Putting the water into waterways

Water Resources Strategy 2015–2020

Canal & River Trust

October 2015

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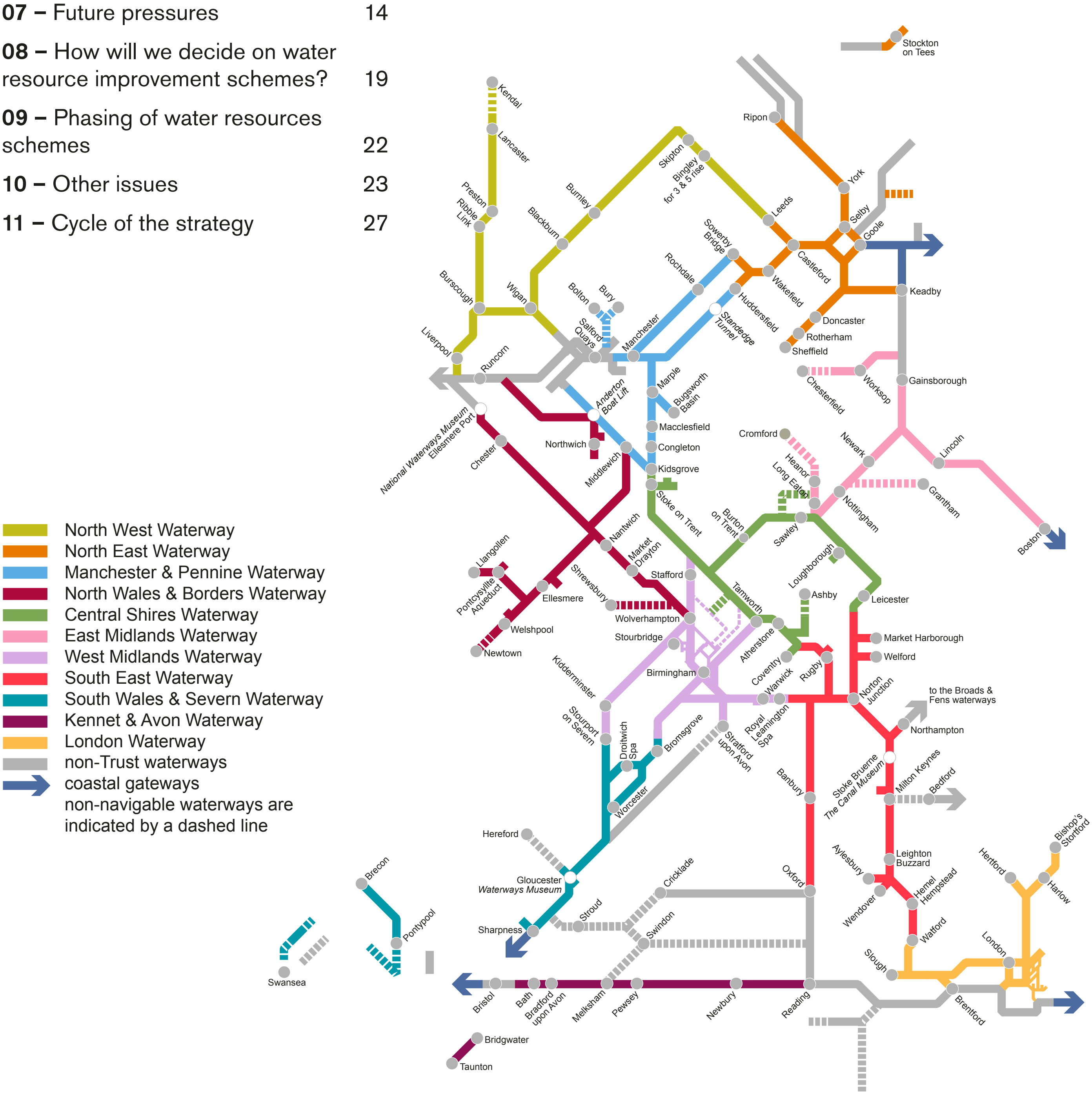

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Executive summary

Delivering a long term security of water supply will help the Canal & River Trust (the Trust) achieve its vision of *living waterways that transform places and enrich lives*. To enable this we have developed a Water Resources Strategy, following consultation, to allow us to plan successfully for the future.
This Strategy sets out our work plan for the next five years and looks as far ahead as 2050 to understand the longer term pressures and challenges.

Key concepts and definitions in our approach to managing water resources are explained, such as hydrological units (waterways that are supplied from the same water sources), **navigational drought** (a period of time where a shortage of water resources in a hydrological unit leads to restrictions or navigational closure), **levels of service** (the frequency we would expect a navigational drought to occur) and **navigational drought closure** (when, as a result of drought at a particular location in a hydrological unit, navigation is possible for less than five hours a day, over seven or more consecutive days).

Our aspirational level of service is 1 in 20 years, i.e. the Trust will maintain and operate the canal network so that drought closures are implemented, on average, less than once every twenty years. Another way to express this is a 5% probability of a drought closure occurring in any single year. The way the Trust will assess and prioritise future investments in water resource improvements, on the basis of their benefit-cost ratio is also shown.

We believe that the greatest pressures on the Trust's water resources in the future are climate change, funding, new legislation and increased boating numbers. How we will investigate and quantify the impacts of these pressures is outlined, primarily through further research, hydrological modelling and reference to industry best practice.

Our approach on three key issues that are frequently raised by our customers and users is explained. These are lock leakage, side ponds and dredging. There is often a misconception about the effect of these issues on our overall water resources reliability. The Water Resources Strategy clarifies a number of areas of misunderstanding and it presents our current view on these issues.

Finally, we explain our five year cycle to produce and implement our Water Resources Strategy. This will incorporate each of the themes above, allowing progress to be made in key areas. It will ensure that lessons are learned and feedback improves the overall management of water resources across the 2000 miles of canals and river navigations we care for.

Our Values

Caring Open Local Involvement Excellence

"Water is vital to the Canal & River Trust. It is the lifeblood of the canals and rivers that we care for and it needs to be carefully managed, particularly in times of drought."

Richard Parry, Chief Executive Canal & River Trust

Strategic actions

We will complete the following 14 actions within the next five years:

1. Continue to work with others to improve our definition of navigational drought.

2. Aspire to a level of service of 1 in 20 years. Work with others to understand the factors that might determine an appropriate level of service for parts of the canal system that are not currently able to meet the 1 in 20 year standard.

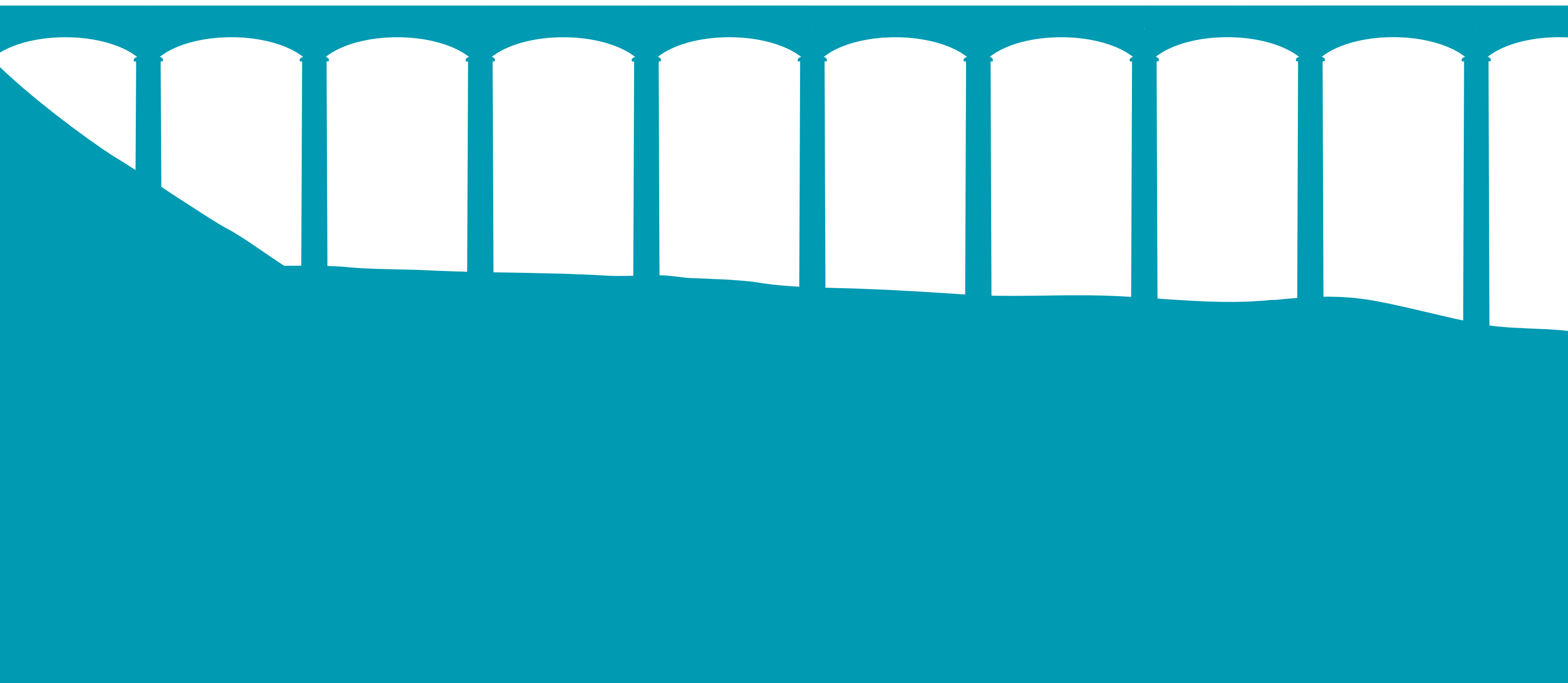
3. Only give our consent to new marinas if their impact on water resources does not reduce the level of service below 1 in 20 years.

