Canal & River Trust
Making life better by water

Realising value from waterways

Asset Management Strategy 2017 (Issue 2)

Custodian: Richard Wakelen, Head of Asset Strategy & Engineering Services

Date: 30 June 2018

Review record:

Issue	Date	Changes
1	10 January 2017	Original
2	30 June 2018	Amendments following external consultation and learning from the pilot phase of the asset strategy work. Includes addition of new section (12) on Serviceability and addition of new appendix.

Contents

Foreword

Our network of historic inland waterways extends some 2000 miles from Teesside to Taunton, connecting many major cities, towns and rural villages. Although their use has changed significantly over the last 200 years, our waterways continue to influence the culture, environments, societies and economies of which they are part. Today they are places of recreation and relaxation, they are routes for sustainable transport and communications, they contribute to energy and water supplies, and are a focus for local regeneration.

The Canal and River Trust is committed to delivering the greatest benefits from waterways that it can. This strategy sets out our approach to the operation and maintenance of our waterways for the next 5 years and beyond, so that they continue to support a diverse range of activities that contribute to personal, community and national well-being.

Richard Parry
Chief Executive
Canal & River Trust

This Asset Management Strategy (AMS 2017) details our strategic asset management plan for the period 2017-2021. It builds on the excellent progress made by the Trust in developing an asset management system over many years and presents some new and innovative changes to further improve how the waterway assets will be managed for generations to come. This is an important strategy to support and enable the Trust to fulfil its vision for living waterways that transform places and enrich lives.

Richard Wakelen
Head of Asset Strategy & Engineering Services,
Canal & River Trust

Summary

The Canal & River Trust is the guardian of 1,913 miles of historic inland waterways across England and Wales. We maintain the nation's third largest collection of listed structures, including locks, aqueducts, bridges, tunnels, docks, wharves, historic warehouses, offices and houses, as well as reservoirs, embankments and cuttings and many important wildlife habitats.

We believe that our canals and rivers are a national treasure which contributes to the well-being of our customers and the communities in which they live. Caring appropriately for this legacy is vital to the achievement of our vision for living waterways that transform places and enrich lives. Our ambition is to attract more visitors to our waterways and museums and support a thriving community of private boaters and boating businesses. We aim to involve local people and volunteers in caring and improving their local waterway and engender widespread support for waterways and the activities of the Trust.

To help ensure that we maintain our waterways efficiently, effectively and sustainably, we developed Asset Management Strategy (AMS) 2017. AMS 2017 sets out our asset management approach for the period 2017 to 2021 inclusive to help realise the value from our waterways for generations to enjoy now and in the future. Whilst the emphasis of AMS 2017 is on the management of physical assets, our activities are focussed on attaining benefits from waterways for our customers and communities. Providing good customer service and a positive customer experience is central to our asset management approach.

Issue 1 of AMS 2017 was issued in January 2017. It has been reviewed and updated to Issue 2 to reflect both the feedback from the consultation sessions we have held, as well as the learning from carrying out the pilot phase of the asset strategy work.

1 Introduction

This Asset Management Strategy is the Trust's five-year strategic plan for 2017-2021. It contains our asset management objectives and defines what needs to be done to improve our asset management capability to meet these objectives and to demonstrate a level of asset management maturity that aligns with the international standard for Asset Management, ISO 55000.

The strategy aims to provide a holistic overview of the Trust's approach to asset management covering the asset management system and considering both current and future requirements influenced by factors such as changes in customer expectations, legislation and climate change.

This document forms part of our asset management system which operates in the context of our charitable, contractual, legislative & regulatory commitments. It is aligned with, and informed by, the role, purpose, vision and values for the Canal & River Trust, and the goals and objectives set out in our organisational strategic plan - *Living Waterways Transform Places & Enrich Lives*. Our asset management system is complementary to our health and safety management system and our environmental management system.

This document should be read in conjunction with our Asset Management Policy which encompasses a set of policy statements and underlying principles that summarise our approach to asset management. The Policy is aligned to our organisational objectives and reflects our commitment to managing our assets efficiently, effectively and sustainably so that our waterways continue to be enjoyed and valued by our customers and communities.

This Asset Management Strategy adds detail to our Asset Management Policy, setting out how we will undertake to manage our waterway assets. It replaces the *Asset Management Plan 2012* and the *Infrastructure Risk Management Strategy 2011-16* and represents the national strategic asset management plan for the Trust. It will be underpinned by more detailed strategies at an asset category level.

The relationships between our organisational plan, our Asset Management Policy, this Asset Management Strategy and other elements of our asset management system are illustrated in Figure 1. The figure also serves to illustrate how our asset management system supports the realisation of value from waterways and the achievement of our organisational objectives.

This Asset Management Strategy has been shared with several of the Trust's national customer groups during 2017 (see Appendix A); further consultation on the strategy and its strategic improvements is anticipated during 2018.

