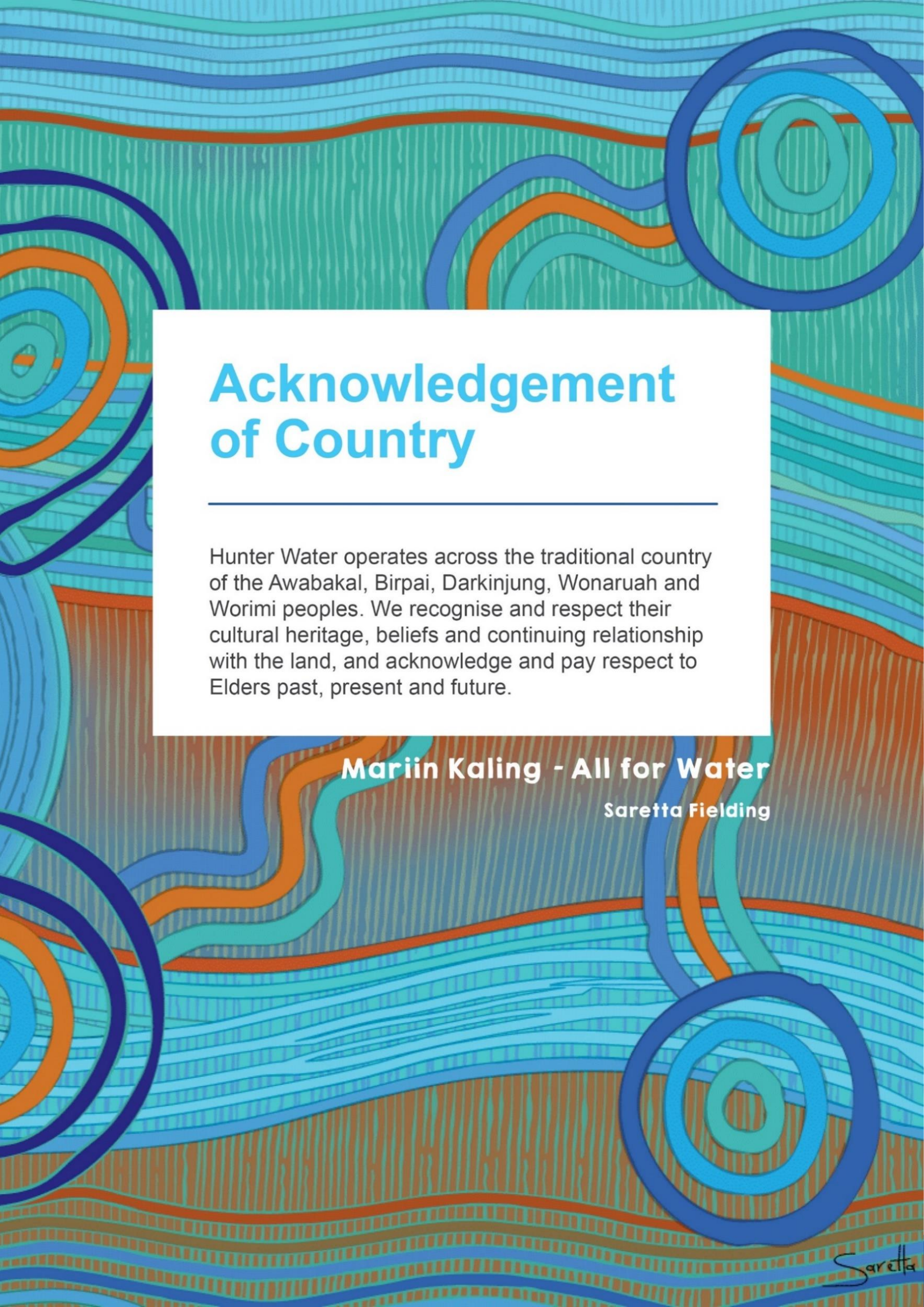
Portfolio Analysis Summary Report

Draft Lower Hunter Water Security Plan

August 2021

Acknowledgement of Country

Hunter Water operates across the traditional country of the Awabakal, Birpai, Darkinjung, Wonaruah and Worimi peoples. We recognise and respect their cultural heritage, beliefs and continuing relationship with the land, and acknowledge and pay respect to Elders past, present and future.



Mariin Kaling - All for Water

Saretta Fielding

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1. PURPOSE

The purpose of this document is to provide a summary of the approach and results of portfolio analysis for the Lower Hunter Water Security Plan (LHWSP). The portfolio analysis focusses on the major supply infrastructure options and demand reduction investment programs.

2. DECISION MAKING APPROACH

2.1. Decision support framework

A best practice decision support framework was adopted for the LHWSP. Key components of the decision support framework are discussed below.

Community input – community engagement throughout the planning process has identified community values and preferences that have informed the goals and objectives of the plan, the design of options portfolios and preferences for trade-offs between objectives. Community preferences for option portfolios were used to inform the refinement of portfolios and levels of service criteria and were considered alongside technical assessment in the selection of the preferred portfolio.

Levels of service and trade-offs – the plan seeks to deliver multiple objectives, including water supply objectives as well as broader social and environmental outcomes. The trade-offs between reliability, social and environmental objectives has been informed by community input and were tested in the portfolio analysis. Various levels of service for reliability were considered.

Economic and financial assessment of portfolios – economic and financial modelling was undertaken to understand both the broader economic benefits each portfolio provides to the community as well as the financial implications for Hunter Water and bill impacts for our customers. Analysis included the trade-offs between sequenced and triggered (or drought response) investments across portfolios, the social cost of restrictions and running out of water as well as qualitative assessment of social and environmental impacts and resilience benefits. The analysis considered the benefits of Central Coast investments to Hunter Water and vice versa.

Risk and uncertainty assessment – the ability for portfolios to remain adaptive to future uncertainties, and position us to take advantage of potential disruptors, was tested through sensitivity testing, scenario analysis and adaptive pathways.

2.2. Goals, objectives and measures

The goal of the LHWSP is to provide a resilient and sustainable water future that contributes to regional health and prosperity and is supported by the community. Figure 1 outlines the plan's objectives in achieving this goal.

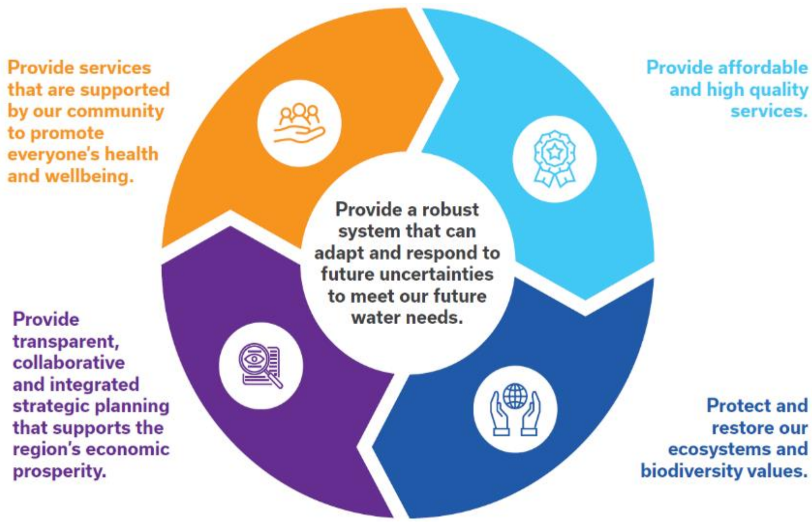

Figure 1: LHWSP Objectives

A range of measures were subsequently developed to support achieving these objectives. The measures are shown in Table 1.

Table 1: LHWSP Objectives and measures

Objective	Measures
1. Provide affordable and high-quality services	• Economic analysis • Financial analysis
2. Provide transparent, collaborative and integrated strategic planning	This objective defines guiding principles for the plan and does not measures for portfolio analysis
3. Protect and restore our ecosystems and biodiversity values	• Terrestrial ecology • Aquatic ecology • Greenhouse gas emissions • Non-renewable resource use
4. Promote everyone's health and wellbeing	• Community support • Heritage and cultural impacts • Direct impacts on the community
5. Provide an adaptive and robust system	• Reliability (see Section 2.4) • Adaptability • Operational resilience

2.3. Community engagement

An extensive engagement program to understand community views, values and preferences has informed decision-making for the LHWSP. Across three phases of engagement, Hunter Water have used a wide range of communications and engagement tools and techniques, both qualitative and quantitative, to ensure there was opportunity for the community to provide feedback on the plan (see Figure 2).

Community engagement throughout the planning process identified community values and preferences that helped inform:

- The goals and objectives of the plan
- Development of criteria against which options and portfolios of options were assessed
- Preferences for trade-offs between these goals and objectives
- The design of the portfolios considered in the development of the Plan
- The water security objectives (reliability level of service) adopted for the Plan
- The preferred program of actions.