4. Ensure that appropriate water resources assessments are undertaken for any proposed restoration or new canal development, aiming for no net impact on long term water resource levels of service.

5. Model all reservoir/groundwater/surface water feeder supported and river fed hydrological units with the new Aquator modelling software package. Where appropriate, spreadsheet models will be constructed for river navigation hydrological units. Continue to focus on developing the quality of modelling reservoir inflow data and model accuracy along with refining canal loss rate estimates.

6. Continue to monitor the Environment Agency and Defra water company planning guidelines and incorporate techniques where it is suitable and there is a benefit to the Trust.

7. Assess the following future pressures on our water resources: climate change, funding, environmental legislation (likely reduction in abstraction volumes) and increased network usage.



8. Model all feasible water resources schemes to assess the total quantity of water each will yield and the Net Present Value, using this to develop the business case for each scheme.

9. Follow the Trusts best practice in assessing social, economic and environmental costs and benefits of different Levels of Service.

10. Aim to implement water resources schemes to coincide with the predicted year which the Trust will no longer be able to meet the agreed level of service for the specific hydrological unit, by inclusion within the Trust's business plan determination.

11. Further explore the water management benefits of main-line dredging and spot dredging. We will investigate the network thoroughly to identify specific locations that would benefit from dredging of canal pounds to create 'reservoir pounds' e.g. summit pounds.

12. Identify and record side ponds as separate sub-assets on each primary lock asset, so that the Trust has a definitive register. Assess the water resources benefits of side pond usage.

13. Take account of water control in lock gate design more comprehensively and assess lock leakage more thoroughly.

14. Progress this and future Water Resources Strategies on a five year cycle. This Strategy will run from 2015 to 2020. Produce and publish an annual report to show our progress against our Strategy actions on our website.

01 Introduction – why do we need a Water Resources Strategy?

Water is vital to the Canal & River Trust (the Trust). Without enough, navigation would not be possible, the natural environment and canal side/boating businesses would suffer and the experience for many of our different visitors (such as anglers, cyclists and walkers) would also be much poorer. The Trust has a vision of *living waterways transform places and enrich lives*. To ensure we deliver this vision, and the six strategic goals that underpin it, it is vital that the Trust delivers long term security of water supply to the canal network. To achieve this and building on previous work, we have developed this Water Resources Strategy (WRS) to allow us to plan successfully for the future.

The Trust needs a reliable supply of water to meet the various demands of an inland waterway network which we carefully manage. These demands include visible uses of water, such as each time a lock is emptied to allow a boat to pass through (there are nearly 1,600 locks across the network, which are used around four million times each year). However, there are also unseen demands for water, such as seepage and leakage through the canal bed (which may have a clay lining that was originally put in place over two centuries ago) and use by vegetation and evaporation.

Due to the size and diversity of the waterway network we manage, we have split it up into **hydrological units**. These units allow us to manage water resources more effectively and help us with strategic analysis. Hydrological units are defined in Section 2, p9.

Within this Strategy, we have set out the overarching vision for how the Trust intends to manage water resources across the network through to 2050. We explain our level of service, consider future pressures on water supply and demand, detail our planned actions over the next five years and look at a variety of other water resource-related issues.

The canal network is unique in the water supply sector due to its large geographical extent and its age. The water supply companies in England and Wales undertake the most similar activities and operations to us and as such we aspire to work as closely as possible to water industry guidance and best practice whilst having no statutory obligation to do so.

We ran an eight week consultation on a draft version of this Strategy between 9 September 2014 and 4 November 2014. The consultation outlined the key issues that we wanted to understand and manage better and sought the input of all our customers and users to help influence the work we do. We specifically asked for input on 15 questions and we invited responses by online survey, email or post. We received a total of 169 responses to the consultation, 154 via the online survey and 15 by email. The majority of responses were very positive. We have used the feedback to endorse or revise our original proposals. Please see Appendix 4, p34, for a list of document references.

02 Key concepts and definitions

The Trust has a duty to maintain its navigations under Section 105 of the Transport Act 1968. The Act classifies waterways into three categories: cruising, commercial and remainder. The list of cruising and commercial waterways is in Schedule 12 of the Act.

The categories can be defined as:

- **Cruising –** the Act requires the Trust to keep these waterways in a suitable condition for use by cruising craft
- **Commercial –** the Act requires the Trust to keep these waterways in a suitable condition for use by commercial freight-carrying vessels
- **Remainder –** any waterway which is not a cruising or commercial waterway

In order to meet the duty for cruising and commercial waterways, the Trust must ensure that there is a sufficient depth of water in canals for navigation. The Trust's duty for remainder waterways is to ensure they are dealt with in the most economical manner possible consistent with the requirements of public health and the preservation of amenity and safety. It is therefore very important that we manage water resources carefully to ensure that we meet all of our duties.

Even with careful management and planning, there will be occasions when restrictions and stoppages will need to occur. These can be due to a variety of factors such as operational reasons (e.g. for necessary engineering works), instances of misuse or vandalism (e.g. lock paddles being left open and pounds emptying), flooding and for a lack of water resources (through drought).

Drought is a natural phenomenon that historically has had an impact on navigation across the waterway network. Drought events in recent years have highlighted how prolonged periods of dry weather can have an impact on public water supply, agriculture, the environment and of course navigation.

We normally monitor the water resource position of our network on a weekly basis (or daily basis in a drought). We have also produced drought plans which provide advice and actions to be undertaken when pre-defined water resource risk triggers have been reached. These range from early warning signs (aiming to preserve water supplies at an early stage to reduce water shortages), during the drought itself and into drought recovery and normal operation. Our key aims are to minimise the disruptions to our many customers and visitors, protect the environment and communicate what is happening.

There are various definitions of drought available. It is impossible to agree on a single definition of what drought means for all purposes. This is because drought impacts on different individuals or groups in different ways.

Droughts can typically be characterised into three classes:

- **'Meteorological drought'** can be defined as a period of time with lower than average rainfall
- **'Agricultural drought'** can be defined as a period of time where agricultural output is reduced as a result of insufficient water
- **'Hydrological drought'** can be defined as a period of time where streamflows fall below an expected rate

None of these adequately cover the impact of a drought on navigation. Within our consultation document, there were a number of respondents who told us that our proposed definitions were not very clear. Consequently, we have redefined a **'Navigational drought'** and will work with our stakeholders to improve their understanding. The new definition is:

- **A period of time where a shortage of water resources in a hydrological unit leads to restrictions or navigational closure**

Strategic action 1

Continue to work with others to improve our definition of navigational drought.

A hydrological unit (HU) is defined as:

- **Waterways that are supplied from the same water sources**

Having hydrological units allows us to manage water resources more effectively and helps us with strategic analysis. We have defined 53 hydrological units across the network and they are characterised into three different types (please refer to Figure 1, page 10 and pages 28-31 for definitions and further information).

As droughts can happen at any time, it is important for the Trust and its customers to understand the frequency with which drought may have an impact on people's use and enjoyment of the waterways. This is determined using the concept of 'level of service'. This concept is complex as there are many factors that affect it. This includes varying rainfall, reservoir storage, differing demands and expectations of canal users. There is also a financial cost associated with maintaining supply to meet demand and an even greater cost attached to increasing supply (i.e. increasing the level of service).