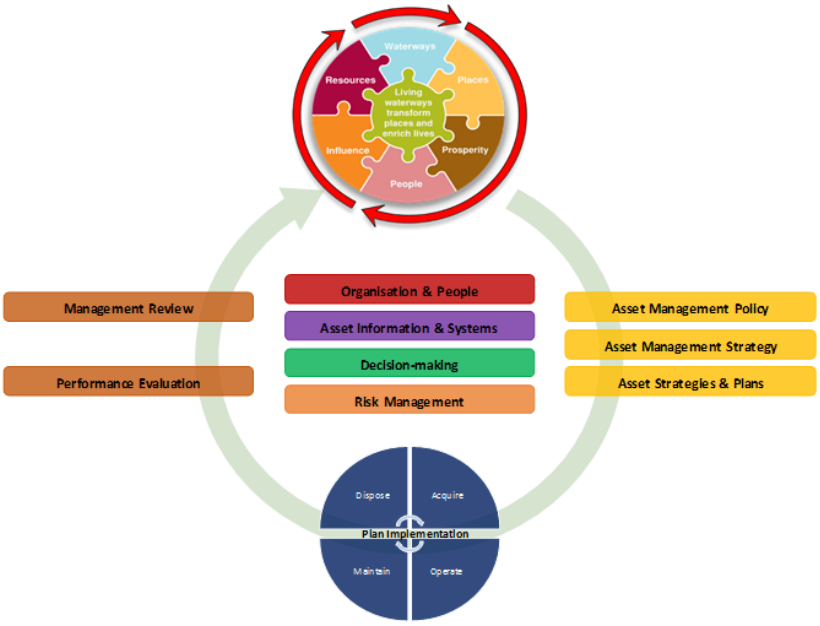


Figure 1 Our asset management framework

2 Asset summary

The Canal & River Trust is custodian of a network of inland waterways and associated reservoirs and docks in England and Wales which are of historical, environmental, cultural and economic importance to the nation. The enjoyment of our waterways is founded on the historic structures such as locks, aqueducts, bridges, tunnels, embankments, cuttings, docks, wharves, historic warehouses, offices and houses, as well as the water, natural habitats and other historical sites and artefacts which complete the waterway landscape. We are committed to managing these features (or assets) as efficiently, effectively and sustainably as possible to fulfil our vision for living waterways that transform places and enrich lives and enable our waterways to be valued and enjoyed by future generations.

Most canals in the UK were constructed between 1750 and 1840 (a period of so called 'Canal Mania') during the Industrial Revolution. Designed by pioneering engineers such as Brindley, Telford and Rennie, they played a pivotal role in transport, transforming the movement of bulk goods. However, with the advent of the railways in the 1830's, freight transport on the canals declined and consequently, many canals became uneconomical and fell into disuse, or were abandoned.

Interest in canals, particularly for leisure cruising, was renewed in the 1960's. Since then, many canals have been improved; and some have been restored to navigational use. Today, our canals and river navigations vary in their use; some support commercial traffic, but most are enjoyed by powered leisure boats of which there are over 35,000 on our waterways. A similar number of unpowered craft (e.g. canoes) also use the waterways. Linking the UK's main centres of population, waterway towpaths provide routes for walkers and cyclists. They are also popular angling venues. Some canals and river navigations support important utility services, supplying water for both public and agriculture use, contributing to local surface water drainage systems, and accommodating fibre-optic communication cables and other utility networks along their towpaths and bridges.

The Canal & River Trust manages 1,913 miles of waterways (1,571 miles of canal and 342 miles of river), from the Tees Navigation in the north, to Taunton in the south-west, and London in the south-east. Our waterways are one of the World's great historic estates, including 49 Scheduled Ancient Monuments, 2,701 listed buildings, and 1 UNESCO World Heritage Site (Pontcysyllte aqueduct and canal). They also traverse and adjoin a further 4 World Heritage Sites, 317 conservation areas, 42 historic parks and gardens and 9 historic battlefields.

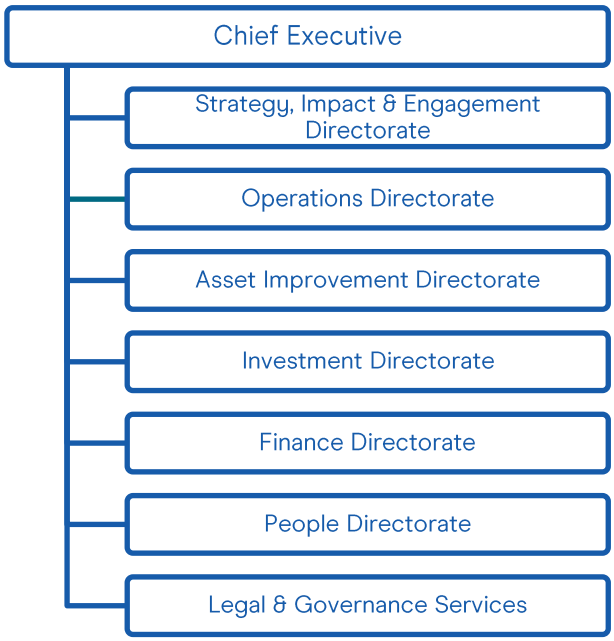
In addition to their heritage value, our waterways, reservoirs and docks are recognised as being important for wildlife on a local, national and international scale. They support some 63 Sites of Special Scientific Interest, 13 of which are also designated as Special Areas of Conservation and/or Special Protection Areas. They are also home to a variety of rare and important plants and animals, including floating water-plantain, water voles and bats.

This Asset Management Strategy has been developed to summarise our approach to managing our waterway assets.

3 Current performance

3.1 Our organisational structure

The executive structure of the Canal & River Trust is illustrated in Figure 2.



Our Operations directorate runs our waterways and acts as champion for our customers, ensuring service and experience are given prominence in work prioritisation and delivery.

Our Asset Improvement directorate, includes technical teams responsible for identifying, prioritising and specifying work requirements, and teams responsible for carrying out maintenance, repair and renewal works to our waterway assets.

Both directorates are supported by central functions which provide consistent services to all parts of the organisation.

Figure 2 Organisational structure

3.2 Asset management outcomes

In line with the obligations of our Grant Agreement with Defra, our asset management performance is currently assessed and reported annually against a suite of defined measures known as the Publication Data (Canal & River Trust Annual Report & Accounts). Several of the measures relate to the condition of our assets which are graded from A to E, where A represents an asset in prime condition and E represents a seriously deteriorated asset. Three of the measures, known as the 'Relevant Standards', are used to determine the payment of the conditional element of the Defra Grant; these are summarised in Table 1.

The green cells in Table 1 indicate results that are better than the Defra thresholds. Performance since 2012 has been positive and there has been a continual year-on-year reduction in the number of condition D and E Principal Assets.