Phase 1: 2018

What we did

- Deliberative forums
- Online surveys
- Surveys at events
- Stakeholder engagement

What we learned

Community values and aspirations

- Water quality
- Reliability of water supply
- Environment

Community stance on restrictions and expected levels of service

- The community strongly supported restrictions during drought and supported Hunter Water's stages of restrictions

How we incorporated

- Community values underpinned the goals and objectives
- Learnings from this stage were key inputs into the decision support framework as well as trade-offs between objectives

Phase 2: 2019-2020

What we did

- Deliberative forums
- Online surveys
- Surveys at events
- Established Community Liaison Group
- Community drop in sessions
- Stakeholder engagement

What we learned

Community views on supply and demand side options

- Community members have said they are quite open to us considering all options to secure our water future, but prefer options that reduce reliance on drinking water over options that supplement our water supplies

How we incorporated

- Incorporated into the development of preliminary programs of actions

Phase 3: 2020-2021

What we did

- Online surveys
- Ongoing meetings with LHWSP Community Liaison Group
- Focus groups
- Video presentations for high schools
- Focus group discussions with stakeholder groups

What we learned

- Community preferences for preliminary portfolios
- How the community trades off objectives
- Community preferences for recycled water/stormwater harvesting and water conservation programs
- Views on the level of service the community expects from us

How we incorporated

- Community feedback was considered alongside other ongoing investigations, modelling and analysis to inform the plan

Figure 2: How community views informed decision making

2.4. Water supply objectives (reliability level of service)

The LHWSP includes the concept of enduring supply which is the amount of water that can reliably be produced in a severe and prolonged drought, i.e. is independent of rainfall. In order to minimise the risk of running out of water regardless of the severity of any given drought, the transition to climate independent water source, with a capacity equal to the minimum customer demand, is required as part of a drought response plan.

We tested the community's water needs in drought as part of the development of the LHWSP. The Lower Hunter community supported a range of water restrictions and water use behaviours late in a period of drought that would reduce water consumption from typical levels of 190 litres per person per day to around 100 litres per person per day. This equates to a current minimum customer demand of 125 ML/day.

The plan has been developed to meet the following reliability criteria:

- Consistent with many other utilities in Australia, Hunter Water will aim to have restrictions in place for no more than six months every 10 years on average.
- Hunter Water will meet the community's water supply needs under all climatic conditions, including minimum supply requirements during a long and severe drought. This will require a transition to rainfall-independent water sources as part of a drought management plan.

3. DEVELOPING PORTFOLIOS OF OPTIONS

3.1. Options Development

In line with national urban planning principles, we adopted an 'all options on the table' approach. We considered all feasible options to reduce demand for drinking water and increase supply.

We developed a long list of demand and supply options from literature, technical reviews and community feedback. These options were screened to produce a list of the most suitable options for the Lower Hunter region. The overall process is shown in Figure 3.

Figure 3: Process for developing and assessing options and portfolios

The shortlisted options to decrease reliance on existing drinking water supplies (or demand options) include:

- A range of water conservation and leakage reduction programs of varying scales
- A range of recycled water and stormwater harvesting programs for non-drinking purposes of varying scales.

The shortlisted options to increase water supply (or supply options) include:

- A new Hunter Water connection to the proposed Glennies–Lostock scheme (a new water sharing arrangement with the Upper Hunter)

- Increasing existing water sharing with the Central Coast including upgrading the existing Mangrove Creek Dam and the interconnecting pipeline
- Desalination as either a permanent or drought response source of water, located at either Belmont or Walsh Point, on Kooragang Island, at a range of capacities
- A new purified recycled water for drinking for drinking (PRW) scheme
- A new 230 billion litre on-river dam at Upper Chichester, immediately upstream of the existing Chichester Dam
- A new 160 billion litre off-river dam at Limeburners Creek, east of Clarence Town.

3.2. Portfolios for assessment

We grouped options into several programs or portfolios of actions that are designed to ensure there is enough water supply to meet the projected demand over the 40-year life of the plan.

Each portfolio is made up of:

1. Actions to reduce the demand for drinking water — a range of various levels of investment in water conservation and recycled water for non-drinking programs
2. Actions to increase the supply of drinking water — combinations of shortlisted supply options
3. A drought management plan — a combination of further demand reduction measures as well as drought response desalination to meet the needs of our community during drought.
4. Other non-infrastructure measures as shown in Figure 4.

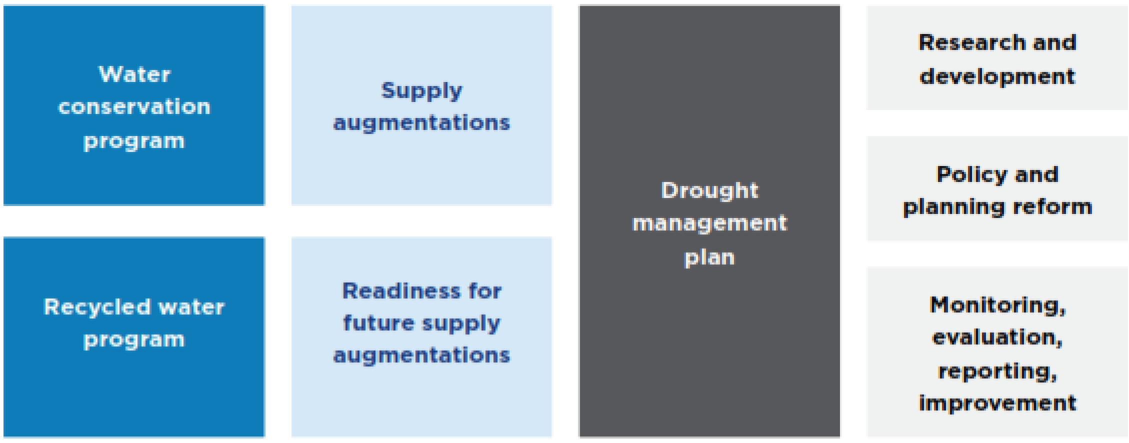

Figure 4: Components of Portfolios

A list of 9 preliminary portfolios was presented to the community in late 2020 / early 2021 as part of the Phase 3 engagement activities. These preliminary portfolios were representative of themes or broader option types, for example, portfolios focussed on demand side options, increasing storage (including new dams), and increasing climate-independent supplies (including desalination). Community feedback and insights and the results of technical analysis were used to refine the portfolios assessed.

The portfolio list was then expanded to 12 for the purposes of the Cost Benefit Analysis to consider the respective costs and benefits of a larger combination of different individual options (see Appendix A for a full description of these portfolios). However, there is a level of redundancy in some of these portfolios and a shortlist of portfolios was developed for final consideration. The shortlisted portfolios considered are:

- Portfolio C: Upper Chichester Dam, Upper Hunter transfers and Central Coast transfers
- Portfolio D: Staged Desalination
- Portfolio E: Limeburners Creek Dam, Upper Hunter transfers and Central Coast transfers
- Portfolio F: Purified Recycled Water for Drinking
- Portfolio G: Accelerated Belmont Desalination, Upper Hunter connection and PRW

- Portfolio H: Larger desalination plant at Walsh Point
- Portfolio L: Upper Hunter transfers, Central Coast transfers and Belmont Desalination

The portfolio descriptions only include the major supply and demand investments and are not a complete representation of all actions. As described earlier, each portfolio also includes drought response actions (known as a drought management plan, or DMP), programs of water conservation measures and recycled water and stormwater harvesting measures for non-drinking. Four different investment programs were developed for water conservation and three investment programs were prepared for water recycling.

4. PORTFOLIO ANALYSIS

Portfolio analysis included inputs from hydrological modelling, engineering analysis, demand forecasting and water use behavioural assessment. Key inputs and measures for the analysis are included in Appendix B.

The key tools used for portfolios analysis were:

- a detailed CBA which captures the monetised economic, social, and environmental impacts of investment options on the welfare of the NSW community
- a qualitative/non-monetary assessment of a range of social and environmental impacts (including community support)

The methodology and results for both the CBA and qualitative assessment are described below.

4.1. Cost Benefit Analysis (monetised assessment)

4.1.1. Cost-benefit analysis is a key tool for informing a decision

Hunter Water engaged Frontier Economics to undertake the CBA in line with best practice guidelines.[1,2] The LHWSP CBA helps answer the following key questions:

- What portfolio of actions for providing water security to the Lower Hunter generates the highest net benefit to the NSW community?
- How robust is each portfolio to uncertainty, and what level of flexibility do they provide?

Supporting the CBA, Frontier Economics undertook funding and distributional analysis to identify potential cost recovery pathways for the investments and to understand how costs and benefits may ultimately be distributed across groups within the NSW community.

4.1.2. The Net Present Value measures the quantified net benefits to the community

To measure community-wide impacts, CBA uses opportunity costs or ‘real resource’ values rather than the financial cash flows between parties.[3] Future costs and benefits are discounted using a social discount rate to provide their ‘present value’ (PV). The CBA calculates the net societal benefit by summing the monetised benefits minus the monetised costs (net present value).

The net present value (NPV) is the key output from a CBA to help inform a decision. It is referred to as an Expected NPV (ENPV) in the LHWSP CBA because the results reflect an average, or expected, result based on the probabilistic hydrological modelling that underpinned the analyses.

The CBA assesses the costs and benefits over the 40-year life of the LHWSP.

4.1.3. The CBA captures complex interdependencies about decisions within the Lower Hunter and the broader region

The CBA draws on outputs from Hunter Water’s in-house hydrological model and a separate CBA model developed for the Central Coast’s Water Security Plan (CCWSP).

The CBA integrates two important elements of water resource planning:

- Ensuring the water supply system can provide enough water over the long-term to meet average demands with defined levels of service. That is, long-term average reliable supply of water is greater than the demand for water. We refer to this as the supply-demand balance.
- The ability to manage and respond to drought conditions.

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[1] NSW Government, Guide to Cost-Benefit Analysis, (TPP17-03), March 2017

[2] Infrastructure NSW & NSW Treasury, *Guidelines for Resilience in Infrastructure Planning: Natural Hazards,* August 2019

[3] For example, the economic evaluation focuses on the opportunity cost of any land required for infrastructure, rather than simply including the purchase price of land.

Integration of these elements in the CBA allows proper evaluation of options that simultaneously manage drought and the long-term supply-demand balance. In the CBA, investments in additional supply capacity can occur for either of these two reasons.