We have defined the concept of level of service as:

- **How frequently the Trust expects a navigational drought to occur**

In order for us to analyse the frequency of drought, we have also created a definition for drought closure. We have defined a navigational drought closure as:

- **When, as a result of drought at a particular location in a hydrological unit, navigation is possible for less than five hours a day, over seven or more consecutive days**

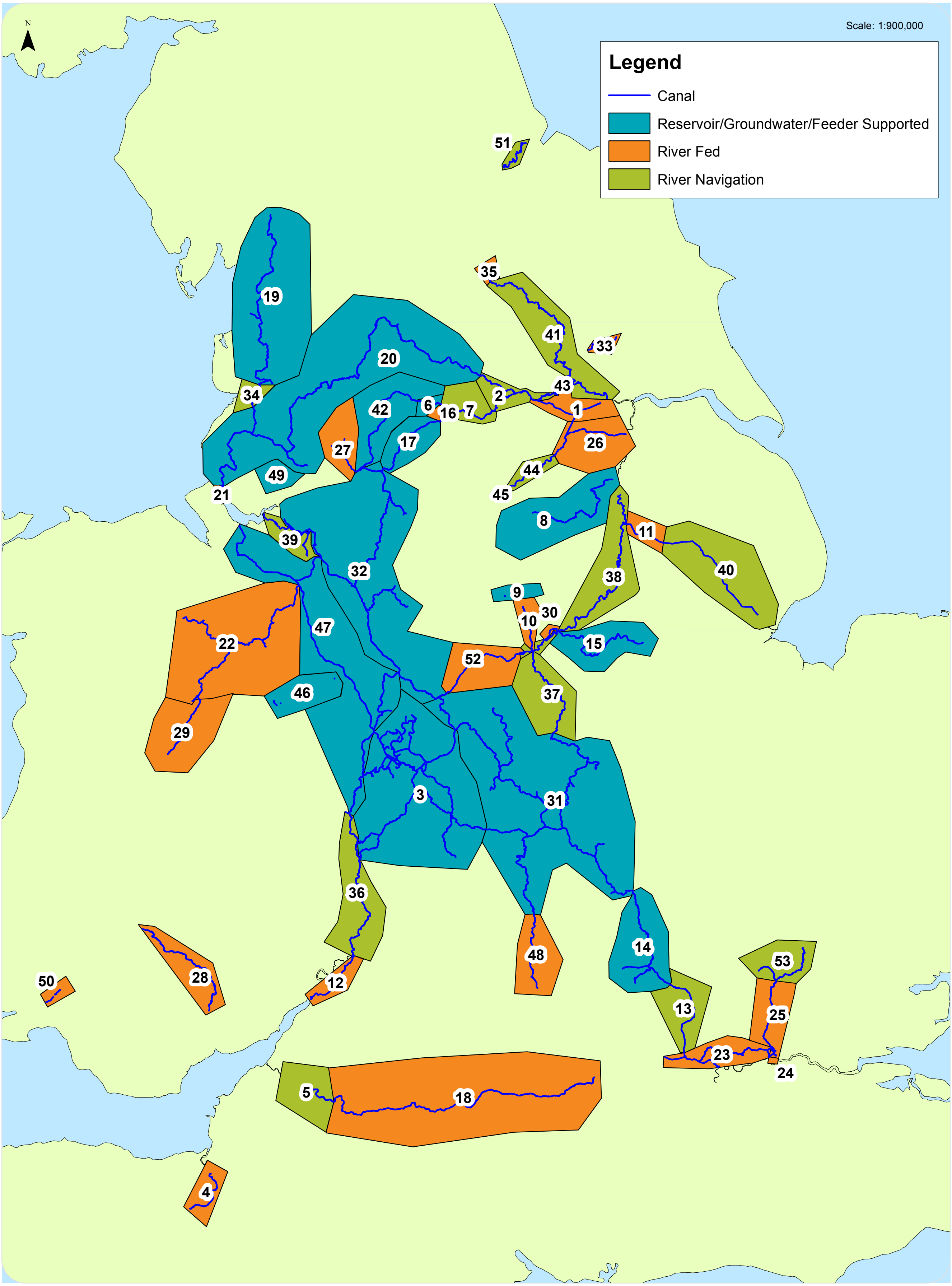
It was difficult to agree a single definition for drought closure due to the impacts of different timings when navigation was not possible on the variety of waterway users. We decided on the timescales within our definition following feedback from numerous waterway users during recent drought events. There was broad consensus that if there are restrictions for more than five daylight hours within a single day, over a repeated number of days, the waterway is effectively closed to navigation.

It is important to note that these definitions and most of the focus of this Strategy concentrates on powered navigation which uses locks. It is unlikely that we will close the canals for non-powered craft that do not utilise locks, such as canoeists, kayakers and other forms of paddlesport, unless it is an extreme drought where sections of canal may need to be drained.

There will be restrictions and stoppages for other reasons that are not due to drought, such as planned and unplanned maintenance. Our definitions and level of service is specifically related to drought. We endeavour to limit restrictions and stoppages as much as possible by careful water management.

We aim to ensure that all reservoir engineering works (which are typically in the interests of safety) are carefully planned and delivered to minimise the disruption that they may cause, seeking alternative supplies or mitigation measures where appropriate.

Additionally, we will try to avoid more than one reservoir per hydrological unit being affected in any single year. Sometimes we will impose restrictions in order to save water to try to prevent closures becoming necessary. It is also important for boaters to ensure that paddles are closed properly and to share locks were possible to conserve water.



Canal & River Trust

Figure 1: The 53 hydrological units*

*(Please see Appendix 1, p28-31 for definitions and further details)

Why do we need a level of service?

It is important for us to have a level of service to help with the following:

- **Strategic planning and future investment decisions –** Strategic planning provides an indication of the level of investment needed in the long term to maintain a specified level of service.
- **Prioritising works and asset management –** By having a level of service there is an understanding of what the water resource requirements are for any section of the waterway network and this is incorporated into maintaining the waterway infrastructure to an appropriate condition.
- **Providing a baseline for the assessment of developments with a water demand –** A level of service provides a baseline for the determination of water availability for new marina developments and water sales. For example, it is inappropriate to sell water if we do not know how much water there is available to sell.
- **Future pressures –** With the uncertainties of climate change, a level of service provides a baseline from which a range of future scenarios can be simulated and therefore strategic decisions can be made.
- **Communicating internally and externally –** Having an agreed level of service provides a tool for communicating risk within the Trust and to external stakeholders. Canal users will know what to expect.

What is our agreed level of service?

After feedback from stakeholder engagement and the formal consultation responses, we have decided to aspire to a level of service of 1 in 20 years. We will maintain and operate the canal network so that drought closures are implemented, on average, less than once every twenty years, i.e. there is a 5% chance of a drought closure occurring in any single year. It is possible that we will set out different levels of service for parts of the network if the 1 in 20 year standard is not technically feasible or financially achievable.

In the next five years, we will work with our stakeholders to understand the factors that might determine an appropriate level of service for parts of the canal system that are not currently able to meet the 1 in 20 year standard. Through our water resource planning we will identify and cost a range of water resource development schemes that would deliver improved levels of service for these parts of the network. This will allow the Trust and its stakeholders to make informed decisions on the appropriate level of service.

Strategic action 2

Aspire to a level of service of 1 in 20 years. Work with others to understand the factors that might determine an appropriate level of service for parts of the canal system that are not currently able to meet the 1 in 20 year standard.

New marinas will be given consent if their impact on water resources does not reduce the level of service below the standard of 1 in 20 years. With regards to water sales to third parties, as a general rule, agreements will have clauses where a supply of water cannot be guaranteed. This means that achieving a 1 in 20 year standard for boaters takes priority over the supply of water for sale. However, some specific water sales have more robust contracts with minimum supply clauses (for example, some supplies to water companies).

Strategic action 3

Only give our consent to new marinas if their impact on water resources does not reduce the level of service below 1 in 20 years.

05 Impacts of restorations and new canals on level of service

The most recent canal restorations to be completed were the Droitwich Canals which reopened in 2011 after lying derelict for more than seventy years. These canals join the Worcester & Birmingham Canal and the River Severn Navigation. There is the potential for other restorations to link to the Trust's existing network or be unconnected. Some examples include: the Cotswolds Canals, the Wiltshire & Berkshire Canal and the Hatherton & Lichfield Canals. Elsewhere, brand new canals have been proposed, for example, the Bedford & Milton Keynes Canal (which is proposed to link the Grand Union Canal in Milton Keynes with the River Great Ouse in Bedford) and the Daventry Canal Arm (linked to the Grand Union Canal).

The Trust believe that supporting restoration schemes will contribute to the Trust's charitable object **"To promote, facilitate, undertake and assist in, for public benefit, the restoration and improvement of inland waterways".**

Furthermore, **"The Trust believes that increasing the size of the navigable waterway network for public benefit is not only a key charitable purpose but also a powerful way to demonstrate our work and the benefits waterways bring to millions whilst growing support for our cause." (Canal & River Trust, Shaping Our Future, July 2012).**

However, prior to the Trust fully approving a request for a restoration or a new development, an appropriate water resources assessment must be undertaken. This is because there could be a water resources impact and increased risk to the existing canal network (if connected), as well as generating a water demand itself. We proposed this in our consultation and it received a very positive response. We have therefore decided to continue with this approach.

Proposers will need to be able to demonstrate their potential requirements for water. The assessment the Trust will undertake will determine whether the proposal can achieve the agreed level of service and whether it will have an acceptable impact on the existing network (i.e. not resulting in the existing network failing to meet the agreed level of service).

