as part of Hunter Water's PFAS operating strategy. Rule 1 removed. Rules 2 and 3 retained.

EQ 4.1 Are the assumptions underpinning the LHWP still appropriate

	Question	2013/14	2014/15	2015/16	2016/17	2017/18	Finding	Comment
	at 75ML/day unless it runs out of water. *<u>Rule 3</u>* *When overall system storage is below 40%, Tomago Sandbeds is operated at 45ML/day whenever water is available in Tomago Sandbeds.*							
4.1.7	Is future climate represented by historical climate records as of 2012? How do any changes impact on supply (yield) modelling?	Yes	Yes	Yes	Yes N/A	Yes N/A		An emerging area of research is investigating the possibility of extending the historic instrumental climate records using palaeo climate records. Hunter Water has engaged the University of Newcastle to develop a palaeo informed synthetic climate data set for use in the next LHWP. Possibility of increased use due to temperature increases as a result of climate change will be considered as part of the next LHWP.
4.1.8	Is the assumption that Tomaree aquifer can deliver a constant sustainable supply of 7ML/d still valid?	Yes	Yes	Yes	No	No		A model has been developed so that the volume no longer needs to be assumed. A rule based approach for the aquifer will be developed for the next LHWP
4.1.9	Is 10% total storage representative of nearly empty?	Yes	Yes	Yes	Yes	Yes		
4.1.10	Is the actual non-residential use trending close to the base case forecast?	Yes	Yes	Yes	Yes	Yes		Non Residential use in 2017/18 was 19.4 GL. This is slightly higher than the LHWP forecast of 19.1 GL but within the sensitivity bounds of the base-case forecast.
4.1.11	Has Kooragang Industrial Water Scheme offset 3 GL/year of potable water use from Dec 2014?	n/a	No	No	No	No		Since 2014, KIWS has offset an average of 1,825 ML/year. 2,495 ML of potable water was offset in 2017-18.

	EQ 4.1 Are the assumptions underpinning the LHWP still appropriate							
	Question	**2013/14**	**2014/15**	**2015/16**	**2016/17**	**2017/18**	**Finding**	**Comment**
4.1.12	Have the revised environmental flow rules for Chichester Dam and Seaham Weir been implemented? Do the revised environmental flow rules better reflect natural flow variability?	n/a	n/a	n/a	No	No No Yes		The new rules have been partially implemented at Seaham Weir and are on track for final implementation when new gates and fishway are constructed. Rules will be implemented atChichester Dam when DoI revises the Hunter Unregulated Rivers WSP.
4.1.21	Are the triggers for commencing temporary desalination still appropriate for minimum lead time? *(ie, it is assumed that commencing design and approval no later than 65% total storage level and construction no later than 35% will enable operation to commence no later than 15%)*	Yes	No	No	No	No		Revised as part of 2016 MERI evaluation to: -'now': investigations, site selection, concept design and EIS/planning approval -65%: procurement for design and construct package with optional exit points -30%: start operation, if construction completed (must produce water by 15%)
4.1.22	Can temporary desalination units supply a minimum of 9ML/d? (ie, capability)	n/a	n/a	n/a	Yes	Yes		Concept design will be prepared for options greater than 9 ML/day.
4.1.23	Can Central Coast transfers supply an average of 30ML/d northbound by 2017?	No	No	No	No	No		There have been delays to infrastructure delivery. HW infrastructure will be ready to receive 30 ML/day by the end of November 2018, but works by CCC are estimated to be delayed until end-2021
4.1.24	Does the application of Water Wise Rules result in a demand reduction of 2.5% of residential demand?	n/a	?	?	?	?		Water Wise Rules were introduced on 1 July 2014.
4.1.25	Are the Water Wise Rules cost assumptions still valid?	n/a	Yes	Yes	Yes	N/A		In 2017/18 Hunter Water changed the direction of water conservation messaging, focusing on the Love Water campaign and investing $340,000 over the period.
	EQ 4.2 Is the regulatory and operating environment still consistent with the LHWP?							
	Do any changes influence the measures and implementation actions?	No	No	No	Yes	Yes		Changes are discussed in Section 7 and include: • Governance of IWAP and CEOs

	Question	2013/14	2014/15	2015/16	2016/17	2017/18	Finding	Comment
EQ 4.1 Are the assumptions underpinning the LHWP still appropriate								
	Issues include but are not limited to: • *Institutional arrangements* • *Hunter Water regulatory environment* • *BASIX* • *Environmental regulation changes which may impact on the viability of measures in the plan (eg, EEC, threatened species)*							• Regulation via WSPs and NRAR • Changes to operating strategy for Tomago sandbeds resulting from finding of PFAS Expert Panel. • Recommendations from the Greater Hunter Regional Strategy • IPART review of recycled water • Water conservation MOU for the Sandstone Megaregion initiative
EQ 4.3 Has new technology, information or methods emerged that will influence the measures and their implementation?								
	Do any changes influence the measures and implementation actions in the LHWP? *Key issues include but are not limited to:* • *Population forecasts or forecasting methods* • *Climate modelling* • *Results of testing demand forecast assumptions* • *Technology or measures that didn't make the plan* • *Desalination technology* • *Relevant changes in other water authority practices to improve best practice* • *Relevant media for emerging issues* • *Potential to use contingency measures not included in the LHWP*	No	Yes	Yes	Yes	Yes		Opportunities for better modelling climate through the use of paleo informed synthetic data could influence the LHWP and are discussed in Section 7. Revised population forecasts from DPE are higher than expected and will be accounted for in Hunter Water's major review of the demand forecast for the next LHWP.