For the purpose of the portfolio analysis, the reliability of each option is a function of the yield that it adds to the supply system. Its yield then determines the timing of the next augmentation such that the upfront cost of that option and the deferred costs of subsequent augmentations are assessed together within the cost benefit analysis.

Once implemented, options with a high yield also reduce the risk of reaching drought triggers, with associated benefits of avoided major drought investment as well as the cost to society of time spent in water restrictions. Both of these benefits have been costed and are included in the CBA.

If investments are made as a drought response, they can then be used to respond to future droughts and to meet long-term demand growth, deferring the need for other previously planned investments. Similarly, investments triggered by the need to meet long-term growth in demand provide the water supply system with additional capability to supply water during a drought. Planning separately for drought and long-term growth could potentially lead to inefficient decisions.

The CBA also accounts for potential impacts across the Lower Hunter, Upper Hunter, and Central Coast. Due to existing or potential connectivity between these regions, decisions in one system can affect the optimal timing, size, and value of investments in adjacent systems.

We undertook extensive sensitivity, scenario, and adaptive pathway analysis to explore key questions and understand how robust the portfolio CBA results are to a variety of risks and uncertainties.

4.1.4. The development and evaluation of portfolios of water supply and demand measures is iterative

Consistent with NSW Treasury CBA guidelines, there are six main steps in the LHWSP CBA process (see Figure 5):

1. Defining objectives, or levels of service, that all portfolios must achieve
2. Identifying an appropriate base case and other portfolios (or sets) of measures that achieve the objectives. The portfolios contain measures to increase water supply and to manage water demand
3. Identifying, quantifying and monetising (where appropriate and practical) the range of economic, social and environmental costs and benefits of the portfolios
4. Evaluating the incremental costs and benefits of each portfolio, relative to the base case
5. Using sensitivity and adaptive pathways to assess the resilience of portfolios to risks and uncertainties
6. Identifying the portfolio or pathway that generates the largest net benefit to society.

We used an iterative approach to help systematically explore the very large solution space, and progressively work toward identifying the portfolios that provide the highest societal net benefits.

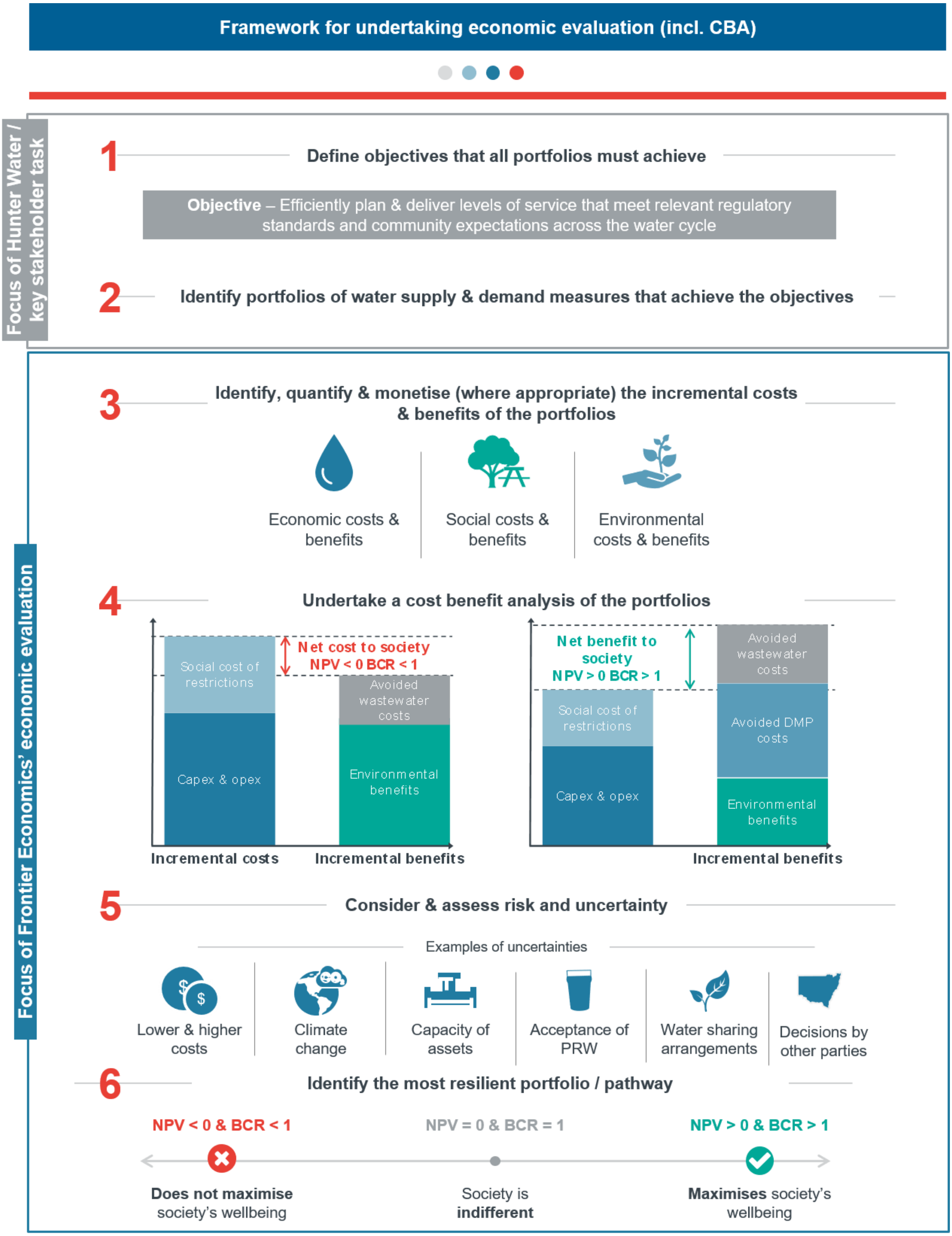

Figure 5: Overview of the approach to economic evaluation

Source: Frontier Economics

4.1.5. The portfolios contain a variety of build and non-build water supply and demand measures to meet long-term growth and respond to drought conditions

In addition to the portfolios described in Section 2.2, several potential recycling schemes and water conservation measures were considered. To understand the broad drivers of value across these investments, the CBA consolidated the measures into programs – three recycled water programs, and four water conservation programs.

We evaluated the base water supply portfolios with each of the 12 combinations of recycled water and water conservation programs. As described in Section 2.2, this report presents the results for a final shortlist of seven distinct portfolios, which includes the preferred recycled water and water conservation programs.

4.1.6. We evaluated the costs and benefits of portfolios in meeting the objectives, incremental to a base case

In CBA, costs and benefits of a proposed course of action are assessed relative to a base case, in order to understand differences in the state of the world *with* and *without* the proposal. An incremental cost exists where a portfolio has a higher cost (or lower benefit) than the base case. An incremental benefit exists where a proposal has a lower cost (or higher benefit) than the base case.

Hunter Water does not have an agreed or existing preferred long-term supply augmentation. As such, there is no natural "Business As Usual" (BAU) way of achieving the LHWSP objectives that would make an obvious base case to use for comparing alternative portfolios. A staged desalination portfolio (Portfolio D) was determined to be suitable because it is a common supply option delivered in other Australian jurisdictions and internationally. This choice of base case does not reflect an existing position by Hunter Water or other stakeholders of a potential future supply augmentation, nor does it influence the relative ranking or merit of the evaluated portfolios.

4.1.7. The portfolios deliver a range of outcomes and costs and benefits

While all portfolios of water supply and demand measures are designed to meet the water supply objectives of the LHWSP over time, there are material differences in the outcomes delivered by each portfolios:

- The yield benefit provided by each supply augmentation
- The timing of supply augmentations
- The likelihood of triggering design or construction of desalination capacity as part of a DMP
- Time spent in water restrictions
- The likelihood of insufficient water supply during a drought (supply shortfall)
- The yield provided to the Central Coast Council's water supply system
- The 'footprint' of land required. This land could otherwise contain biodiversity or be used for farming or industrial purposes
- The delivery costs of various options and any consequent costs required, or avoided, in the water and wastewater supply systems.

Differences in these outcomes drive many of the costs and benefits that are valued in the CBA. Figure 6 provides a summary of the included costs and benefits. We monetised these costs and benefits where practical and appropriate, and considered other impacts quantitatively or qualitatively.

Frontier Economics used recognised methodologies to value each of the costs and benefits in accordance with best practices principles.