Relevant Standard	Measure	Thresholds		Results					
		Warning	Breach	Jul 2012	2012/13	2013/14	2014/15	2015/16	2016/17
Safe Waterways	Principal Assets in Grades D&E	23%	25%	17%	15.2% +	14.7% +	14.1% +	13.8% +	13.43% +
Towpath Condition	Towpaths in Grades A, B, C	60%	50%	75%	76. 3% +	75.8% -	76.1% +	78.42% +	78.51% +
Flood Management	>£2m breach damage D&E culverts & embankments	4%	7%	2.3%	1.32% +	1.57% -	1.41% +	1.44% -	0.96% +

Table 1 Defra Grant Agreement 'Relevant Standards' 2012- 2016.

Our general stewardship of the waterways is also assessed and reported annually against the Network Stewardship Score (NSS). The NSS is a combined measure of the condition and functionality (usability) of, and the public benefit delivered by, our waterways. The overall condition of the waterways in terms of physical condition of our assets, functionality of the network, and asset-related safety is summarised through the combination of 11 indicators into a Waterways Condition Index. Progress in delivering public benefits in respect of visitor numbers and customer experience is summarised through the combination of a further 7 indicators into a User Benefits Index. A summary of the indices and their scores for the last four years are presented in Table 2.

Index	Score			
	2013/14	2014/15	2015/16	2016/17
NSS Index	114	119	119	120
Waterways Condition Index	118	119	123	125
User Benefit Index	106	117	111	113

Table 2 Summary of National Stewardship Scores, 2013-2016

The User Benefit Score for 2015/16 fell in relation to 2014/15 due to a decrease in visitor numbers and a reduction in customer experience scores.

Although useful in reflecting our general stewardship as a single index, the complexity of the index means that poorly performing measures can mask good performing measures in the calculation of the NSS score and the scores reported for the NSS indices do not have direct meaning for our customers.

So, in respect of the NSS, our approach will be two-fold: firstly, we will continue to ensure that we achieve a satisfactory level of performance across the index and continue to report the score to Defra; and secondly, we plan to review its on-going use. Our plan is to develop a more meaningful set of asset-related outcomes that provide a better understanding of performance for our customers and communities. During the next few years, we anticipate replacing the NSS with these new outcomes. In this regard, we are looking at the potential to develop indices of network availability and reliability.

Our strategy is to ensure that we perform consistently, year-on-year, to a satisfactory level that maintains the safety, serviceability, availability and reliability of our waterways for the benefit of our customers. This means we will continue to focus our investment at an appropriate level to deliver asset-related outcomes and meet the Defra 'Relevant Standards'.

3.3 Asset management system

We continue to develop our asset management system in line with industry standards. The UK standard for asset management, Publicly Available Specification (PAS) 55:2008 was replaced by the full international standard ISO 55000: 2014. Under both standards, an organisation's level of asset management maturity is measured on a 5-point scale. Both standards acknowledge that 'compliance' may be achieved at different levels depending upon the maturity of the organisation and the nature and complexity of its assets. A maturity score of 3 is deemed full compliance with both PAS 55 and ISO 55000.

In 2009, as British Waterways, an internal assessment of the asset management system was undertaken against PAS 55, using the Institute of Asset Management (IAM) self-assessment methodology. The maturity level was assessed at 2.3. In 2011, an external, peer review of the asset management system was carried out, involving United Utilities, Yorkshire Water and the Highways Agency. Using the IAM self-assessment methodology for PAS 55, the maturity level was determined to be 2.6.

In May 2016, the Canal & River Trust carried out a self-assessment of the asset management system against ISO 55000 – the international standard for Asset Management which replaced PAS 55 in 2015. The assessment score was 2.86. A further self-assessment carried out in May 2017 saw the assessment score increase to 2.87.

Our strategy is to continue to develop the maturity of our asset management system ensuring we align with the principals of ISO 55000. We will consider the option, and cost-benefit of, obtaining formal certification to ISO 55000.

3.4 Investment

Our total expenditure on waterway infrastructure maintenance in 2016/7 was £152.5m; expenditure in the previous year, 2015/6 was £144.3m (Canal & River Trust Annual Report & Accounts 2017). Much of the additional expenditure in 2016/17 relates to the works performed following the winter floods – particularly the repairs in the Calderdale area.

Recently, our investment in the maintenance, repair, refurbishment and replacement of our infrastructure assets has been planned in accordance with our *Infrastructure Risk Management Strategy 2011-16* as follows:

- categorisation of risk associated with our Principal Assets according to their condition grades and consequence of failure grades;
- prioritisation of investment in our Priority Projects Programme based on risk, and in line with the Defra target to maintain the number of Principal Assets in condition grade D or E below 23% and our aim to eliminate the risk from Principal Assets with the poorest condition grade E and highest consequence of failure 5, through appropriate repair, replacement or mitigation;
- prioritisation of investment in our Priority Works Programme including lock gate replacements, planned preventative maintenance and repairs, according to condition and risk; and
- consideration of planned expenditure against our Steady-State model which estimates the current cost of sustaining the various aspects of waterway maintenance sufficiently to prevent long term decline and maintain the waterway infrastructure in a reasonably functional condition.

Future investment will continue to be based on prioritising assets in the worse condition and with the highest consequence of failure. A more refined condition score and condition index is being developed and this will be used along with consequence of failure (including its monetisation) to support the prioritisation and level of investment. Investment will be optimised across all key investment programmes including Priority Projects, Priority Works, Operational Contracts, Operational Capital and Fundraising. Our strategy is to ensure that we invest at the appropriate level to deliver the asset-related outcomes and meet the Defra 'Relevant Standards'.

The actual level of investment beyond 2017 is expected, in the short term, to be in line with historical values. However, the development of new asset condition indices and new asset strategies, is expected to offer opportunities to realise a more effective and efficient investment plan but could also identify some areas of additional investment.