Generally, there should be no net impact on long term water resource levels of service but in some cases we may agree that the restoration or new development could have a lower level of service. We also understand that there may be compelling arguments for accepting a reduction in the level of service for the existing network to allow a restoration or new canal if, for example, it enables the Trust to achieve other benefits and meet its charitable objects and wider aims and aspirations. Each proposal will be treated on a case-by-case basis.

Strategic action 4

Ensure that appropriate water resources assessments are undertaken for any proposed restoration or new canal development, aiming for no net impact on long term water resource levels of service.

Measuring level of service and baseline data

The majority of reservoir/groundwater/surface water feeder supported hydrological units currently fall within the interconnected canal network covered by our Water Resources Model (a optimisation model designed specifically for British Waterways in 2001). This is currently the primary tool used to assess water availability to meet canal demands. Analysis of the model outputs show the frequency that a critical drought threshold is reached and therefore the level of service that can be achieved in each hydrological unit modelled.

Water resource assessments for river fed hydrological units and river navigation hydrological units have been carried out as part of ad hoc studies. The level of service in these systems is dependent on the flow regime of the river(s) and there is generally little or nothing that the Trust can do to influence this.

Unfortunately, the current Water Resources Model is coming to the end of its functional life because the software is no longer compatible with modern supported software packages (for example, latest versions of GIS[1]). A project is currently being undertaken to replace the Water Resource Model with an industry standard modelling package called 'Aquator'[2].

The respondents to our consultation endorsed our proposal that in the future, we will model all reservoir/groundwater/surface water feeder supported and river fed hydrological units with the Aquator modelling software package. River fed hydrological units generally do not have any reservoir storage; their water supply comes from a complex combination of hydrological conditions and hydraulic control. Where appropriate we will construct spreadsheet models for river navigation hydrological units so that their water resource positions can be assessed.

The modelling programme is phased to make the best use of the Trust's Water Management Team. Within five years, all hydrological units currently within the Water Resources Model will be created in Aquator. In addition to this, due to increasing regulatory pressures, we will also model the Monmouthshire & Brecon Canal and the Gloucester & Sharpness Canal (these are river-fed hydrological units). This is shown in Appendix 1, p28-31. The remainder of hydrological units will be modelled in subsequent phases and a detailed programme will be given in future Water Resources Strategy documents.

Several respondents thought that we should try to accelerate progress with our modelling schedule and following this, we have increased the team resource. We will review progress regularly over the first five year cycle. The scale of the modelling task is still considerable for the team.

It is inevitable that there will be uncertainties in strategic modelling. Uncertainty can originate from supply and demand data, as well as model conceptualisation and model output analysis. Therefore, it is important to reduce uncertainties wherever possible. In recent years we have focussed efforts on developing the quality of modelling reservoir inflow data and model conceptualisation accuracy. The consultation responses supported this approach. In addition, canal loss rate estimates are also a key area where our knowledge has improved considerably but there is still more work to do here.

Strategic action 5

Model all reservoir/groundwater/surface water feeder supported and river fed hydrological units with the new Aquator modelling software package. Where appropriate, spreadsheet models will be constructed for river navigation hydrological units. Continue to focus on developing the quality of modelling reservoir inflow data and model accuracy along with refining canal loss rate estimates.

Water companies, our closest industry comparison, use techniques outlined in Environment Agency and Defra guidance to determine their strategic water resource requirements, using concepts such as headroom[3]. Within our consultation we proposed that we should utilise this guidance where appropriate. This proposal was agreed by our respondents. We will continue to monitor the guidelines (and input to their continued development, where appropriate) and incorporate techniques where it is suitable and there is a benefit to the Trust.

Strategic action 6

Continue to monitor the Environment Agency and Defra water company planning guidelines and incorporate techniques where it is suitable and there is a benefit to the Trust.

[1], [2] & [3] See Appendix 3 Glossary for definition

07 Future pressures

It is critical that we assess the role of future pressures on our water resources to be able to plan effectively over the longer term. We have reviewed the current best practice and relevant industry guidance and considered how the pressures can be assessed using our water resource modelling software. Few future pressures can be quantified with certainty. Therefore, our modelling is partly an exercise to determine the likely range of impacts on our network.

The pressures we have considered are:

- **Climate change**
- **Increased boating**
- **Reduced funding causing asset deterioration that impacts on water resources**
- **Environmental legislation reducing our water availability**
- **Water transfers (strategic transfers, primarily in response to drought)**
- **Water rights trading (which will be modified through the Abstraction Reform process)**
- **Water sales (selling surplus water from our network)**
- **Expanding our network (new or restored waterways) – See Section 5, p12**

A number of other pressures were suggested to us during the consultation. These include population increases, changes in society, water quality issues, invasive species and water conservation. We have decided not to take population increase and society changes forward now as they are very uncertain and we do not have the required expertise in-house to analyse them. Water quality issues and invasive species are very important to the Trust and are looked after by the Trust's Environment Team as they are unlikely to have water resources impacts.

We will continue to improve our understanding of water conservation issues, encouraging everyone working for the Trust (including volunteers and seasonal staff) to be aware of its importance. Wherever possible, we will ensure that remedial works are prioritised to address persistent issues.

Climate change

Climate change is renowned as being uncertain. The only impact of climate change we will model for in this Strategy cycle is on feeders (watercourses flowing into the canals, including groundwater sources) and reservoir inflows. The impacts on canal losses, lockage or third party water sales will not be assessed. This is due to the fact that the evidence of direct links between a changing climate and these factors is not sufficiently robust to act as a useful decision-making tool.

We plan to develop a bespoke approach to modelling the effects of climate change that is appropriate to the uncertainties associated with climate change science, the available team resources (staff/modelling time) and the technical requirements of the wider modelling solution used. The assessment made by water companies (specifically United Utilities and Severn Trent[4]) will be used as a benchmark and we may adapt their approaches to our unique requirements.

The modelling will be completed by using the following documents, and subsequent updates, where relevant and appropriate:

- **Latest climate change projections for its climate impacts analyses – UKCP09, 2009**
- **Environment Agency (EA) Guidance for Climate Change Assessment (EA, 2012a)**
- **Environment Agency Water Resource Management Plan Guidance (EA, 2012)**
- **Future Flows project (CEH et al., 2012)**
- **UK Climate Change Risk Assessment work (Defra, 2012a)**
- **Climate Change Approaches in Water Resource Planning (EA, 2013).**

Increased boating

The pattern of network usage via boating is dependent on a variety of factors including weather conditions, water availability, cost and availability of moorings, licence fees, insurance, fuel and other running costs, to name a few. We plan to assess the impact of increased network usage using scenarios of no change (0%), together with 1% and 2% annual increases in lockage from 2015-2050.

[4] These Water Companies cover geographical areas that substantially overlap with the Trust's network and they both use the Aquator modelling software

Reduced funding causing asset deterioration

We have assumed that there is a direct link from funding to asset condition which will impact on water resources in the long term. As an example, a lower income is likely to mean that less money will be spent on maintenance of our feeder channels. This reduction in maintenance is likely to mean that some feeders may deteriorate over time. Feeders in a poor condition will have a lower transfer capacity and will not be able to provide the canal network the required amount of water.

The Trust has a range of sources of income, including the contract with Government which is secured until 2027. During the Strategy cycle, we will consult relevant teams within the Trust to estimate the income we might expect to receive from each of our income sources, through to 2050.

The Trust's Asset Strategy will be able to advise us on how changes in funding will affect future works, which will impact on water resources. Model outputs will therefore incorporate potential changes in funding should future income reduce and/or fail to increase with inflation.

New environmental legislation reducing our water availability

The Water Resources Act 1991 (Section 26) controls the abstraction and impoundment of water. This legislation was updated in November 2003 by the Water Act 2003 (c.37 Section 5) and several key changes were made to the licensing system. Some of these have been enacted and others are still awaiting a commencement order.

The main change that will impact the Trust is the removal of the exemption for water transfers into canals. It is currently thought that the commencement order for this section of legislation will be implemented no earlier than January 2016. There is likely to be a two year window for applications to be made and between three and five years for the Environment Agency to determine the applications. Natural Resources Wales are likely to need less time than the Environment Agency to determine the applications. However, by 2023 we should have all the abstraction licences that are required by law.

There is a risk that a number of our existing abstractions will have conditions placed upon them that will restrict the quantities of water we can abstract through licensing under the Water Act, 2003, driven by the Water Framework Directive and other legislation. We have analysed all of our feeders by likelihood and severity of reduction and can now assess each feeder for the impact of potential reductions using a risk-based approach.

As mentioned above, the licencing is being undertaken over a period of up to seven years. As such, the amount that feeder abstractions may be reduced by and how this is applied to the inflow sequences to models will need to be developed over the next three years alongside developments within the licencing policy.

We will follow the methodologies below:

1. Feeders will be divided into three categories:
   a. Severe reductions to our abstraction
   b. Moderate reductions to our abstraction
   c. No reduction expected to our abstraction.

Each of these three categories will have a reduction reflecting the severity of reduction in our abstraction. This reduction will then be applied to all feeders which fall into that category.