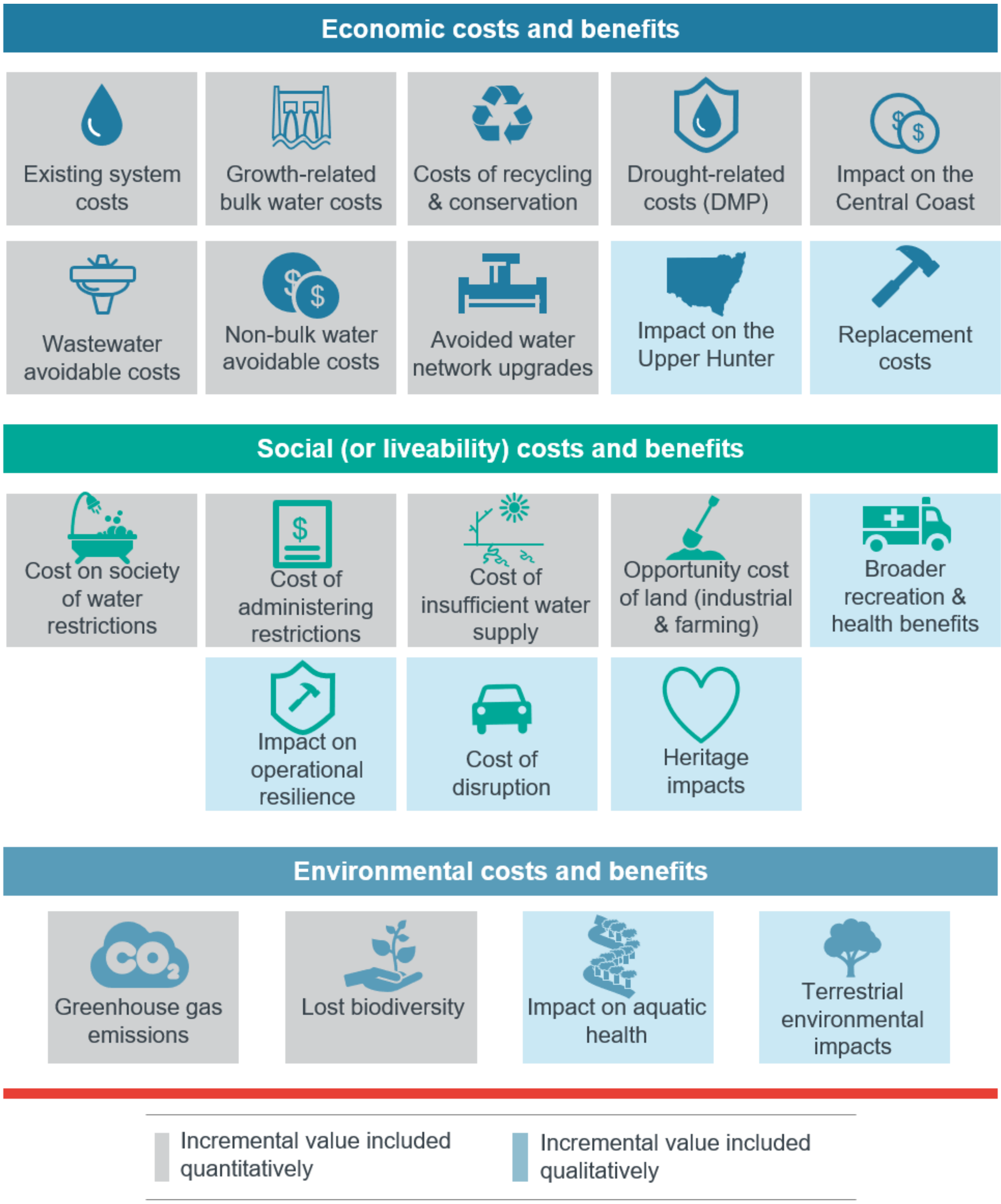

Figure 6: Costs and Benefits included in the CBA

Source: Frontier economics

4.1.8. Portfolio G (Belmont desalination, Upper Hunter connection, and later PRW) provides the largest net benefit to the NSW community

CBA results for the final seven portfolios are shown in Figure 7. Note that the results for each of the portfolios are all shown relative to Portfolio D (base case), hence why this portfolio isn't shown. A value in the cost column for a portfolio indicates that the listed component was higher cost (or lower benefit) than the base case. A value in the benefit column indicates that the component was lower cost (or higher benefit) than the base case.

Where no cost is shown for a component, it does not mean that the cost is necessarily zero, rather the cost component is the same as in the base case (i.e. the incremental value is zero). The ENPV of Portfolio D is by definition zero as all portfolios are compared incrementally to this base case. The non-incremental ENPV of the portfolios is in the order of $700million to $1billion.

We estimate that Portfolio G generates the highest net benefit to the NSW community of $112m. Comparatively lower capital investment in growth-driven supply augmentations and lower likelihood of triggering investment in a drought-response desalination plant drive the majority of this benefit. This portfolio has slightly higher operating costs due to the operation of a PRW scheme from the mid-2040s that we have assumed would operate at maximum capacity, as it is multifunctional and simultaneously meeting objectives relating to water supply and wastewater systems.

In general, the CBA results favour inter-regional transfers, smaller desalination plants, and PRW as preferred supply augmentations. Portfolios with new dams are not favoured due to the high costs of construction, and high social and environmental impacts. These results align well with results from the qualitative assessment as discussed in Section 3.2.

Several of the portfolios containing a series of smaller options that make use of existing infrastructure, such as inter-regional transfers, performed better than portfolios with significant large upfront investment, such as new dam options. This is because the monetised benefits of lower or deferred infrastructure costs typically outweigh the water security benefits provided by portfolios/actions that provided considerable headroom – i.e. where the new reliable supply capacity substantially exceeded demand.

The benefit accruing to the Central Coast community of each portfolio is considerably different. Portfolios, that involve expanding Mangrove Creek Dam or increasing the transfer capacity between the Lower Hunter and Central Coast (such as Portfolio L), provide the largest benefit to the Central Coast. The benefits presented reflect the yield benefits generated under the existing water sharing agreement between the regions.

The Belmont desalination plant is the preferred desalination option for supply capacities up 30 ML/day. Beyond this capacity, the preferred site is Walsh Point. Further work is required to determine the optimal operating rules for a desalination plant in the Lower Hunter.

Increased water conservation investment beyond our current level can reduce the risk and cost of triggering DMP investments and can defer later growth investments. However, the costs of some conservation activities may outweigh the benefits. Further work is required to assess the cost-effectiveness of specific water conservation activities on a case-by-case basis using established frameworks.[4]

A number of industrial recycled water and integrated water management schemes (including stormwater harvesting and groundwater extraction) perform well in economic modelling and could be progressed as part of a least cost servicing approach. An expanded recycled water irrigation scheme for parks and sporting fields is less cost effective, but can offer broader societal and environmental benefits. Additional dual reticulation schemes assessed are generally not cost effective compared to other supply options. PRW is generally more cost effective than non-drinking recycled water schemes.

[4] For example, the Economic Level of Water Conservation (ELWC) methodology embedded in Hunter Water's Operating Licence.

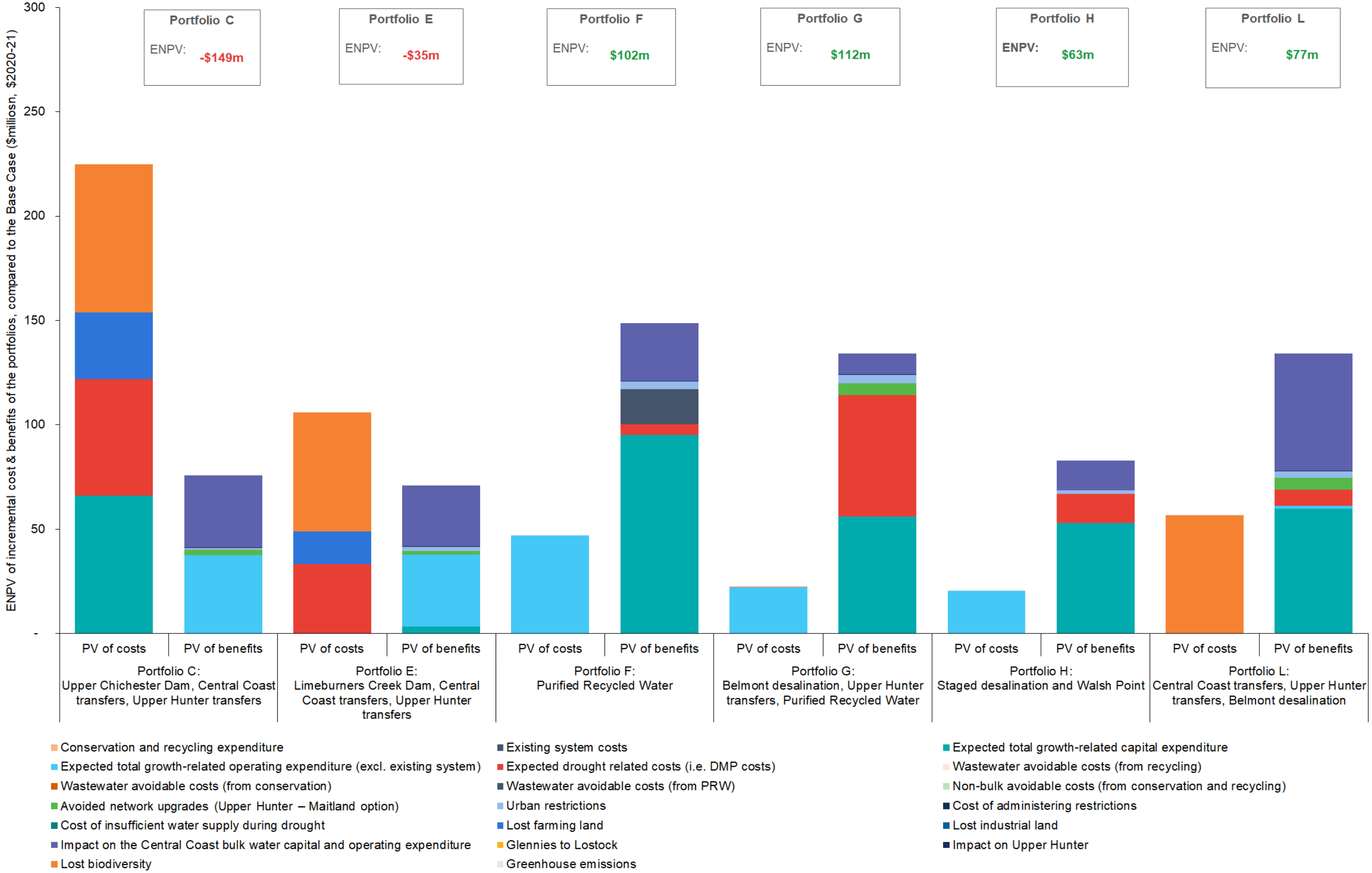

Figure 7 – Cost Benefit Analysis Results

4.1.9. Portfolio G is resilient to a range of risks and uncertainties

We undertook extensive sensitivity, scenario, and adaptive pathways analysis to ensure that the proposed course of action is robust to key uncertainties around the inputs and assumptions used in the CBA model, and about what may happen in the future. We completed over 100 sensitivity and scenario tests. Portfolio G was resilient to most uncertainties tested and provided one of the highest net benefits in most of these analyses.