4 Asset management objectives

Our aim is to focus the way we manage our assets to deliver our vision for living waterways that transform places and enrich lives and realise the value of waterways for customers and communities. We wish to grow the number of people using and enjoying our waterways and engage widespread support for waterways and the work of the Trust.

Our key organisational objectives for asset management are:

- To focus our asset management activities on the achievement of the goals and objectives set out in our organisational strategic plan;
- To manage our assets efficiently, effectively and sustainably to provide safe and serviceable waterways and towpaths at the lowest cost for our customers and stakeholders; and
- To continually improve our asset management capabilities to help accomplish our objectives.

This Asset Management Strategy sets out our asset management approach for the period 2017 to 2021 inclusive.

5 Health & safety

The Trust has statutory duties under the Health and Safety at Work Act 1974 and Occupiers Liability Act 1984 to protect its employees, contractors, volunteers, customers and the public from harm. We have additional duties under a wide range of statutory instruments concerning the operation and maintenance of our assets.

The Trust has chosen to develop and implement a health and safety management system (HSMS) aligned to BS OHSAS 18001: 2007. The HSMS is a systematic approach to addressing the health, safety and welfare issues within the Trust. This management system applies to all Trust activities in England and Wales, including the work of our people and volunteers, and the impacts of our activities on contractors, volunteers and the public. In addition, it seeks to control the inherent risks of the Trust's waterways on customers and neighbouring communities. Under the HSMS, health safety and welfare issues are identified and addressed, and performance improved where reasonably practicable.

Our strategy is to continue maintaining and implementing an effective HSMS system to minimise the risks associated with all work activities and control the inherent risks of the Trust's waterways.

6 Environmental management & heritage conservation

Our waterways are enriched by their natural and historic environmental assets. The management of these assets (the built heritage and archaeology; and the quality of air, land, water, flora and fauna and conservation of under the Trust's stewardship) is governed by our environmental management system (EMS), which accords with the principles of ISO 14001: 2015.

The EMS operates within the context of the Trust's charitable, contractual, legislative & regulatory commitments and is aligned with the Trust's role, purpose, vision & values, and strategic objectives. The Trust is assigned statutory duties for the historic and natural environment under the British Waterways Act 1995. Our activities are also subject to the provisions of many additional statutes concerning the management of the natural and historic environment.

The EMS is relevant to all the Trust's activities, in respect of both what we do and what we procure. It influences the way in which we manage and work with our contractors and suppliers.

Our waterways are used for navigation and recreation. We seek to integrate the needs of those who visit and use the waterways with a sustainable approach to effective management of the waterways natural and historic environment.

In line with our vision, we seek to become the acknowledged expert in achieving sustainable integration of the competing needs and uses of the waterways. Compliance with legislation and regulation is a minimum requirement. We aim to exceed this requirement by continually improving our performance and following appropriate best practice.

Our approach to the management of our natural environment is:

- To identify and report on the condition of our environmental assets (our natural environmental capital);
- To prioritise those assets of greatest public benefit and those impacts that most threaten them and set targets to protect and improve asset condition;
- To ensure our people, contractors and customers are aware of the value of our environmental assets and the processes and guidance we have in place to protect and enhance them;
- To implement measures to achieve our targets for protection and enhancement; and to ensure legal compliance; and
- To monitor and report on our progress.

The Trust's primary heritage assets consist of its historic canals and river navigations, and their built heritage, archaeology and man-made landscapes. Our cultural heritage consists of the historic boats, portable artefacts and archives that the Trust manages in partnership with others. Beyond these, the wider historic environment includes assets that are not managed by the Trust but are nevertheless important to the appeal and use of our waterways.

Our aim is for the heritage of the waterways to be treasured as a valued national asset. The careful protection and management of that heritage is an essential part of the ongoing work to achieve our vision.

Where balances and judgments need to be made between competing resources and activities, we will take a long term and strategic view that assumes a presumption in favour of preserving the waterway heritage.

7 Customer services – establishing needs & expectations

The Canal & River Trust's inland waterways support a range of activities that benefit a variety of customers. Our Governance structure includes Regional Advisory Boards aligned to our individual regional operational units. These bring together a range of people with relevant skills, knowledge and expertise to support the Trust and represent customers' and stakeholders' interests. They include boaters, canoeists, anglers, walkers, cyclists, those with experience of business, local government, environmental & heritage conservation, communities, volunteering, young people, health & well-being, diversity & fundraising. We are also supported by several Advisory Groups including Navigation, Freight, Heritage and Environment and Angling. The groups include external representatives with skills, knowledge and expertise in each field whose primary role is to give advice on strategic issues. In addition, we consult with customers through a variety of other forums.

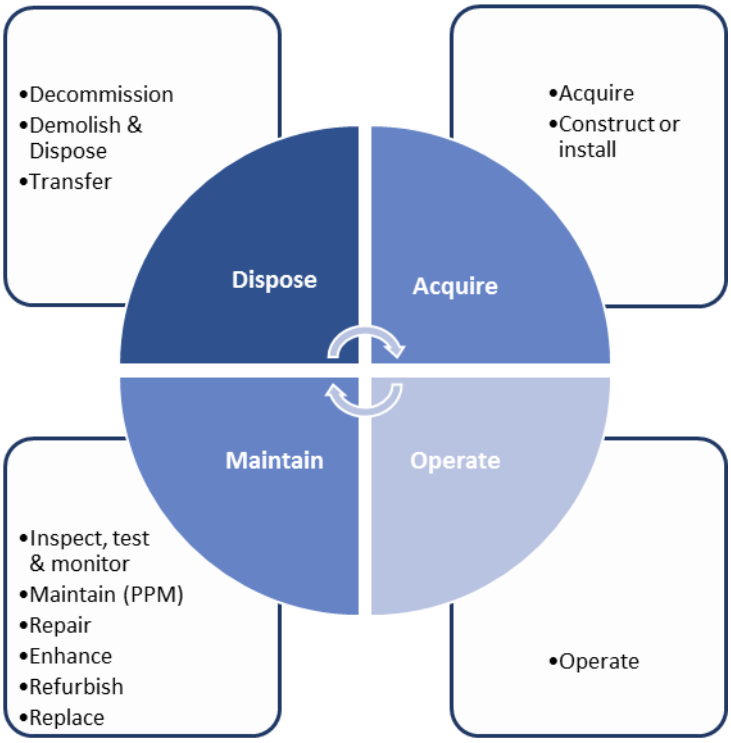
We will continue to engage with the various consultative groups to understand our customers' ambitions for both existing and future services provided by our waterways and consider how the realisation of these ambitions may be best supported by our asset management activities. This will include on-going consultation on the development of a suite of customer service standards, including safety standards; standards concerning the provision of customer facilities; vegetation management standards; and information concerning waterway dimensions.