KEQ 4 Action Summary

Recommended actions from the evaluation findings for KEQ 4 are summarised below

9. Utilise paleo-informed synthetic data in hydrologic modelling and economic analysis to better capture the impacts of climate change and variability.

10. Hunter Water to develop an approach for climate correction in the demand forecast model to better understand the impact of weather on demand and the water savings from WWR, demand management and water efficiency measures

8 Conclusions and recommendations

The key findings from the 2018 evaluation of the LHWP are summarised below:

KEQ 1

- Supply and demand modelling indicates that the projected demand for water will exceed the system's reliable yield in 2037/38, two years later than the LHWP forecast.
- Total demand is trending within forecast sensitivity. The current residential demand forecast is above the LHWP forecast, while the forecasts for non-residential and non-revenue water are below the LHWP forecast.
- The increase in residential water consumption in 2016/17 and 2017/18 is likely attributable to weather conditions that were hotter and drier than average.

KEQ 2

- The Kooragang Industrial Water Scheme supplied 2,495 ML in 2017/18, the highest volume since the scheme was commissioned, but below the forecast of 3,000 ML/year.
- Hunter Water's water efficiency programs, primarily aimed at business customers, achieved a savings of 513 ML.
- Hunter Water completed 2,333 km of active leak detection in 2017/18 and reduced their Infrastructure Leakage Index from 1.4 to 1.2.

KEQ 3

- Hunter Water and CCC have developed a joint WATHNET model to further explore the potential water security benefits to both regions of water transfers and other supply and demand options.
- CCC has experienced unavoidable delays in constructing transfer infrastructure. This has had implications for the volume of water that can be transferred between the regions, increasing risks during drought for Hunter Water and increasing costs to CCC.
- Hunter Water is planning to commence construction on a new fishway and control gates to improve environmental flows at Seaham Weir by 2020 to 2021.
- DoI has experienced delays in finalising amendments to the Hunter Unregulated and Alluvial Water Sources WSP 2009.
- Investigations of the Lower Hunter alluvial groundwater source yielded water that was too saline for potable use and it was determined that there would be no further investigation of the option as a source of supply
- Readiness activities for temporary desalination are underway, but have been delayed by approximately 15 months against the 2017 MERI timeline. As current storage levels are high and alternative procurement options are available, it is likely that water could be available in a severe drought.

KEQ 4

- Hunter Water is collaborating with the University of Newcastle to generate paleoclimate informed stochastic rainfall and streamflow data as an input to the hydrologic models to better account for climate variability over thousands of years (before instrumental climate records).
- A major review of the demand forecast model will include climate correction and will provide insight about the impact of Water Wise Rules on residential demand. This is will be undertaken as part of the next LHWP.
- A review of the governance structure for the LHWP and terms of reference for the governance groups is underway as part of the development of the next LHWP.
- The IPART review of recycled water and the completion of the Hunter Regional Strategy may impact on the measures in the plan and will be considered in future MERI evaluations and in the development of the next LHWP.

Recommended actions from the 2018 evaluation

No.	Action	Lead
1	Continue to monitor the trend of increasing residential demand to better understand the drivers (climate change, behaviour bounce-back, etc) and how this might inform the major review of the demand forecast for the next LHWP.	Hunter Water
2	In developing the next LHWP, ensure that water efficiency and recycled water scheme options that rely on third parties appropriately account for uncertainties in expected water savings	Hunter Water DoI
3	Ensure the economic level of water conservation (ELWC) methodology takes into account potential environment and societal costs and benefits to ensure efficient investment in loss minimisation, water efficiency and recycled water and is consistent with the approach used for the LHWP analysis	Hunter Water
4	Progress construction of infrastructure to increase inter-regional transfers between Central Coast and Hunter Water by the revised timing of end-2021	CCC
5	Progress amendments to the Hunter Unregulated and Alluvial Water Sharing Plan to facilitate environmental flows for Chichester Dam	DoI
6	Convene the Groundwater Working Group for an update on research into groundwater dependent ecosystems at Tomago and Tomaree and agree a way forward for assessing impacts of groundwater extraction into the analysis for the next LHWP	DoI
7	Progress readiness activities for desalination including water quality monitoring and preparation and submission of EIS	Hunter Water
8	Continue to engage with businesses and locals councils on integrated water management, such as stormwater harvesting opportunities	Hunter Water
9	Progress work with the University of Newcastle to generate paleo-informed synthetic data for use in hydrologic modelling and economic analysis for the next LHWP	Hunter Water
10	Hunter Water to develop an approach for climate correction in the demand forecast model to better understand the impact of weather on demand and the water savings from WWR, demand management and water efficiency measures	Hunter Water