The inputs and assumptions tested in sensitivity and scenario analysis included:

- Capital and operating costs of supply options
- Energy costs
- Avoided costs in the water and wastewater system
- Discount rate
- Forecast demand for water – reflecting uncertainty about population growth and industrial expansion
- Climate change – both drier and wetter climate futures
- Valuation of environmental costs and benefits
- Effectiveness of water conservation activities and recycled water investments (i.e. the quantity of potable water savings achieved)
- The water supply benefit provided by options
- The operating rules for desalination plants
- Social cost of water restrictions
- Value of additional water to the Central Coast Council water system.

A summary of the results of the sensitivity analysis is provided in Appendix C.

Notably, a drier climate in the future (climate change) can significantly bring forward the timing of augmentations required to reliably meet water demand in the Lower Hunter. Based on the modelling undertaken, this could increase the cost of some portfolios by up to $60m. Portfolio G was one of the best performing portfolios under a dry climate future – in general, the merit order of portfolios remained similar.

Quantitative adaptive pathways analysis (also known as real options analysis) showed that investment in the Belmont desalination plant may be considered a “no regrets” option, and that while there is some uncertainty about the Upper Hunter transfers option, this pathway can still provide a large net benefit to the community if pursued. We also used adaptive pathways analysis to better understand potential planning and approval risks relating to PRW and new dams.

Qualitative adaptive pathways work enabled us to map and investigate potential investment pathways at a more detailed level including phases of the asset delivery cycle including planning, approval, design and construction. This was useful for identifying key points where decisions were needed, to assess risks about locking into or out of various pathways, and also to consider flexibility and adaptation opportunities relating to the investments.

4.1.10. Portfolio G is also the least cost approach for delivering Hunter Water services

There is an established framework for funding the efficient costs of water supply measures through the Independent Pricing and Regulatory Tribunal (IPART)-regulated water and wastewater developer and periodic charges levied on Hunter Water customers. The efficient costs usually reflect the least cost means of delivering water and wastewater services to customers, while complying with all regulatory and service standard requirements (e.g. level of service and environmental regulatory requirements) – unless there is sufficient evidence that customers are willing to pay for services or outcomes higher than those mandated by regulation.

The least cost approach for Hunter Water to deliver its services and meet its regulatory requirements can be, but is not necessarily, the socially optimal outcome from an economic perspective. That is, the approach that provides the greatest net benefit to the NSW community as a whole.

To determine which portfolio represents the least cost approach, we narrow the perspective of analysis to consider only the costs and benefits borne by Hunter Water in delivering its services to required standards and complying with its regulatory requirements, rather than the costs and benefits to the NSW community as a whole. This means the analysis includes financial costs rather than economic costs. For example, instead of valuing biodiversity based on the community's estimated willingness to pay, we value it based on the financial costs that Hunter Water would potentially incur to participate in mandatory biodiversity offset (or credit) schemes.

The figure below contains the results of the portfolio analysis under this 'least cost' perspective. A green bar above the line illustrates a cost saving compared to the Base Case, and a red bar below the line illustrates an additional cost compared to the Base Case.

The results show that in this case, the portfolio that we consider to be the least-cost portfolio (Portfolio G) for delivering our services is also the portfolio that we consider provides the highest net benefit to the NSW community as a whole. This demonstrates that there is a clear path for funding the efficient costs of the recommended portfolio.

To secure funding for the portfolio of measures through IPART-regulated prices, Hunter Water will need to demonstrate to IPART that individual projects are efficient. This requires individual projects be supported by a robust business case, to be consistent with Hunter Water's long-term investment plan (including the LHWSP), and to be delivered efficiently.

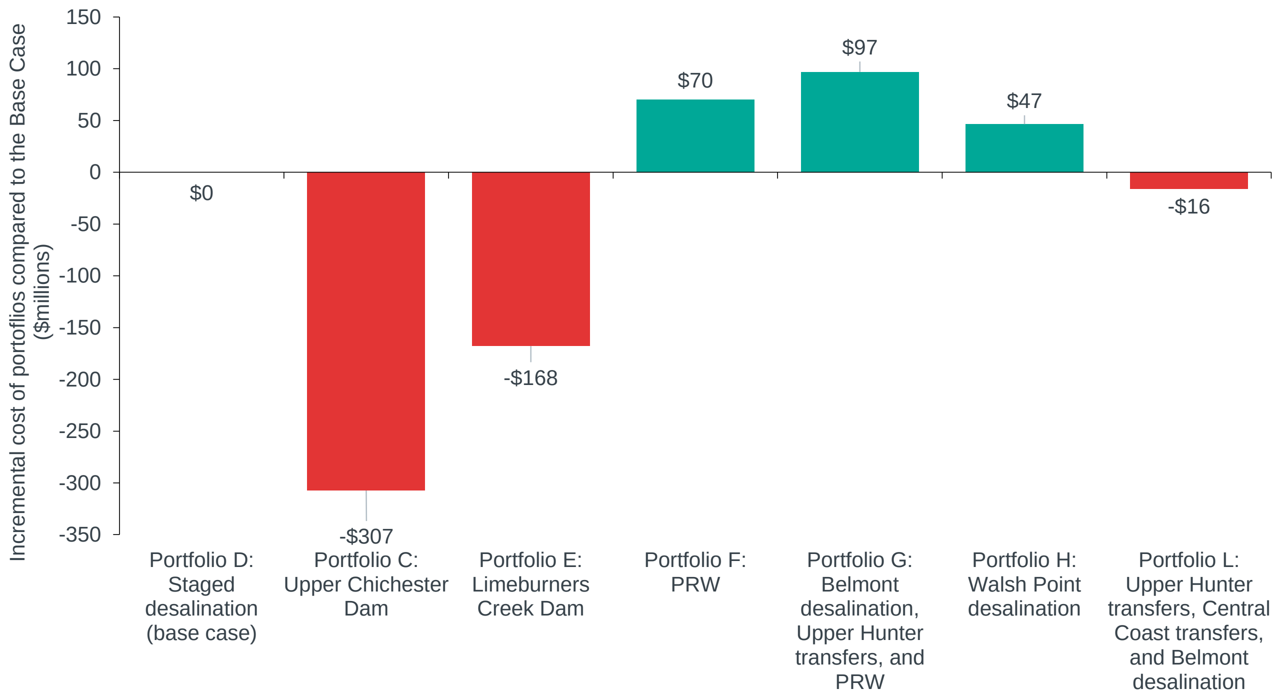

Figure 8 – Least cost analysis results

4.2 Non-monetary and qualitative assessment

4.2.1. Approach

An assessment of social and environmental benefits and impacts was considered alongside the CBA results and community views in decision making.

The qualitative assessment focused on the measures under Objectives 3, 4 and 5 as described in Section 1.2. A summary of the basis of the qualitative assessment and information sources is provided below.

Table 2: LHWSP Objective 3 – Basis of assessment

Measure	Basis for assessment
Objective 3: Protect and restore our ecosystems and biodiversity values	
Terrestrial ecology: impacted land area and threatened species potentially impacted	• Outcomes of desktop and field ecological assessments for new dam options undertaken by consultants. • Environmental Impact Statement completed for the Belmont Desalination Plant. • For most options, pipelines and treatment plants assumed to be constructed on disturbed land and/or impacts offset. • New dam options would impact local terrestrial ecology. In line with the community's priority for an environmentally sustainable water supply, portfolios with new dams have been assessed on the basis that additional ecological offsets beyond legislative requirements would be delivered.
Aquatic ecology: Impacted stream length and aquatic species	• Outcomes of desktop and field ecological assessments for new dam options undertaken by consultants. • Brine discharges from the Belmont desalination plant assessed through marine modelling. • Assessment of the impacts of reduced wastewater discharges to the Lower Hunter estuary for PRW options. • New dam options would impact local aquatic ecology. In line with the community's priority for an environmentally sustainable water supply, portfolios with new dams have been assessed on the basis that additional ecological offsets beyond legislative requirements would be delivered.
Greenhouse Gas Emissions: Scope 2 and 3 emissions	• Scope 2 emissions (energy usage) estimated based on assumed operating rules. • Scope 3 emissions estimated based on embedded energy in construction materials based on calculated volumes and unit rates from literature for a range of asset classes. • In line with the community's priority for environmentally sustainable water supply, portfolios with desalination have been assessed on the basis that emissions relating from energy use would be reduced through the purchase of renewable energy or carbon offsets.
Non-renewable resource consumption and water consumption	• Estimate of the material consumed and the freshwater extracted for drinking for construction and operation. Includes sourcing raw materials for construction of dam walls, pipelines and plant infrastructure.