2. Each feeder will be assessed for its risk.
   Using current information that we have gathered in preparation for Water Act 2003 licencing, each feeder will be reviewed and an appropriate change applied where the abstraction has been highlighted as being at risk from licence reductions.

Further reform of the abstraction licensing system in England and Wales, which has been proposed by Government for implementation from the early 2020's, could also add to our future pressures although this is not within our first Strategy cycle. As such, we will continue to work closely with policy-makers and regulators to try to minimise the impacts of any new legislation on the Trust's water resources and ensure adequate planning and preparation time is factored in for any legislative change. We will also pursue a more proactive lobbying approach where the likely impacts are disproportionately costly or burdensome to the Trust.

Water transfers, water rights trading and water sales

- **Water transfers** involve strategically moving water through our network to be utilised by someone else. Transfer agreements can either be temporary for specific times of the year (i.e. for use in a drought) or constant throughout the year. Before any transfer could take place, a detailed feasibility study would be required. These must be investigated on a case by case basis. It is always expected that for a water transfer, the third party is providing the initial source of water to be transferred.
- **Water rights trading** is the process of exchanging and dealing with abstraction rights. At present, the Trust is exempt from needing licences for surface water abstractions but this will change once the Water Act 2003 is enacted. It will dramatically increase the number and extent of abstraction licences that we hold and could potentially trade with others. Abstraction reform from the 2020's may also present opportunities.
- **Water sales** are contracts we enter into with third parties to sell our surplus water (typically this is water that is surplus to the amount needed to meet the level of service). These are very site-specific and need to be investigated on a case-by-case basis.

The configuration of our network has the potential to act as a route for water transfers and to enable water rights trading. We will assess proposed water transfers but these will not form a specific part of this Strategy given the early stage of the feasibility assessments for such projects and the high degree of uncertainty. It should be noted that thorough environmental assessments would have to be completed before any water transfers were agreed.

At present, it is not possible to assess the potential impact of water rights trading as we do not have a significant number of licences to trade. Consequently it will not form part of this Strategy. Furthermore, we would only seek to trade our water rights where we were confident we had sufficient water to meet current and future demands. We do not expect this to be a common situation.

Water sales will also not form part of the workload within the Strategy other than in an assessment of the baseline water resource situation (i.e. to ensure any existing and proposed water sales are accounted for as a demand for water).

Expanding our network

Although there is the potential for our network to expand, it is understood that the majority of current projects are many years away from being complete. Consequently, we will not be assessing interactions with new waterways as a specific future pressure within this Strategy due to the uncertainty and complexity in the range of possible restorations and new canals, but we will examine each proposal on a case-by-case basis (see Section 5, p12).

In summary, after consultation we have decided that the future pressures we will be assessing in detail within this Strategy cycle are:

- **Climate change**
- **Funding**
- **Environmental legislation (likely reduction in abstraction volumes)**
- **Increased network usage**

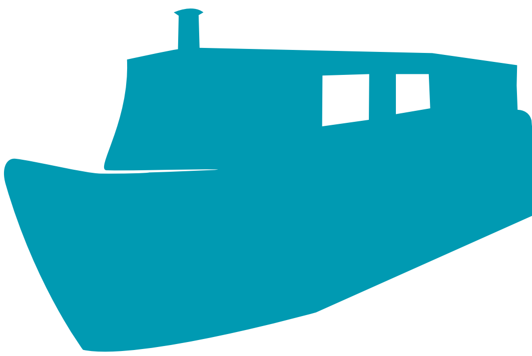
Strategic action 7

Assess the following future pressures on our water resources: climate change, funding, environmental legislation (likely reduction in abstraction volumes) and increased network usage.

Each of the pressures above will be assessed by a range with an upper and lower boundary to reflect future pressures to the year 2050. These modifications will be made to the 18 models which will be constructed within the first three years of phase 1 of the Strategy.

We will assess the water resource position for the modelled hydrological units. This assessment will determine whether each hydrological unit is forecast to be in surplus or deficit by 2050, against the agreed level of service.

As we develop the new water resource position for each hydrological unit, we will begin assessing potential schemes which may benefit the hydrological unit which has been identified as being in a deficit against the agreed level of service in 2050.



Our plan of modelling future pressures will be undertaken alongside our plan for establishing baselines (please refer to Table 1, below). From the baseline models, we will apply the future pressures which will provide the predicted surplus/deficit for 2050 relative to the agreed level of service (of 1 in 20 years).

Year One (2015/16)	Year Two (2016/17)	Year Three (2017/18)	Year Four (2018/19)	Year Five (2019/20)
• Undertake detailed research into climate change factors to develop a bespoke approach to assessing the impacts of climate change on the Trust's network. • Consult the planning and asset teams to discuss future funding and its impact on water resources	• Define the impacts that will be applied to the assets which will be affected by changes in funding. • Define which methodology for producing the percentage reductions to all feeders which will be affected by Water Act licencing is most appropriate.	• Apply the 0%, 1% and 2% increase on the 2015 lockage to produce lockage figures for 2050. • Apply the bespoke approach for climate change (determined in Year One) to derive flow factors for feeders. • Apply the decided approach for reductions in feeder flows due to Water Act curtailment to derive appropriate flow factors for the feeders.	• Finalise the input sequences into the model by applying all factors. • Run the model for the different scenarios to assess the impact of future pressures.	• Run the models to assess the benefit of potential schemes which could be implemented to provide the water required to ensure we will meet the level of service in 2050.

Table 1: Our five year plan for modelling future pressures

How will we decide on water resource improvement schemes?

Our modelling plan (shown in Table 1) will assess the benefits, in terms of improvements in the level of service of various schemes to enhance water supplies and/or reduce water demands.

We will follow the flow diagram below (Figure 2) to subsequently decide which water resource improvement schemes should be recommended for implementation.

Determine scheme(s) to address the water shortage and quantify their yields –
could be new water supplies or a reduction in the water demands. Hydrological analysis is required.

▼

Model schemes to establish the overall improvement in the HU –
preferably over a long-term modelling period (usually 90 years of historical sequences), if the relevant data is available.

▼

Rank according to the agreed level of service and the yield benefits –
including individual and combinations of schemes.

▼

Calculate the whole life costs of the scheme(s) (or Net Present Value, NPV) –
combine capital costs with operational costs refer to p20-21 for more information.

▼

Apply an overall risk factor to scheme costings –
accounts for the broad uncertainty within the range of schemes.
Also takes account of innovative schemes which have not been created before and external factors (e.g. land access, heritage, consents) which may affect the cost of the final delivered schemes.

▼

Combine the yield with NPV costs for each scheme. Prioritise within each HU, based on the ranked cost (£ per Ml/d)

▼

Review prioritised list of schemes – by Asset Management & Performance team advise on any practical concerns.

▼

Establish the investment profile required to implement all schemes in all hydrological units –
timings for when investment is needed.

▼

Investment decisions on schemes made by Directors and plan approved by Trustees –
taking account of how we prioritise water resource schemes against all other areas of the Trust's expenditure

Figure 2: Flow diagram for deciding on water resources improvements

Quantifying whole life costs of schemes

It is important that we calculate the whole life costs and Net Present Value, (NPV) of proposed water resources schemes as improvements in the supply/demand balance can often be found through a wide range of schemes. NPV calculations are a common approach used to appraise long-term investment projects. They are the sum of the present values of costs (capital and operational) and benefits over a period of time. A discount rate is used to compare the present value of money to what it would be in the future, taking inflation and interest rates into account. The rate will we use will reflect the economic and market conditions at the time of assessment and will be completed on a project-by-project basis. Some schemes will have a high capital cost (but comparatively low operating cost) and others will have a low capital cost (but high operating cost). Calculating the NPV allows a meaningful comparison of the cost of different schemes (to prioritise investment). The following approach was endorsed by our respondents.

We will calculate the NPV for both capital and operational expenditure over a design life of 35 years. This period was chosen because:

- **it gives a reasonable balance between the design lives of a typical range of schemes;**
- **it caters for schemes that have a very high proportion of either capital or operational costs within their NPV;** and
- **it does not place an excessive emphasis on future costs that will occur many years from now.**

To estimate the capital costs for each scheme, we will complete the following actions –

- **Historic works cost data will be analysed to determine broad construction cost rates**
- **Actual costs and quotations for specific items will be investigated**
- **Typical costs for the management of the project will be estimated – design and project delivery**

Estimating the operational costs over the design life of a scheme has two key elements. There are running costs and routine maintenance, which includes replacing consumable items. The majority of schemes will not have high running costs as once they are complete, they will function as they are designed to (e.g. a new gravity feeder or a replacement crest on a waste weir). Schemes that involve pumping however are likely to have high running costs.

Pumping schemes consume electricity and incur Carbon Tax costs. Energy costs will be based on current energy prices, initially these will be estimated as 12 pence/kWh (over the 35 year design life) although this figure is subject to change. Carbon Tax costs will be calculated using the methods recommended by the Carbon Trust (Carbon Footprinting Guide, 2012). Currently, an estimated cost for the production of carbon is £16 per tonne. We will review these factor costings regularly to ensure that they represent the values used throughout the Trust and are broadly in line with external standards. All schemes will involve routine maintenance costs. These will be calculated based on the Trust's Planned Preventative Maintenance costs and renewal.

