NERA
ECONOMIC CONSULTING

How Should the Appropriate Horizon for Integrated Water Resource Planning be Ascertained?

Thames Water

Draft – Executive Summary

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Executive Summary

Overview and key findings

NERA was commissioned by Thames Water to consider the question *"How should the appropriate time horizon for integrated water resource planning be ascertained?"* The general answer is that the horizon should be chosen so that projected effects (costs, benefits) beyond that time (which are therefore not treated explicitly in the planning exercise) are unlikely to affect the decisions about what it is best to do initially. In this report we draw on reviews of horizon-setting in other sectors and jurisdictions, and on discussions in the academic literature, to develop a framework that will aid the planner in ascertaining the appropriate horizon for a specific planning exercise. The framework is outlined in more detail later in this Executive Summary and in the report.

Applying the framework to the case of statutory Water Resources Management Planning (WRMP) in England and Wales shows that the appropriate horizon may not be the same from one water resource zone or set of zones to the next. In many zones the statutory minimum horizon of 25 years will be too short to identify some potentially important supply-demand problems, such as deficits arising through population or climate change. By "too short" here we mean that a 25 year horizon is too short to be sure that important possible problems will be identified in good time by the WRMP planning cycle, in view of: the possible rates of change in the underlying drivers (e.g. population, water use-efficiency, climate change effects on rainfall); the time it may take to address impending shortfalls with good solutions (forming them, obtaining planning permission and funding for them, and implementing them); and the consequences of facing a near-term or actual shortfall, in the form of either or both of the high costs of experienced shortages, and any higher-cost of the solutions that can be implemented in time.

In view of these factors a horizon of 40–60 years seems more appropriate as the minimum for the problem-identification element of WRMP exercises, depending on the complexity of the problem being solved. Forecasting or forming scenarios of that length seems practical given today's information sources and methods for forming projections.

The appropriate horizon for the subsequent appraisal of solutions will be that which ensures that the best solution can be reliably identified, and it also may vary from zone to zone in WRMP exercises. It will depend in part on the size and timing of the identified problems, and in part on the nature and extent of the solutions that are available.

In some water resource zones or sets of zones, there may be no identified shortfall or supply risk anywhere in a long horizon, so no solution appraisal is necessary. In other zones, relative to the size and timing of the identified deficits, there may be a notably greater supply of solutions which are available at low cost, and which are able to be quickly implemented, and which have fairly short scheme-lives so do not have long-lasting benefit periods. In such cases the effects (costs, benefits) occurring within the current 25 year minimum statutory planning horizon are probably sufficient as the basis for identifying the best initial actions in a WRMP exercise. This is on the presumption that – as is required and is practised in WRMP in England and Wales - the water resource plan for each zone will be fully revisited on a five or six year rolling basis.

By contrast in other water resource zones or sets of zones there may be large identified shortfalls continuing or appearing after 25 years, or there may be options with long lead times or asset lives that are apparently good candidate solutions and so need to be ruled-in or ruled-out of the set of best initial actions. In these WRMP cases a horizon longer than 25 years will be needed to ensure that the initial actions that are best overall are properly identified.

For WRMP in some zones or sets of zones with complex planning problems it may be appropriate to make projections of shortfalls over, and to appraise solutions over, horizons longer than 60 years. This will be so when the longer horizon is needed to ensure that most of the present-valued benefit and cost of each option is treated explicitly within the appraisal. However as the horizon lengthens the most-distant projected figures will usually become less reliable, and the discount factor will fall, lessening the most-distant years' impact on any present-valued appraisal criterion. The best initial actions will therefore become increasingly insensitive to the most-distant years' effects. In WRMP work in England and Wales effects beyond horizons of 100 years or so are most unlikely to influence the best initial elements of solutions.

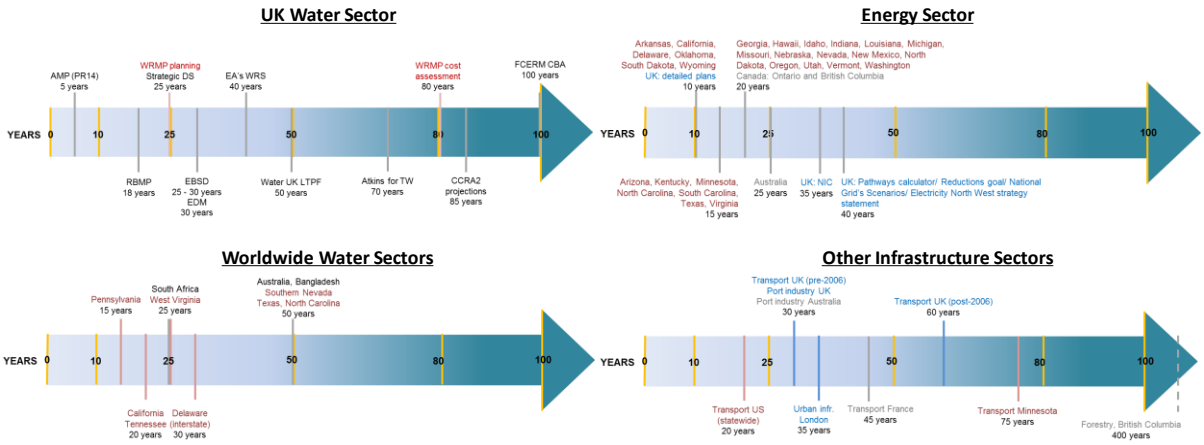
Successful use of horizons longer than the current 25 year statutory minimum for water resources planning in England and Wales requires a set of challenges to be met. They include: the need to provide transparency for stakeholders about more distant effects and how they come to influence the best initial plans; the need to consider the legitimacy of plans from stakeholders' points of view across a long time period and possibly multiple generations; the need for the organisations involved in the water planning to consider long-term uncertainties about wider driving factors, including some where long term projections are not readily available from other sources currently; and the extra technical and modelling complexity that arises in considering water availability and demand over longer timescales.