We will also constitute and convene an Asset Management Advisory Group, comprising experienced asset management practitioners, to provide advice, help us grow our asset management capabilities and bench-mark our asset management performance.

8 Asset strategies

All assets have an asset life (i.e. the period from its creation to its end of life), during which it passes through several stages of management known as the life-cycle. At each life-cycle stage, an asset may be subject to different types of intervention which may serve to prolong its life.

We have recently reviewed and redefined our asset life-cycle interventions as summarised in Figure 3. They will provide the foundation for aligning our asset strategies and plans and will enable greater understanding of the impacts of our investment upon our assets, asset systems and asset portfolio.



In 2015, we published a Water Resources Strategy aimed at providing long-term water security for our waterways and their customers. We are currently preparing a Flood Risk Management Strategy.

We are also preparing asset strategies for locks, lock gates, bridges, aqueducts, culverts, tunnels, embankments & cuttings, bank protection, towpaths, channels, pumping stations, sluices & weirs and reservoirs. We aim to complete many of these by October 2018.

Our asset strategies will focus on the full asset life-cycle and will be developed to optimise the lifetime cost of ownership and ensure the safety, serviceability, availability and reliability waterways for customers.

The new asset strategies will determine the appropriate level of interventions and investment required to ensure we provide a sustainable level of performance across defined asset-related outcomes and to ensure we meet the Defra 'Relevant Standards'.

Figure 3 Asset life cycle

Planned replacement, refurbishment and maintenance tasks for all assets will be co-ordinated to optimise our total investment costs. In addition, the following will be considered during the development of asset strategies and investment plans:

- Assets will be provided, refurbished and maintained to provide the required levels of performance and functionality at the overall optimised whole-life cost;
- Residual service lives of existing assets (useful lives) will be determined on an economic basis, with the intent to only replace an asset once it has reached a point where the residual life is unacceptable from a safety or network performance perspective;
- The environmental impacts of all decisions and actions will be assessed, including energy consumption and pollution hazards;
- The heritage value of assets to our waterways, reservoirs and docks will be assessed from an historical perspective;
- Wherever new installation, refurbishment, or maintenance work is proposed, the work shall be undertaken with the least possible inconvenience to customers, and all reasonable precautions taken to ensure staff and public safety;
- Use of, and potential retention as, strategic spares shall be considered;
- Public and operator safety will be assured in the short and long term;
- Network security levels will be maintained in respect of the risk of breach or third-party acts, and improved where it is deemed appropriate;
- Network and customer performance levels will be maintained in respect of network reliability and availability and improved where it is deemed appropriate;
- Statutory requirements will be met; and
- Advancements through internal and external research and development will be fully evaluated and implemented only where appropriate.

9 Acquiring or constructing new assets

There is on-going assessment of the need for new assets to be added to the existing network, for example the provision of additional mechanisation or automation of movable bridges or lock gates, or the construction of additional flood risk mitigation assets. Our strategy is to continue to assess these options from a customer benefit perspective whilst ensuring we achieve value for money.

Due to the change in use of waterways from a commercial and industrial network to one that is nearly solely used for leisure and tourism, the opportunities for network growth or building new assets is limited. However, the completion of restoration projects may result in the addition of existing assets to the Trust's portfolio.

Our strategy will be to continue to support these projects, ensuring that new waterways and associated assets meet the standards of the Trust as they are restored and connected to the network and ensuring that they can be maintained at the appropriate standards thereafter. We will continue to engage through the complete restoration project cycle, sharing our experience, knowledge and expertise.

Other opportunities for expansion exist through the potential bringing together of existing operational waterways. The Environment Agency (EA) is responsible for over 600 miles of navigable waterways, including the Thames. Our strategy will continue to be open to the potential bringing together of the EA navigations with the Trust waterways. We will ensure that any such change is managed by both parties using good asset management practice. This will include understanding and assessing the existing condition, risk, operational and customer service activities as well as the full costs to maintain and operate the navigations for the foreseeable future.

10 Operating the waterways

Effective operation of our waterways is key to ensuring that our waterways are kept open and accessible for customers. Fundamental to our operations is water management. This involves maintaining navigable water levels by monitoring and managing water supplies from our reservoirs, feeders and pumping stations; and mitigating the impacts of excess water (storm events) through the regulation of water supplies and over-flow weirs and sluices. Our day-to-day water management is guided by the preparation of Weekly Water Budgets and implementation of operational advice contained in our Water Control Manuals.

Information on water levels and the operating state of pumps and motors is collected both manually and by our Supervisory Control and Data Acquisition system (SCADA). Our strategy will be to continue to develop the SCADA system to match operational needs.

Operational water losses can be reduced through effective management of locks. The Trust's operation of some of our larger sea locks, river locks and lock flights, is key to safe and continued navigation. Our strategy will continue to ensure an appropriate mix of assisted (Trust operated) and motorised locks; we will continue assess the operational and customer benefit of providing more assisted sites (operated by volunteers, where appropriate).