Strategic action 8

Model all feasible water resources schemes to assess the total quantity of water each will yield and the Net Present Value, using this to develop the business case for each scheme.

Social and environmental costs and benefits

The formation of the Trust and its declared charitable objects has led to broader thinking in terms of cost benefit analysis. Consideration should ideally also be given to social and environmental costs and benefits.

As such, it was deemed appropriate to investigate other options for assessing the suitability of water resource schemes (in addition to NPV costs and the water resource benefits) for attaining or maintaining a particular level of service. Four methods for assessing the social and environmental costs and benefits were reviewed. These were: Valuing Ecosystem Services (Defra, 2007), Value Transfer Guidelines (Eftec, 2009), Benefits Assessment Guidance (Eftec, 2012) and Study Social Return on Investment (Cabinet Office of the Third Sector, 2012).

After reviewing the guidance on the above methods of assessment of social and environmental costs and benefits, it was clear that any meaningful analysis would require extensive input from specialists in the fields of social studies and environmental economics. Added to this, there is still considerable uncertainty and debate around the suitability of these different assessment techniques.

Therefore, our future water resources schemes will continue to be prioritised on whole life costs (via NPV) and water resources benefits (£ per Ml/d) as these methods are robust, transparent and well-understood. As individual schemes are identified, detailed environmental appraisals will be undertaken and the Trust's objective to seek environmental enhancement will be pursued together with opportunities for wider social benefits in line with the Trust's charitable objects.

The Trust has recently embarked on a partnership with Cardiff University's Sustainable Places Research Institute to examine the social, environmental and economic impacts of waterways across the UK. We will review the outputs of this collaboration as part of the next cycle of the Strategy.

A large proportion of our respondents supported this approach but there were others that thought that we should still go ahead with calculating the social and environmental costs. As such, we will consult our colleagues to ensure that we are following the Trust's best practice in assessing social and economic costs and benefits.

Strategic action 9

Follow the Trusts best practice in assessing social, economic and environmental costs and benefits of different Levels of Service.

9 Phasing of water resources schemes

In 2011, we completed a number of Water Resource Plans where we modelled a range of possible schemes which could claw back the predicted water resources deficits by 2030. Using the modelled schemes, indicative investment profiles were generated which provide clarity on the likely phasing of schemes for each of the affected hydrological units. These were based on the magnitude of the increasing deficit as modelled over the period to 2030. An indicative investment profile can be seen in Figure 3 (below).

Each water resource scheme will be modelled to assess the total quantity of water it will yield, and the NPV cost. From this list of schemes we will assess which schemes will provide the optimum benefit to the system which is then planned for implementation to coincide with the predicted year which the Trust will no longer be able to meet the agreed level of service for the specific hydrological unit. This approach gives the 'saw-tooth' effect visible in Figure 3 below, as each scheme is implemented to address the deficit at that time.

We will continue to use the same approach for new water resources schemes, as it is a proportionate response to the modelled deficit, and ensures we are not over- or under-investing.

Strategic action 10

Aim to implement water resources schemes to coincide with the predicted year which the Trust will no longer be able to meet the agreed level of service for the specific hydrological unit, by inclusion within the Trust's business plan determination.

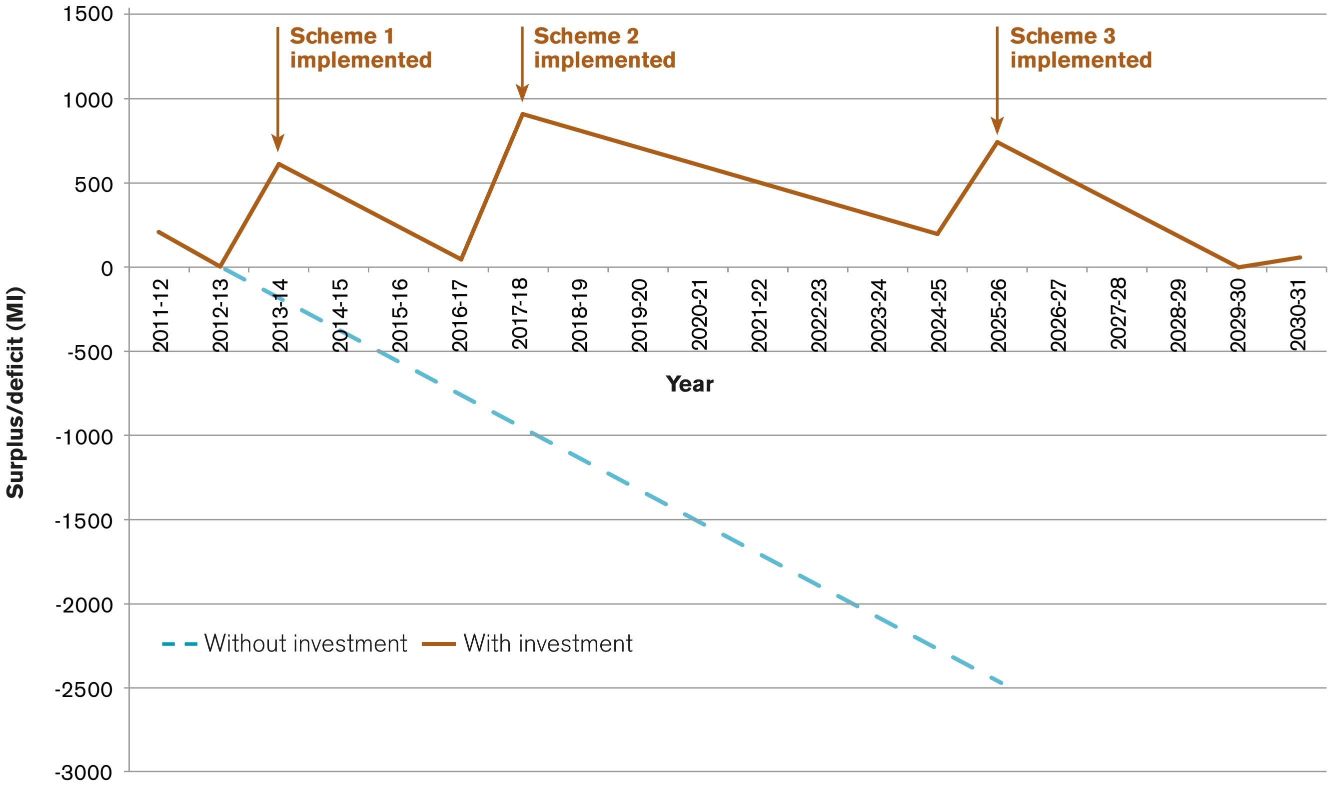


Figure 3: Illustrative investment profile

There were several respondents in the consultation that were confused by the illustrative investment profile that we included so we have tried to improve this to make it easier to understand.

Other issues

Dredging, side ponds and lock leakage are regularly cited as issues that we should be considering, because of the effect they are perceived to have on water usage. As such, we have reviewed them from a water resources perspective. Following consultation, we have set out our positions below. There are many aspects of these three issues that have not been rigorously studied in the past and many perceptions about potential water savings and costs that needed to be put to the test.

Dredging

Our approach to dredging set out below, was strongly supported by respondents in our consultation document.

There are three aspects of dredging that we considered:

- **Dredging for navigation and water resources**
- **Dredging to create 'reservoir pounds'**
- **Dredging of reservoirs to recreate storage that has been lost due to siltation**

In terms of dredging for water resources, we will further explore the water management benefits of main-line dredging and spot dredging. The Trust has produced a Dredging Strategy and water resource requirements will be included, so that any water resources benefits are quantified and optimised.

We will investigate our network thoroughly to identify specific locations that would benefit from dredging of canal pounds to create 'reservoir pounds' e.g. summit pounds. We will examine the costs of the works and the benefits in terms of water resources and will examine their potential for supply/demand options when determining the optimal solution to addressing a deficit. It should be noted however, that pound storage below the highest cill level is dead storage from a water resources perspective.

10

Strategic action 11

Further explore the water management benefits of main-line dredging and spot dredging. We will investigate the network thoroughly to identify specific locations that would benefit from dredging of canal pounds to create 'reservoir pounds' e.g. summit pounds.

Based on previous experience from costing schemes for the Water Resources Plans 2011, reservoir dredging is very unlikely to be prioritised in favour of other water resources schemes as it is not cost effective to do so. An example is Toddbrook Reservoir where we estimated that dredging the reservoir could increase the capacity by ~220 Ml. When the scheme was costed, it was significantly above the water industry standard figure of ~£1 million per Ml/d and the cost of alternative sources of supply.