Practices in setting planning horizons

The licensed public water supply companies in England and Wales must each produce statutory water resource management plans (WRMPs) for their water supply zones, using a planning period of 25 years or more. Early discussions of WRMP approaches, for example in the sector studies known as EDM and EBSD, recommended a planning period of 25-30 years but without much explicit justification. The company WRMPs must and do meet or exceed the Environment Agency's (EA's) formal guidance on WRMP methods including the choice of horizon. The most recent EA Water Resource Planning Guidelines (May 2016) require companies to take a long term view to properly reflect the water supply risks in the company area, and strongly encourage companies to go beyond the 25 year statutory minimum planning period where a longer horizon is appropriate in view of those risks. Some investigations made by UK water sector companies or regulators have had much longer horizons, of 80 years or more. For example the EA's *"Flooding and Coastal Erosion Risk Management Report"* employs a 100-year horizon for the cost benefit analysis of flood control options.

Our review of a range of other jurisdictions' choices of planning horizons, looking for the motivations behind the horizons adopted, found the horizons were usually identified but the motivations for them were unstated in most cases. Some cases are shown in the diagram below. Some regions plan water resources over a relatively short period – for example 15 years in the U.S. State of Pennsylvania. Others use much longer horizons – for example in

Australia, where droughts lasting a dozen years or more are part of the historical record, authorities plan water supply initiatives using a 50 year horizon. In the energy sector, mandated planning horizons appear often to be shorter than those employed by water resource planners, possibly reflecting the energy sector's shorter infrastructure lives. Horizons of more than 25 years have been adopted in other sectors, for example in the UK the Department of Transport recommends a 60 year horizon be used in appraising long-lived asset decisions. Extremely long horizons are evident in a few cases: national carbon reduction plans often span centuries, and so do some forestry plans.



There is little theoretical or applied academic literature which directly discusses the issue of deciding the appropriate horizon. The US Environmental Protection Agency sets out four factors to be used in considering the appropriate planning horizon for a specific case: (i) the expected life of capital investments; (ii) the point at which benefits and costs reach a steady state; (iii) statutory and other requirements; and (iv) the extent to which benefits and costs are separated by generations.

Our selective review of the practices and the discussions of motivations in horizon-setting in other sectors led to indications of what the important elements might be, rather than definitive findings. However the indications were enough to be a material help to us in forming a framework for ascertaining the appropriate horizon for water resources planning.

A framework for ascertaining the horizon

A simple framework can be used to help ascertain the appropriate time horizon for an integrated water resource planning exercise. This framework has been developed with the statutory water resource planning (WRMP) exercise in mind, for a water resource zone or set of zones in England and Wales. This is a context where the availability and reliability of long-term forecasting and scenario results has improved substantially since the 1990's, where uncertainty over long term population and climate change effects has increased, and where there are very long lead times and asset lives for some good candidate solutions. The framework is also relevant to other water resource planning exercises and potentially to infrastructure planning in other sectors.

To be clear, the framework is intended to be conceptual, to be an aid to the planner in thinking about the appropriate horizon, and is not a formulaic quantitative tool.

The framework takes the form of adopting a starting interim assumption of a horizon that is reasonable for the context. For example in a WRMP application this might be the 25 year statutory minimum horizon, or it might be longer. The framework then has the planner ask a series of questions where each answer "yes" or "no" shows whether there is any good reason to make the horizon longer for this exercise. The questions address in turn the feasibility of making long projections of water supply and demand measures, the likelihood that the horizon is long enough to identify important problems, and the need to use a longer horizon to reliably identify the best initial solutions. The planner cycles through the questions, and extends the horizon if the answers suggest that doing so is an improvement, until there is no longer an overall improvement from doing so. The questions are listed below, along with a chart representing the framework as a flow diagram.

1. **Consider the feasibility of making longer term projections:**
   A. Can we produce reasonably reliable forecasts or good scenarios beyond the current planning horizon?

2. **Consider the timing of possible important problems:**
   A. Are there important costs or/and benefits, that can be affected by initial actions, that lie beyond the current horizon?
   B. Given the discount rate, would the costs and benefits beyond the current horizon form a substantial share of the present-valued criterion?

3. **Consider the timing and duration of the good candidate solutions:**
   A. Are asset lives, added to implementation lead times, substantially longer than the current horizon?
   B. Are there plentiful readily-implemented good options relative to the size of the problem? meaning that a "fast-footwork" approach offers sufficient flexibility out to and beyond the current horizon?