Effective operation of moveable bridges, especially the large powered bridges, is important for the movement of boats and maintaining routes for road users and pedestrians. We will continue to ensure an appropriate mix of manually operated and powered bridges, utilising appropriate technology that provides cost effective and user-friendly ways to automate bridge movements.

11 Understanding asset condition

Our current standard for inspection (*Asset Inspection Procedures 2017* (AIP 2017)) classifies our infrastructural assets into Principal Assets (whose failure could lead to major disruption or have serious consequences for our waterways, customers and neighbours) and non-Principal Assets (the failure of which is of lesser significance to the Trust, its customers or neighbours).

Under AIP 2017, our Principal Assets are subject to a hierarchy of inspections (including Principal, Annual and Length Inspections) which provide information on the condition, consequence of failure and serviceability of each asset and the details of any defects affecting the asset. Each Principal Asset is assigned a condition grade from A to E, where A represents an asset in prime condition and E represents a seriously deteriorated asset.

The consequence of failure (COF) of each Principal Asset is rated on a scale from 1 (low COF) to 5 (high COF). The volumes (total numbers) and percentages of Principal Assets across the relevant condition grades and consequence of failure grades are illustrated in Tables 3 and 4.

	Consequence of Failure Grade				
Condition Grade	1	2	3	4	5
A - Very Good	153	135	48	40	4
B - Good	937	894	373	205	49
C - Fair	2313	2076	776	506	135
D - Poor	493	463	181	82	33
E - Bad	43	32	10	3	0

Table 3 Principal Asset volume condition and consequence of failure matrix (1 April 2017)

	Consequence of Failure Grade				
Condition Grade	1	2	3	4	5
A - Very Good	1.53%	1.35%	0.48%	0.40%	0.04%
B - Good	9.39%	8.95%	3.74%	2.05%	0.49%
C - Fair	23.17%	20.79%	7.77%	5.07%	1.35%
D - Poor	4.94%	4.64%	1.81%	0.82%	0.33%
E - Bad	0.43%	0.32%	0.10%	0.03%	0.00%

Table 4 Principal Asset percentage condition and consequence of failure matrix (1 April 2017)

AIP 2017 does not require the assignment of condition grades and consequence of failure grades to all non-Principal Assets, although some non-Principal Assets, including towpaths and bank protection; minor cuttings and embankments; and other structures such as retaining walls, have been graded.

The five-point scale for asset condition grades is useful for distinguishing those assets that are in a good condition from those that are in a poor condition. However, we need greater understanding of where assets are within each condition grade band.

To enhance our understanding of the condition of our infrastructure assets and their probability of failure, condition scores and condition indices are being developed. These consider the relevant factors that influence asset condition and generate a score on a numerical scale of 1 to 100 based on the assignment of: condition scores to elements of the assets; ratings for the relative significance of the elements to the structural integrity of each asset; and thresholds to indicate when intervention to an element is required.

Our strategy for inspections will be to assess how our existing inspection regime can be optimised and aligned to the data and reporting requirements for the new asset condition indices. This is likely to introduce changes to the data collected, how it is collected, and the frequency it is collected.

12 Serviceability

Serviceability is already well defined in the Trust's Annual Inspection Procedures (AIP). It is measured using a scale of 1 to 3 reflecting the assets' ability to meet service requirements. The assessments are made at each annual and principal inspections. Serviceability reflects performance of an asset to the required design capacity, or under-performance due to dilapidation or imposition of increased service standards.

An asset with a serviceability 1 is fit for purpose, an asset with a serviceability 2 is restricted use, and an asset with a serviceability 3 is unfit for purpose. Serviceability measures are applied to a range of assets including locks, weirs, sluices, pumping stations, towpaths, bridges, culverts, walls, feeders, cuttings and embankments.

Our strategy is to retain the measurement of serviceability. It is an important measure that indicates the ability of our assets to provide an adequate level of service to our customers.

Our strategy continues to minimise the number of assets with a serviceability of 2 or 3.

13 Maintaining the assets

Our current standard for maintaining assets (*Planned Preventative Maintenance 2016* (PPM 2016)) defines maintenance requirements and responsibilities for the PPM of fixed and moveable operational infrastructure; operational and joint operational/estates buildings; and mechanical, electrical, instrumentation, control, and automation (MEICA) assets. It includes powered locks, moveable bridges, pumping stations, powered sluices, and boat lifts, and SCADA assets including remote flow and level sensors not associated with other operational assets.

Our strategy for PPM is to move to a formal maintenance process, ensuring adherence to consistent maintenance standards and specifications. It is to identify the levels of resource and expenditure required to carry it out effectively, and to enable effective monitoring of the maintenance regimes.

The first phase of generic PPM task lists and maintenance plans have been set up in SAP for 7 priority asset types. These are; aqueducts, moving bridges, culverts, locks, sluices, canal and river weirs.

The intention is that these generic task lists are further assessed and optimised for each asset. It is anticipated that the implementation of PPM will initially increase the resource requirements for delivery, whilst at the same time reduce the level of reactive work. As PPM task lists are rolled out to all assets and the programme progresses there should be a net reduction in reported faults, defects and, therefore, reactive works against each asset, allowing the Trust to focus resource on further improvement and extended maintenance programmes.

One improvement that we will consider is the benefit of a condition-based maintenance programme. This will be assessed only where it is appropriate to do so, and where there is sufficient information to understand the optimum maintenance intervention. To support the future assessment of maintenance activities, the Trust will be reviewing the benefits that can be obtained through the deployment of Reliability Centred Maintenance (RCM) and Failure Modes and Effect Analysis (FMEA).

14 Repairing the assets

The Trust monitors interruptions to the use of its inland waterways due to asset-related failures. Faults on the waterways are classified as either an unplanned stoppage or a failure (electrical, mechanical or structural). In respect of waterways, unplanned stoppages relate to a closure of either the navigation or towpath or, in some cases, both. In respect of bridges, unplanned stoppages may result in a road closure, impacting navigation, road users, pedestrians and, in some cases, services.