Side ponds

Side ponds can be defined as:

- **Brick or stone built ponds at the side of a lock, used to hold water for the purpose of water saving**

These are not be confused with side pounds, which can be defined as:

- **Sections of canal used to increase the water storage between locks in a flight e.g. with a steep gradient**

The Trust presently does not have any form of position statement or Strategy for managing, reinstating or operating side ponds. They have never been specifically identified nor inspected as assets in their own right and instead are considered as being part of the primary asset (the lock) they are associated with. Additionally, there is no accepted methodology for assessing the water resources benefits for them (or the risks of water wastage if used incorrectly). As such they have been given very little focus.

The majority of respondents to our consultation agreed with our approach set out below. We will consider each site on a case-by-case basis and the costs and benefits to the wider business including water resources, environment and heritage will be investigated along with the downstream water resource requirements. We acknowledge that side ponds can also be used as an educational feature to emphasise the need to conserve precious water.

Consultation within the Trust suggests that if sideponds were to be used, reinstated or created, then clear instructions should be provided. Anecdotal evidence suggests that water was wasted in the past by incorrect use. An automated system that would only allow paddles and sluices to be operated correctly, or the use of volunteer lock keepers at sites with side ponds (locking up when not manned), would help reduce this risk.

Side ponds will be identified and recorded as separate sub-assets on each primary lock asset, so that the Trust has a definitive register of locks with side ponds and a simple spreadsheet analysis tool will be developed that will be able to assess the water resources benefits of side pond usage.

Strategic action 12

Identify and record side ponds as separate sub-assets on each primary lock asset, so that the Trust has a definitive register. Assess the water resources benefits of side pond usage.

Lock leakage

There are various locations within the Trust's network where lock leakage is a significant issue. There are various types of lock leakage including lock gate leakage, paddle leakage, leakage under the cill and through the lock walls. Of these, lock gate leakage and paddle leakage have the greatest impact on water control and water resources and are a very visible form of apparent water wastage to our customers.

The impacts on water resources of lock leakage in a flight of locks tends to depend on the need to transfer water down the flight to meet demands further down the system. If the need to transfer water down a flight is greater than the net lock leakage then there is generally no water resource benefit from repairing lock gates. A reduction in the net leakage rate in the gates will simply mean that there will be higher flows in the bypass structures to achieve the required transfer rate. However, this does not mean that there will be no benefits from lock gate repairs (such as heritage and flood control issues) and of course improving customer perceptions about the level of maintenance of the Trust's network.

Within this first Strategy we will consider how best to communicate with our customers about leaking lock gates and their impacts on water supply, particularly during periods of drought.

The greatest water resource benefits from lock leakage repairs are when the need to transfer water is less than the net lock leakage rate. This is because the additional water passing down the flight is likely to be lost from the canal system in the trough pound or at a terminus of the canal (e.g. at a lock onto a navigable river or via docks into an estuary). These benefits from repairs are greatest in systems where the water supply is limited and back pumps have been installed to recirculate and/or transfer the water. A significant lock leakage in this scenario results in inefficient pumping as the leakage water has to be recycled as well as the lockage water.

Lock leakage, and in particular, lock gate replacement is addressed in the Trust's Asset Inspection Procedures. At present, lock gates are assessed separately from the primary lock asset as their lifespan is much shorter than the lock itself.

Lock gates are assumed to last around 25 years and it is therefore necessary to replace about 4% of the gates annually. This means that about 150-200 lock gates need to be replaced every year (most broad locks have four gates, two head and two tail whereas narrow locks tend to have only one head gate and one tail gate). While other assets in the Trust are prioritised on risk (the product of condition and consequence of failure), lock gates are currently prioritised on condition only, of which water leakage is only one factor (and does not explicitly consider the need to transfer water down the flight).

We have recommended that the design of lock gates explicitly considers the following aspects. The height of the gates with respect to the freeboard above normal water level needs to be taken into account as well as the weirage required by the gate and how this is impacted by fenders. Additionally, the water resource impacts of lock leakage need to be investigated taking account of the position of the locks in the canal system and the need to transfer water past the structures, the impacts on the management of canal pound levels and the impacts on pump efficiency. The above approach was agreed by most respondents to our consultation.

Strategic action 13

Take account of water control in lock gate design more comprehensively and assess lock leakage more thoroughly.

Cycle of the strategy

We will progress this and future Water Resources Strategies on a five year cycle. This Strategy will run from 2015 to 2020. There was considerable support for this approach in our consultation, particularly from water industry respondents who work to a similar timescale. The Strategy will be updated and revised following feedback, progress made and any relevant changes or developments that affect the water resources of the Trust's network.

Every year, updates will be made to the following hydrological model elements where appropriate:

- **Water sales;**
- **Marinas;**
- **Inflow sequences;**
- **Annual lockage values**
- **Reservoir storage tables;**
- **Any other change to the network assessed as requiring an update to the model.**

We will also produce and publish on our website an annual report to show our progress against our Strategy actions. The Water Resources Strategy document will be updated every five years. The cycle will involve the following activities as shown in Figure 4 below.

Strategic action 14

Progress this and future Water Resources Strategies on a five year cycle. This Strategy will run from 2015 to 2020. Produce and publish an annual report to show our progress against our Strategy actions on our website.

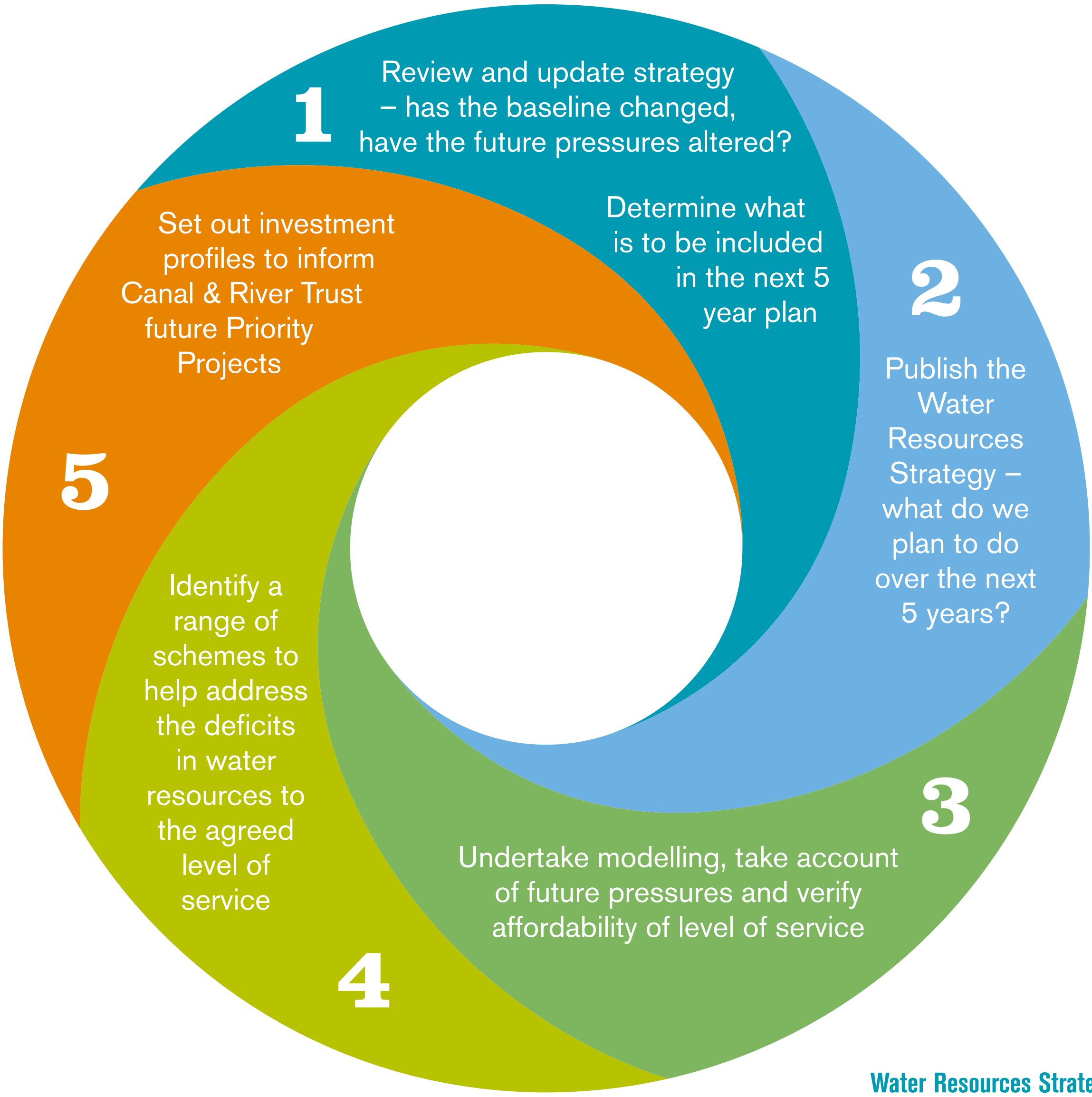


Figure 4: Water Resources Strategy Cycle

Appendix 1

Hydrological units, including phase 1 modelling cycle.