Table 3: LHWSP Objective 4 – Basis of assessment

Measure	Basis for assessment
Objective 4: Promote everyone's health and wellbeing	
Community Support	• Survey responses rating support for options (Phase 2) and preliminary portfolios (Phase 3). The portfolios were refined following the preliminary portfolios presented in the Phase 3 community survey and a judgement was made on the most representative results for portfolio analysis.
Heritage and cultural impacts	• Outcomes of desktop heritage assessments undertaken by consultants. • Literature review on historical and current Aboriginal values around water, and insights from engagement with representatives of the local Aboriginal community on their viewpoints and values. • Environmental Impact Statement completed for the Belmont Desalination Plant. • For most options, pipelines and plants assumed to be constructed on disturbed land.
Direct Impacts on the Community	• Community feedback on options and portfolios. • The number of properties impacted or displaced for new dam options and feedback from consultation with impacted landowners.

Table 4: LHWSP Objective 5 – Basis of assessment

Measure	Basis for assessment
Objective 5: Provide an adaptive and robust system	
Adaptability:	• Assessment of how the option defers the need for larger more expensive options while also keeping future options open. • Adaptive pathways analysis of the options' performance in providing future adaptability and flexibility to respond to changes in future conditions.
Operational resilience: Diversity and robustness	• The additional supply provided by a new source that is independent of the existing bulk water supply system.

4.2.2. Results

The results of the non-monetary and qualitative assessment are described below for each objective. A colour coded table representing the results for individual options is shown in Figure 8 and the shortlisted portfolios are shown in Figure 9.

Objective 3: Protect and restore our ecosystems and biodiversity values

All new dam options were assessed as having high value biodiversity habitat. New dam options generally have higher potential environmental impacts compared to other options due to inundation of land and changes to stream flows. An expansion of Mangrove Creek Dam would also have potential impacts although they would likely be less significant than impacts of a new dam.

PRW and water conservation have positive environmental benefits due to reduced freshwater extraction and reduced wastewater discharges to waterways. Recycled water for non-drinking has similar benefits but on a smaller scale.

All infrastructure options would result in a net increase in greenhouse gas emissions and the consumption of non-renewable resources. When considering both embedded energy in construction materials and energy use during operation, the best performing option is water conservation.

Based on the location of Limeburners Creek Dam and its surrounding geology, the dam wall would likely be constructed using locally sourced quarried rock, which has lower embedded energy compared to concrete dam construction as proposed for Upper Chichester. Both new dams would have very low operational energy requirements.

Desalination is a high energy consuming water supply option. The greenhouse gas emissions associated with energy use could be offset through the supply of renewable energy or purchasing carbon offsets for this option.

Water transfers with the Upper Hunter perform well overall with low impacts to ecosystems and biodiversity based on the assumption that pipelines and treatment plants would be generally be constructed along already disturbed corridors or impacts offset. However, the option has moderate to high energy requirements and associated greenhouse gas emissions.

Objective 4: Promote everyone's health and wellbeing

All options and preliminary portfolios are broadly supported by our community based on feedback from communication engagement activities (all above 60% support). Water conservation and recycled water for non-drinking have the highest level of community support. New dam portfolios have slightly lower support (and a higher level of opposition) than other options.

The importance to First Nations/Aboriginal peoples of using water responsibly supports a continued focus on water conservation and recycled water, and making the most of existing water resources, particularly before investing in new infrastructure.

New dam options and the Mangrove Creek Dam expansion have potential heritage and cultural impacts as these areas would likely have been occupied in the past by First Nations/Aboriginal peoples. Other options have low or negligible heritage or cultural impacts.

New dam options would have direct impacts on the community as local residents would be displaced due to land becoming inundated or inaccessible.

All infrastructure options would generally have short term impacts on local communities associated with construction activities.

Objective 5: Provide an adaptive and robust system

Dams store a large volume of water that extend the system's ability to withstand drought but they rely on rainfall and don't ensure an ongoing supply of water in a long and severe drought.

Compared to alternative options, the two new dams assessed have longer lead-times to plan, construct and fill and carry an elevated risk of triggering expensive drought response infrastructure in the interim.

Water conservation and incremental supply options provide the most future flexibility to adapt to changing conditions. Inter-regional water transfers improve the resilience of the water supply system, by providing a water source from outside of the existing system. They also defer the need for larger more expensive options while keeping future options open.

Desalination adds significant adaptability as a rainfall-independent source with flexible operation that can be ramped up and down over time as required. It is also most suitable to completing readiness activity upfront so that construction of expensive infrastructure can be delivered in response to drought.

Desalination provides significant operational resilience in the case of a drought or operational event, independent of Hunter Water's existing bulk water supply system.

Upper Hunter transfers also provide significant operational resilience benefits, if connected directly to the water supply system in Maitland.

PRW provides a water source that doesn't rely on rainfall (except in extreme droughts) but it is assumed to be treated through the Grahamstown Water Treatment Plant and is therefore not independent of Hunter Water's bulk water supply system.

Criteria	Measure	SUPPLY OPTIONS						DEMAND OPTIONS	
		Increased Central Coast transfers, Mangrove Creek Dam augmentation	Upper Hunter connection	Upper Chichester Dam	Limeburners Creek Dam	Desalination	Purified Recycled Water for Drinking	Recycled Water for non-drinking	Water Conservation
Goal: Protect and restore our ecosystem and biodiversity values									
Terrestrial ecology	Impacted land area, threatened species	Inundatation of 1-2 km^2 of land with high biodiversity value	Negligible	Inundation of 10 km^2 of land with high biodiversity value	Inundation of 8 km^2 of land with high biodiversity value	Negligible	Negligible	Negligible	Nil
Aquatic ecology	Impacted stream length	Negligible assuming no change to environmental flows	Changes to stream hydrology downstream of Lostock Dam	New innundation area. Reduced downstream flows.	New innundation area. Reduced downstream flows.	Negligible	Positive benefit due to avoided wastewater discharges	Small positive benefit of reduced wastewater discharges	Small positive benefit of reduced wastewater discharges
Greenhouse gas emissions	Scope 2 (operation) & Scope 3 (construction) tonnes CO2	High due to pumping	High due to pumping	High embedded energy in dam wall construction.	Low embedded energy in dam construction. Low operational energy	Medium embedded energy. Operational energy offset	Medium embedded energy in plant construction and operational energy	Medium embedded energy in plant construction and operational energy	Negligible
Non-renewable resource consumption	Qualitative assessment	Raw materials for construction; Ongoing freshwater extraction	Raw materials for construction; Ongoing freshwater extraction	Large volume of raw materials for construction. Ongoing freshwater extraction	Large volume of raw materials for construction. Ongoing freshwater extraction	Raw materials for construction. Reduction in freshwater extraction	Raw materials for construction. Reduction in freshwater extraction	Raw materials for construction. Reduction in freshwater extraction	Reduction in freshwater extraction
Goal: Promote everyone's health and wellbeing									
Community support	Survey responses indicating support	around 70%	around 70%	60-70%	60-70%	60-70%	70-80%	around 90%	around 90%
Heritage impacts	Qualitative assessment	Possible cultural heritage impacts from dam expansion	Negligible	Possible cultural heritage impacts from dam expansion	Possible cultural heritage impacts from dam expansion	Negligible	Negligible	Negligible	Nil
Direct impacts on the community	Impacted land owners	Construction phase impacts	Construction phase impacts	Displacement of local landowners	Displacement of local landowners	Construction phase impacts	Construction phase impacts	Construction phase impacts	Nil
Goal: Provide an Adaptive & Robust System									
Adaptability	Qualitiative based on adaptive pathways analysis	Incremental, does not limit future options	Incremental, does not limit future options	Long lead time, large up front investment, low adaptability	Long lead time, large up front investment, low adaptability	Incremental, does not limit future options	Requires other options delivered up front	Incremental, does not limit future options	Program is adaptable, does not limit future options
Operational resilience	Additional daily bulk supply from new sources	30 Ml/d	Additional 50 ML/d	Nil	Nil	Up to 105 ML/d	Nil (supply into dam)	<5 ML/d	N/A