Our strategy for unplanned stoppages is to ensure the current level of reliability and availability is maintained in a sustainable way. We are looking at the potential to develop new indices to help us understand network availability and reliability. Where appropriate, we will improve the level of reliability and

availability in line with a prioritised investment plan. Our inspection, maintenance, refurbishment and replacement of assets is all critical to ensure we optimise our level of reliability and availability for the benefit of our customers.

15 Dredging

The siltation of navigable channels is a prime measure of service for boating customers. It also influences the ecology of waterways and their potential to support angling. Poorly dredged waterways create navigational difficulties, may accelerate erosion and scour leading to increased leakage and towpath and bank collapse – potentially increasing maintenance costs in the longer term. River navigations present particular problems with longer term degradation of lock cuttings and localised depositions after storms affecting the channel and requiring expensive reactive dredging.

Dredging is very expensive and typical costs per kilometre are currently in the range £100k to £200k rising to £500k for contaminated material removal. Costs have risen significantly due to increased environmental regulation, particularly governing waste disposal.

Dredging activities generally fall into one of two different approaches: mainline dredging and spot dredging. In most circumstances, main-line dredging involves dredging long lengths of canal to restore them to acceptable depth for navigation. Most dredging undertaken is of this nature. It ensures a regular defined bed profile and provides a depth 'reservoir' to accommodate a degree of future siltation before re-dredging. The programme of mainline dredging is informed by hydrographic surveys of the network.

Spot dredging addresses a short length of canal where navigation is impeded by a local obstruction. It includes dredging of winding holes, bridge and lock approaches and siltation areas at inflow positions. This type of dredging is normally more expensive in terms of unit costs than main-line dredging and does not deal with the longer term general reduction in channel depth due to on-going siltation.

Our strategy is to prioritise main-line and spot dredging alongside all other asset requirements based on risk.

A new Dredging Strategy is being developed, which will look to prioritise both main-line and spot dredging across the network. Changes to our approach may be adopted if they are considered an improvement on our current strategy.

16 Vegetation management

The Trust's network of waterways and reservoirs are open to public access and recreational use. Much of the network is bordered by hedgerow trees and wooded cuttings and embankments which support an ageing tree stock. Although trees contribute significantly to the landscape and ecology their growth has the potential to cause damage to structures, adversely impact on navigation or use of the towpath and there is potential for whole or partial failure resulting in loss or injury.

The Trust has an approved standard for tree risk management which defines requirements for programmes of regular inspection and on-going management to minimise the risks of loss or injury caused by failure of part or all of a tree.

The management of vegetation on structures is critical to minimise degradation of our assets and to maintain access to inspect, maintain and operate our assets. Maintenance requirements are identified in our standard for Planned Preventative Maintenance and through our asset inspections.

Our approach to the management of other vegetation along our waterways is to prevent its growth from impeding navigation and/or the use of towpaths whilst maintaining the ecological and landscape benefits it brings to the waterways.

A new Vegetation Management Strategy is being developed in consultation with customer groups. It will consider requirements for vegetation management to maintain the condition of our assets and the

serviceability of our waterways for customers. Changes to our approach may be adopted where they are identified to be an improvement on our current strategy.

17 Prioritising investment

Investment in existing assets is currently focused on controlling the number of Principal Assets in condition grades D and E. A threshold of 23% is set within the Defra contract and a target of 15% has been set within the Trust. Investment is prioritised based on an assessment of condition and consequence of failure. Assets with a condition of D and E with a high consequence of failure are prioritised for investment.

There are always competing investment demands, pulling upon a finite amount of financial investment. Determining priorities for investing in existing and ageing assets, compared with the need to install new assets (e.g. to provide improved water security) can often be complex. Such decisions require a good understanding of existing condition, existing consequence of failure, and overall the risk of either an asset failing, or an event such as drought occurring.

To improve our ability to make better decisions, ensuring we invest and spend our money wisely, especially when competing investment decisions require prioritisation, we will be developing new asset investment modelling capability and new asset strategies. This new modelling capability will enable us to prioritise investment using asset condition, asset criticality, asset risk and a common risk currency.

Our vision is to develop new asset investment models based on a common asset modelling methodology which we have called CONCEPT. The new CONCEPT methodology and models will determine a common approach for measuring the condition of all assets through a condition score and a condition index. Initially, our focus will be on Principal Assets, followed by the Non-Principal Assets. The asset investment models will provide the capability to determine current asset condition, as well as predict future asset condition, accounting for the effects of degradation.

Asset and network criticality is currently assessed using three factors, as defined in our AIP 2017 standard. The three criticality factors are safety, flood risk and the financial impact of an asset failure. The highest risk assets are deemed to be reservoirs and embankments due to the risk of a breach, and therefore the consequence of failure of these assets can be high.

To further enhance our criticality assessment, the introduction of a fourth factor is being developed. The new factor will assess the criticality of assets from a customer's perspective and will reflect the impact of an asset failure upon the ability of our customers to enjoy and access the network. This factor will enable assets to be ranked in terms of the consequence of failure and aid engineers in the prioritisation of investment, from the perspective of customer access and use.

An additional aspect of the modelling capability will be the determination of a common currency. This will be based on providing the probability of failure as a percentage multiplied by the consequence of failure in terms of its financial impact. It is possible to determine the probability of failure through the condition score of the assets as well as looking at historical failure rates and predicted failure rates based on assessing functional failures.

The determination of a common currency will enable optimisation of investment across different asset categories and enable a trade-off in terms of financial risk between different assets. Our investment programmes will be formulated with consideration to balancing risk, service levels and a willingness to pay.

We will develop a 10-year rolling investment plan, using the asset investment models as a decision support tool to aid in the prioritisation of interventions on the waterway assets.