In 2008, we defined 14 priority hydrological units and used these for the assessment and analysis within our National Water Resource Plan 2008 (NWRP 2008). Since then, we have incorporated the Trust's entire network within hydrological units. The number of hydrological units within England and Wales increased from 14 (NWRP 2008) to 53. Further to this, we characterised the units into three different types:

- **Reservoir/groundwater/surface water feeder supported systems –** these are waterways often seen as the 'classic artificial canals', where they are man-made channels often crossing river catchments. They are mainly supplied by reservoirs or groups of reservoirs (with reservoirs typically being located on or near the canal summit pounds). However, other sources of water can include pumped groundwater sources or surface water streams flowing directly into the canal.

Map Ref	Hydrological unit	Hydrological unit type
1	Aire & Calder, Knottingley & Goole Canals	River Fed
2	Aire & Calder Navigation	River Navigation
3	Birmingham Canal Navigations (BCN)	Reservoir/groundwater/feeder supported
4	Bridgewater & Taunton Canal (B&T)	River Fed
5	Bristol Avon Navigation	River Navigation
6	Calder & Hebble Canal	Reservoir/groundwater/feeder supported
7	Calder & Hebble Navigation	River Navigation
8	Chesterfield Canal	Reservoir/groundwater/feeder supported
9	Cromford Canal	Reservoir/groundwater/feeder supported
10	Erewash Canal	River Fed
11	Fossdyke Canal	River Fed
12	Gloucester & Sharpness Canal (G&S)	River Fed
13	Grand Union South	River Fed
14	Grand Union Tring	Reservoir/groundwater/feeder supported
15	Grantham Canal	Reservoir/groundwater/feeder supported
16	Huddersfield Broad Canal (HBC)	River Fed
17	Huddersfield Narrow Canal (HNC)	Reservoir/groundwater/feeder supported
18	Kennet & Avon Canal (K&A)	River Fed
19	Lancaster Canal	Reservoir/groundwater/feeder supported
20	Leeds & Liverpool Canal (L&L)	Reservoir/groundwater/feeder supported

- **River-fed systems –** these are either canalised river sections or man-made canals sometimes linked to rivers, but are predominately fed by the upstream river catchment.
- **River navigations –** these are sections of river that have had relatively minor, or even no alteration to allow for navigation. The channel may have been widened or dredged to provide the required dimensions for navigation and locks are required to allow for gradient changes. Weirs are often required, particularly near locks to create sufficient depth for navigation. The demands of displaced lockage are entirely met by the catchment flows from upstream.

Previously, the majority of effort has been focused on reservoir/groundwater/surface water feeder supported systems as they require more water resources management effort and have greater interconnectivity within and between hydrological units. We have focused much less on the water resource reliability of the river-fed systems and river navigations. This is due to the reliance of river-fed systems and river navigations on the flow regime within the river catchments which are outside of our direct control. Please refer to the table below which details all 53 hydrological units, their unit type, model software and planned modelling within the first five year cycle of the Strategy.

Model Software	Planned Modelling within 1st five year cycle of water resource strategy
Aquator	No
Spreadsheet	No
Aquator	Yes
Aquator	No
Spreadsheet	No
Aquator	No
Spreadsheet	No
Aquator	No
Spreadsheet	No
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Aquator	Yes

Continued on p30 ▶

Map Ref	Hydrological unit	Hydrological unit type
21	Liverpool Docks	River Fed
22	Llangollen & North Montgomery Canals	River Fed
23	London Canals	River Fed
24	London Docklands	River Fed
25	Lower Lee/Lea Navigation	River Fed
26	Lower Sheffield & South Yorkshire Navigation, Stainforth & Keadby Canal and New Junction Canal (Lower SSYN, S&K and NJC)	River Fed
27	Manchester Bolton & Bury Canal (MB&B)	River Fed
28	Monmouthshire & Brecon Canal (M&B)	River Fed
29	Montgomery Canal South	River Fed
30	Nottingham & Beeston Canal	River Fed
31	Oxford & Grand Union Canals (OX&GU)	Reservoir/groundwater/feeder supported
32	Peak & Potteries (P&P)	Reservoir/groundwater/feeder supported
33	Pocklington Canal	River Fed
34	Ribble Link	River Navigation
35	Ripon Canal	River Fed
36	River Severn Navigation	River Navigation
37	River Soar Navigation	River Navigation
38	River Trent Navigation	River Navigation
39	River Weaver Navigation	River Navigation
40	River Witham	River Navigation
41	Rivers Ure & Ouse	River Navigation
42	Rochdale Canal	Reservoir/groundwater/feeder supported
43	Selby Canal	River Fed
44	Sheffield & South Yorkshire Navigation (SSYN)	River Navigation
45	Sheffield & Tinsley Canal	River Fed
46	Shrewsbury & Newport Canal	Reservoir/groundwater/feeder supported
47	Shropshire Union and Staffs & Worcester Canals (SU&SW)	Reservoir/groundwater/feeder supported
48	South Oxford Canal (SOX)	River Fed
49	St Helens Canal	Reservoir/groundwater/feeder supported
50	Swansea Canal	River Fed
51	Tees Navigation	River Navigation
52	Trent & Mersey Canal	River Fed
53	Upper Lee & Stort Navigation	River Navigation

Model Software	Planned Modelling within 1st five year cycle of water resource strategy
Spreadsheet	No
Aquator	Yes
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Spreadsheet	No

Appendix 2

Organisations that helped us to shape this Strategy

- **Canal & River Trust –** Council Meeting, 4 July 2012
- **Canal & River Trust –** Trustee Meeting, 25 July 2012
- **Canal & River Trust –** Annual Meeting, 9 July 2013
- **Canal & River Trust –** Partnership Meeting and Environmental Advisory Group, 24 September 2013
- **National Association of Boat Owners (NABO) –** Annual General Meeting, 16 November 2013
- **Canal & River Trust –** Internal colleagues during drafting of consultation
- **Nick Reynard –** Centre for Ecology and Hydrology (CEH)
- **Pauline Smith –** Environment Agency (EA)
- **Association of Pleasure Craft Operators (APCO) –** Tim Parker, 27 June 2012
- **Inland Waterways Association (IWA) –** Clive Henderson, Paul Soper, 8th August 2012
- **Consultation responses received from:**

1	Swansea Canal Society
2	Roving Canal Traders Association
3	Lancaster Canal Trust
4	Historic Narrow Boat Club
5	The Commercial Boat Operators Association
6	Fernside Productions
7	Macclesfield Canal Society
8	Owd Lanky Boaters Group
9	Linnet's Circus
10	Consumer Safety UK
11	Association of Pleasure Craft Operators (APCO)
12	Somersetshire Coal Canal Society
13	Shrewsbury & Newport Canals Trust
14	Kings Langley Angling Society
15	ABP Marine Environmental Research Ltd
16	National Association of Boat Owners (NABO)
17	Southern Water
18	Nottinghamshire County Council
19	Herefordshire and Gloucestershire Canal Trust
20	DBA The Barge Association
21	South East Water
22	English Heritage
23	IWA Chester & Merseyside Branch
24	Lincolnshire Branch of the IWA
25	United Utilities
26	Inland Waterways Association (IWA)
27	National Farmers Union (NFU)
28	Colne Valley Anglers
29	W&B Canal Trust
30	Natural Resources Wales (NRW)
31	Welsh Water
32	Thames Water
33	Chartered Institution of Water and Environmental Management (CIWEM) - HQ Policy Team
34	Chartered Institution of Water and Environmental Management (CIWEM) – Chair, Water Resources Panel
35	Manchester & Pennine Waterway Partnership
36	Staffs & Worcester Canal Society

Appendix 3

Glossary

Abstraction – The removal of water from any source, either permanently or temporarily.

Abstraction licence – The authorisation granted by the Environment Agency or Natural Resources Wales to allow removal of water from a source.

Aquator™ – The name of a water resources computer modelling system used by the Trust and some water companies e.g. United Utilities.

Defra – Department for Environment, Food and Rural Affairs.

EA – Environment Agency.

GIS – Geographical Information System is a system designed to capture, store, manipulate, analyse, manage, and present all types of geographical data.

Headroom – Is a buffer between supply and demand designed to cater for specified uncertainties. Uncertainties are inevitable in planning but it is important to reduce them as far as possible.
For more details see References: EA (Environment Agency), 2012b.

Hydrological unit – Sections of waterway that share a common source (or group of sources) of water supply to meet demands for water.

Level of service (LoS) – How frequently the Trust expects a navigational drought to occur

Megalitre (Ml) – A million litres or 1000 cubic metres.

Net Present Value (NPV) – Net Present Value of a schedule of costs for a programme. NPV is a very widely used method to combine various costs occurring over a period of time into a single value for comparison with the NPV of an alternative programme.

UKCIP – United Kingdom Climate Impacts Programme.

WRP – Water Resources Plan.

WRMP – Water Resources Management Plan.

Yield – A general term for the reliable supply of water from a source.

Appendix 4

References

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