LEGEND: Negative | Somewhat negative | Neutral | Somewhat positive | Positive

Figure 9: Qualitative Analysis Results – Options

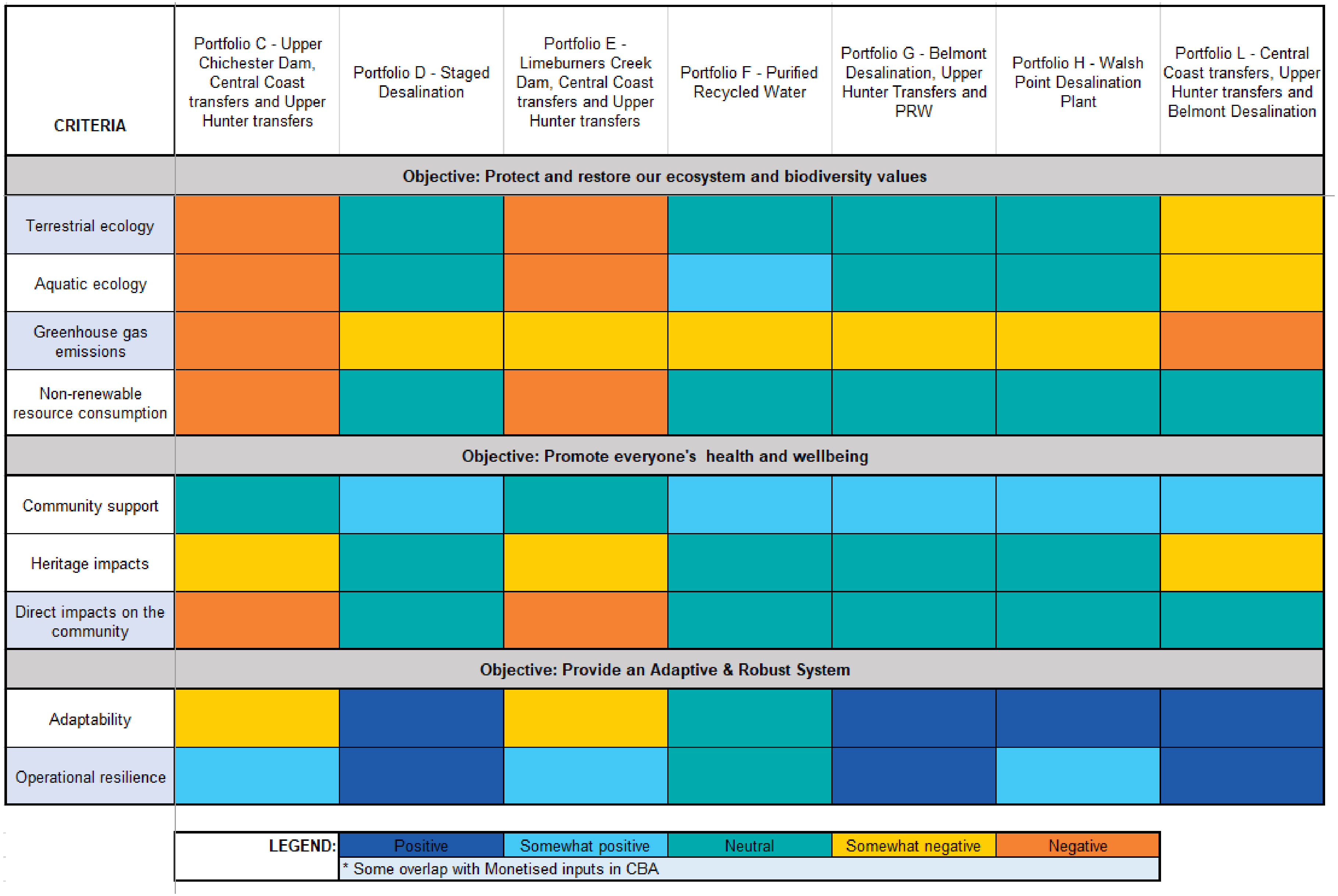

Figure 10: Qualitative Analysis Results – Portfolios

5. Preferred Portfolio

The outcomes of the CBA and qualitative assessment were found to be closely aligned and the results were found to be robust to a range of conditions. The preferred portfolio is Portfolio G, which includes:

- Increased investment in water conservation to support our customers and community to reduce water consumption by up to 17% over the next ten years (compared to 2018 levels).
- Continued investment in leakage to achieve a target of 50 litres per connection per day over the next five years.
- Increase recycled water for non-drinking by up to 1.3 billion litres per year through new and expanding industrial and public open space recycling schemes.
- Delivery of a permanent 30 ML/day desalination plant at Belmont.
- Progress a Hunter Water connection to the Upper Hunter through the proposed Glennies-Lostock scheme.
- Community engagement on PRW as a potential future water supply option and building a PRW demonstration plant.
- Readiness activities for a drought response desalination plant at Walsh Point.

The key considerations in the selection of the preferred portfolio are summarised below.

- The infrastructure mix and sequencing included in this portfolio is the most favourable portfolio from a societal (CBA) and Hunter Water (least cost) perspective. The results of economic modelling are robust to a range of conditions.
- The portfolio includes upfront investment in rainfall-independent supply and reduces the gap to our target enduring supply.
- Belmont desalination plant is a cost-effective supply option and has the shortest lead time to reduce short-term drought risks.
- The portfolio improves regional resilience through water sharing through the connection to the Upper Hunter.
- Purified recycled water for drinking is a reliable and cost-effective supply option and early community feedback is supportive of exploring this as a future supply option.
- The portfolio increases the diversity and resilience of our water system.
- The portfolio is adaptable. The future is uncertain and an incremental investment approach will allow us to adapt and respond to future risks and opportunities, compared to single, large up-front investments that may lock us into less flexible solutions.
- The two dams assessed are not favoured from an economic or financial analysis, or based on their potential social and environmental impacts, and have long lead-times to plan, construct and fill and carry an elevated risk of triggering expensive drought response infrastructure in the interim.
- Economic modelling shows that the investments in water conservation and recycling reduce the risk and cost of triggering DMP investments and can also defer later growth investments.
- Water conservation has strong community and stakeholder support, is highly adaptable to changing conditions, but contains a high degree of uncertainty in terms of up-take rates and effectiveness. The water conservation program is based on building on the behaviour change and efficiency gains achieved in the recent drought.
- Recycled water for non-drinking is also highly supported by the community, but investments are often challenging to implement due to affordability constraints. The recycled water supply program is based on building on existing industrial recycling and public open space irrigation programs.
- The water conservation and recycled water programs balance affordability constraints and community and stakeholder expectations for a strong continued focus in these areas.

APPENDIX A: LIST OF THE 12 PORTFOLIOS ASSESSED IN COST-BENEFIT ANALYSIS

Portfolio	Supply-side measures delivered over time
Portfolio A Upper Hunter transfers, Central Coast transfers, and PRW	• Hunter Water connection to the Glennies-Lostock scheme (Upper Hunter transfers) • Augment HWC-CCC transfer pipeline to 60 ML/day and expand Mangrove Creek Dam • Purified Recycled Water (30 ML/day) • Purified Recycled Water (45 ML/day)
Portfolio B Upper Hunter transfers, Central Coast transfers, and staged desalination	• Hunter Water connection to the Glennies-Lostock scheme (Upper Hunter transfers) • Augment HWC-CCC transfer pipeline to 60 ML/day and expand Mangrove Creek Dam • Walsh Point Desal (30ML/day) with headworks capacity for 105ML/day • Expansion of Walsh Point desal to 60 ML/day with headworks capacity for 105ML/day
Portfolio C Upper Chichester Dam, Upper Hunter transfers and Central Coast transfers	• New dam at Upper Chichester (230GL) • Hunter Water connection to the Glennies-Lostock scheme (Upper Hunter transfers) • Augment HWC-CCC transfer pipeline to 60 ML/day and expand Mangrove Creek Dam
Portfolio D Staged desalination (Base Case)	• Walsh Point Desal (30ML/day) with headworks capacity for 105ML/day • Expansion of Walsh Point desal to 60 ML/day with headworks capacity for 105 ML/day • New 30ML/day desal plant
Portfolio E Limeburners Creek Dam, Central Coast transfers, Upper Hunter transfers	• New dam at Limeburners Creek (160 GL) • Hunter Water connection to the Glennies-Lostock scheme (Upper Hunter transfers) • Augment HWC-CCC transfer pipeline to 60 ML/day and expand Mangrove Creek Dam
Portfolio F Purified Recycled Water	• Purified Recycled Water (30 ML/day) • Purified Recycled Water (45 ML/day) • New 30 ML/day desal plant
Portfolio G Belmont desalination, Upper Hunter transfers and PRW	• Accelerated delivery of Belmont desal (30 ML/day) • Hunter Water connection to the Glennies-Lostock scheme (Upper Hunter transfers) • Purified Recycled Water (30 ML/day) • Purified Recycled Water (45 ML/day)
Portfolio H Larger desalination plant at Walsh Point	• Walsh Point Desal (60 ML/day) • Purified Recycled Water (30 ML/day) • Purified Recycled Water (45 ML/day)
Portfolio I Upper Hunter transfers and staged desalination	• Hunter Water connection to the Glennies-Lostock scheme (Upper Hunter transfers) • Walsh Point Desal (30 ML/day) with headworks capacity for 105 ML/day • Expansion of Walsh Point desal to 60 ML/day with headworks capacity for 105 ML/day
Portfolio J	• Belmont desalination (30ML/day)

Portfolio	Supply-side measures delivered over time
Belmont Desalination, Upper Hunter Transfers, and PRW	• Hunter Water connection to the Glennies-Lostock scheme (Upper Hunter transfers) • Purified Recycled Water (30 ML/day) • Purified Recycled Water (45 ML/day)
Portfolio K Belmont Desalination, Upper Hunter transfers, Central Coast transfers and PRW	• Belmont desalination (30ML/day) • Hunter Water connection to the Glennies-Lostock scheme (Upper Hunter transfers) • Augment HWC-CCC transfer pipeline to 60ML/day and expand Mangrove Creek Dam • Purified Recycled Water (30 ML/day) • Purified Recycled Water (45 ML/day)
Portfolio L Upper Hunter transfers and Belmont desalination	• Hunter Water connection to the Glennies-Lostock scheme (Upper Hunter transfers) • Augment HWC-CCC transfer pipeline to 60ML/day and expand Mangrove Creek Dam • Belmont desalination (30ML/day) • Purified Recycled Water (45 ML/day)

APPENDIX B: PORTFOLIO ANALYSIS INPUTS AND MEASURES

Monetised inputs in CBA

Category	Cost or benefit
Economic	• Capital and operating costs of supply augmentations, water conservation and water recycling. • Capital and operating cost savings in other parts of Hunter Water system (including wastewater impacts). • Costs in other utility's systems (eg costs to Central Coast Council and Upper Hunter) • Capital and operating cost of drought-related expenditure (including likelihood of triggering investment and the resulting impact on 'growth investments) • Opportunity cost of land (farming, industrial)
Social	• Cost to society of water restrictions • Cost to society of running out of water (not meeting minimum customer demand)
Environmental	• Global/local impact of greenhouse gas emissions • Opportunity cost of land (terrestrial biodiversity impacts in inudation areas)

Not monetised: waterway health, other liveability benefits (e.g. reduced risk of inactivity-related diseases), cost of water quality issues, system resilience.

Qualitative and non-monetary measures

Category	Cost or benefit
Social	• Community support • Direct impacts on the community • Heritage and cultural impacts
Environmental	• Impacts on terrestrial ecology • Impacts on acquatic ecology • Greenhouse gas emissions • Non-renewable resource consumption
Resilience	• Adaptability • Resilience

APPENDIX C: SUMMARY OF COST-BENEFIT SENSITIVITY ANALYSIS

Extensive sensitivity and scenario analysis was undertaken to better understand how portfolios perform under different possible futures and how much our assumptions must change to effect the relative ranking of portfolios. In several cases, the assumptions tested were well beyond a plausible range of uncertainty, to help understand how sensitive the results are to specific variables.

Each row in the results chart below highlights the Net Present Value (NPV) incremental to the base case under the stated sensitivity or scenario. The gradient highlighting across a given row provides a visual indication of the rank order of the portfolios under that sensitivity/scenario. Not all sensitivity analyses are presented below.

Sensitivity/scenario	Portfolio D: Staged desalination	Portfolio C: Upper Chichester Dam	Portfolio E: Limeburners Creek Dam	Portfolio F: Purified Recycled Water	Portfolio G: Belmont desalination, Upper Hunter transfers and PRW	Portfolio H: Walsh Point desalination	Portfolio L: Upper Hunter transfers, Central Coast transfers, Belmont desalination	Why look at this? / What question does it seek to answer?
Central case	0	(149)	(35)	102	112	63	77	Central case - reflects Hunter Water's best input assumptions
Discount rate:								
3%	0	62	160	120	163	79	185	Low discount rate sensitivity recommended by NSW Treasury
4.2%	0	(34)	73	115	144	73	138	Estimate of Hunter Water's weighted average cost of capital (WACC)
10%	0	(188)	(77)	88	89	53	51	High discount rate sensitivity recommended by NSW Treasury
Demand forecast								
Lower population and industry growth	0	(230)	(143)	87	106	57	119	What if growth in water demand is much lower than forecast?
Low population growth	0	(163)	(49)	89	101	54	93	What if growth in water demand is lower than forecast?
High population growth	0	(138)	(37)	114	118	65	70	What if growth in water demand is higher than forecast?
Higher population and industry growth	0	(151)	(55)	120	110	67	53	What if growth in water demand is much higher than forecast?
Climate change								
Drier climate	0	(105)	(14)	180	139	94	42	What if future climate is drier than assumed?
Wetter climate	0	(154)	(51)	79	170	57	67	What if future climate is wetter than assumed?
Restriction triggers								
Lower restriction triggers	0	(131)	(24)	121	112	64	65	What is the best portfolio if we lower the triggers for water restrictions by 10%?
Capex:								
All low (-33%)	0	(109)	(24)	71	80	41	58	What if capital costs are lower than expected due to market, site or other conditions?
All high +25%	0	(180)	(44)	123	135	79	91	What if capital costs are higher than expected due to market, site or other conditions?
PRW higher +25%	0	(149)	(35)	17	103	56	72	PRW looks favourable in terms of cost, what if it is more expensive than anticipated?
New dams lower (-33%)	0	15	104	102	112	63	77	What if construction costs of dams are lower than anticipated?
UH transfers higher +25%	0	(150)	(37)	102	81	63	40	What if this key option costs more than anticipated?
UH transfers higher +50%	0	(151)	(39)	102	51	63	4	What if this key option costs more than anticipated?
Belmont desalination higher +12%	0	(150)	(36)	100	84	63	66	What if Belmont desalination is higher cost than anticipated?
Belmont desalination higher +25%	0	(151)	(37)	99	55	63	53	What if Belmont desalination is higher cost than anticipated?
Walsh Point higher +25%	0	(39)	75	210	219	84	186	What if Walsh Point desalination is higher cost than anticipated?
Opex:								
All low (-25%)	0	(154)	(40)	115	117	69	79	What if operating costs, such as energy, chemicals, maintenance, are lower than anticipated?
All high +25%	0	(145)	(31)	87	106	55	75	What if operating costs, such as energy, chemicals, maintenance, are higher than anticipated?
PRW higher +25%	0	(149)	(35)	79	110	61	76	What if PRW operating costs are higher than anticipated?
Desal higher +25%	0	(141)	(27)	109	119	56	85	What if desalination operating costs are higher than anticipated?
Desal lower (-25%)	0	(158)	(44)	93	103	68	68	What if desalination operating costs are lower than anticipated?
Energy costs:								
Green energy used instead of brown	0	(148)	(34)	102	112	62	78	What if green energy is used to run desalination or PRW options?
Green x0.5 price	0	(152)	(38)	109	111	64	75	What if green energy prices decrease substantially (by 50%)
Green x3 price	0	(131)	(15)	77	114	54	91	What if green energy prices increase substantially (by 300%)
Brown x0.5 price	0	(153)	(39)	109	111	64	75	What if brown energy prices decrease substantially (by 50%)
Brown x3 price	0	(134)	(18)	76	114	55	88	What if brown energy prices increase substantially (by 300%)

Legend:

Most favourable portfolio | Least favourable portfolio

Sensitivity/scenario	Portfolio D: Staged desalination	Portfolio C: Upper Chichester Dam	Portfolio E: Limeburners Creek Dam	Portfolio F: Purified Recycled Water	Portfolio G: Belmont desalination, Upper Hunter transfers and PRW	Portfolio H: Walsh Point desalination	Portfolio L: Upper Hunter transfers, Central Coast transfers, Belmont desalination	Why look at this? / What question does it seek to answer?
Central case	0	(149)	(35)	102	112	63	77	Central case - reflects Hunter Water's best input assumptions
Water conservation (WC) and Recycled Water (RW) effectiveness								
50% effectiveness of WC	0	(139)	(38)	114	115	70	63	What if we invest in water conservation, but it is less effective than anticipated?
150% effectiveness of WC	0	(154)	(39)	95	107	60	84	What if we invest in water conservation, but it is more effective than anticipated?
50% effectiveness of RW	0	(149)	(35)	102	112	63	77	What if we invest in water recycling, but it is less effective than anticipated?
200% effectiveness of RW	0	(149)	(35)	102	112	63	77	What if we invest in water recycling, but it is more effective than anticipated?
GHG emissions:								
100% of emissions allocated to NSW	0	(148)	(34)	101	111	62	77	What if we assume a higher proportion of emissions allocated to NSW?
Carbon value x10 and 100% NSW	0	(139)	(28)	91	103	57	73	What if we substantially increase the value of carbon and impact of NSW emissions?
Environmental valuation								
Value placed on biodiversity x0	0	(78)	22	102	112	63	134	What if the community places no value on lost biodiversity?
Value placed on biodiversity x0.5	0	(113)	(6)	102	112	63	106	What if the community places half as much value on lost biodiversity?
Value placed on biodiversity x2	0	(220)	(92)	102	112	63	21	What if the community places twice as much value on lost biodiversity?
Value placed on biodiversity x3	0	(291)	(148)	102	112	63	(36)	What if the community places three-times as much value on lost biodiversity?
Biodiversity value - offset credit (base)	0	(261)	(130)	102	112	63	61	What if we use the base estimate of biodiversity offset costs to value lost biodiversity?
Biodiversity value - offset credit (upper)	0	(333)	(191)	102	112	63	45	What if we use the upper estimate of biodiversity offset costs to value lost biodiversity?
Cost of shortfall:								
100x shortfall price	0	(149)	(35)	102	112	63	77	Cost to community of not providing minimum supply is very uncertain. What if it is higher?
Social cost of restrictions:								
0.5x	0	(149)	(35)	100	110	62	76	What if the community places a lower value on avoiding restrictions than estimated?
2x	0	(148)	(34)	104	115	64	80	What if the community places a higher value on avoiding restrictions than estimated?
5x	0	(146)	(30)	112	123	68	86	What if the community places a much higher value on avoiding restrictions than estimated?
Central Coast Council Long-Run Marginal Cost (LRMC)								
Low (-50%)	0	(166)	(49)	88	107	55	49	What if the monetised value of yield benefit to Central Coast region is lower than estimated?
High +50%	0	(132)	(20)	115	117	70	105	What if the monetised value of yield benefit to Central Coast region is higher than estimated?
No benefit to CCC	0	(183)	(64)	74	102	48	21	What if exclude any monetised value of yield benefit to Central Coast region?
PRW avoided costs								
Lower PRW avoided costs (nil)	0	(149)	(35)	85	112	63	77	What if PRW does not avoid the cost of future wastewater treatment plant upgrades?
Higher PRW avoided costs	0	(149)	(35)	121	112	63	77	What if PRW avoids higher costs of future wastewater treatment plant upgrades?
Level of investment in water conservation (WC) and recycled water (RW)								
WC A2, RW A	0	(155)	(41)	94	104	58	83	Which portfolios perform best with each level of investment in WC and RW?
WC B, RW A	0	(161)	(59)	135	82	53	139	Which portfolios perform best with each level of investment in WC and RW?
WC A, RW B	0	(154)	(39)	95	108	60	85	Which portfolios perform best with each level of investment in WC and RW?
WC A2, RW B	0	(151)	(49)	95	96	52	99	Which portfolios perform best with each level of investment in WC and RW?
WC B, RW B	0	(231)	(68)	145	102	50	152	Which portfolios perform best with each level of investment in WC and RW?
WC A, RW C	0	(157)	(42)	88	97	57	91	Which portfolios perform best with each level of investment in WC and RW?
WC A2, RW C	0	(217)	(49)	126	92	53	124	Which portfolios perform best with each level of investment in WC and RW?
WC B, RW C	0	(192)	(51)	140	108	49	156	Which portfolios perform best with each level of investment in WC and RW?

Legend:

Most favourable portfolio

Least favourable portfolio

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