A phased approach is being taken to the development of the new asset management capability. The pilot phase (phase 1) was carried out between October 2016 and July 2017. The condition score, condition index and risk profile modelling as well as an approach to common currency was developed, initially encompassing fixed bridges, culverts and lock gates. The capability is now being extended to other Principal Assets, in a second phase which will also be used to refine the models developed in Phase 1.

The capability will enhance the existing process already carried out by engineers to develop annual investment plans. It will be complementary with the objective to produce a set of decision supports tools to help engineers make better prioritised investment decisions. The full capability of the new models and asset strategies developed in Phase 1 and 2 will be available to inform the B20 investment plan for the period April 2020 to March 2021.

18 Cost assessment

Investment options will be assessed to ensure value for money. Costs assessment will be based on the whole-life costs of assets. Where practical, investment options will be assessed as a minimum using Discounted Cash Flow (DCF) analysis through which the Net Present Value (NPV) shall be calculated.

In addition to costs and benefits that are considered from an asset specific perspective, if there are wider societal benefits that can be identified and linked to investments, this should also be considered.

19 Network resilience

Network resilience is a focus for the Trust due to the potential impacts of extreme weather events, such as drought and flooding, associated with climate change. The regularity of severe weather events is increasing. Such events affect the resilience of our water supply and infrastructure. The Trust's strategy is to use the best available information to help inform investment and operational decisions to adapt assets to meet future requirements and avoid or mitigate impacts of climate change on asset performance. The focus is on understanding, and potentially improving, the resilience of the waterway network in the face of climate change.

Our Water Resources Strategy 2015 sets out our proposed actions to deliver long term security of water supply. Our Drought Plans set out the actions we take to manage water resources during drought periods, from early warning signs through to drought recovery / normal operation.

We have a clearly defined national approach to the management of flood risk which describes how we undertake to mitigate and manage the potential effects of high rainfall events and flooding. We are currently preparing a Flood Risk Management Strategy focussed on the development of a risk-based approach to manage flood risk; operational management, emergency procedures and post event recovery; and flood resilience and investment, amongst other issues.

20 Improving asset data & information

Asset information provides the foundation for asset management decision-making. The scope of asset information is wide-ranging and includes all meaningful data relating to assets and asset management, such as asset type, location, condition and capability; asset failure histories, work histories, unit costs, as-built drawings, and condition & safety plans. Currently, our asset data is held in several information systems governed by different data maintenance and assurance systems.

Over the period of this strategy, we will continuously improve our asset information, aligning it with business needs, including the production and implementation of optimised asset management strategies and plans. We will specify processes and systems to capture data systematically, enhancing governance and data quality.

We shall develop a Completeness, Accuracy and Timeliness (CAT) score to help us assess the quality of data that feeds the investment models. This is important as the models will ultimately help inform our strategic decision making.

There will be 3 main areas of focus on asset data:

- Data to populate the asset investment models;
- Condition data collected in SAP though inspections; and
- Recording of asset data using ZX notifications in SAP.

20.1 Data to populate the asset investment models

The data to populate the asset investment models is currently stored on text-based electronic Principal Inspection (PI's) reports and requires transposing into Excel, before ultimately being uploaded into the models. It is anticipated that a mix of Trust employees and volunteers will undertake this important and time-consuming exercise. Where volunteers transfer the data, there is an expectation that a validation exercise conducted by Trust engineers and inspectors may be required. In addition, the exercise will identify some gaps in the data that may result in the requirement for some site visits.

20.2 Condition data collected in SAP though inspections

The current condition assessment and storage of condition data in SAP is based on a condition grade of A to E. There is one condition field per Principal Asset. The development of new condition indices will require changes to the collection of data and its storage in SAP. We will update the handheld scripts used by inspectors and develop inspection handbooks for each asset category. The new handheld scripts will provide a step-by-step process to enable the efficient and effective collection of condition data aligned with the requirements of the condition index. The new inspection handbooks will provide guidance on condition assessment with photos and descriptions for the condition and condition scoring. This will help ensure consistency in the condition assessment of assets.

20.3 Recording asset data using ZX notifications in SAP

Data on arising issues that impact asset-related reliability, availability and serviceability is currently recorded as ZX notifications in SAP. A new coding structure will be introduced to classify the data collected into that concerning condition, defects and faults. There is a requirement to ensure that all ZX notifications are correctly coded. There is an expectation that a large proportion of the ZX notifications will be re-classified as condition data and will support the data requirements of the asset investment models. Improvements in the collection of fault information will help us better analyse and understand asset and system failures, trends and through root cause analysis identify potential interventions to prevent or mitigate their impacts upon customers. The analysis will extend to a review of duty logs to identify trends, themes and frequently visited sites.

21 Developing capability

Asset management is multi-disciplinary and the implementation of this Asset Management Strategy depends upon the integrated activity of many of our functional teams. It has been prepared in consultation with an internal Asset Strategy Steering Group, comprising representatives of our Operations, Asset Improvement and Finance Directorates. We will continue to raise awareness of this strategic plan, our asset management system and our asset management across the organisation and engage our people in its delivery and on-going development.

The teams within our Asset Improvement directorate already have an established technical strength. We will continue to grow this expertise through our existing programmes of learning and development and succession planning. We will also take specific action to extend the competences and capabilities of our people beyond the traditional areas of technical strength to include asset management life-cycle planning and decision-making to support the development of optimised maintenance regimes and the prioritisation of investment. This will be achieved through the development and delivery of bespoke training modules

and through vocational training received during the development of the asset investment models and asset strategies.

In addition to technical skills, our Growing Our Trust internal engagement programme seeks to develop a culture that supports behavioural change including effective communication and collaboration, customer focus and accountability. This will directly support the development of a culture necessary to improve our asset management.

As well as growing our people's awareness and competencies in asset management we will continue to grow organisational capability through the continued maintenance and development of our asset management system. We have prepared and will implement an improvement plan for our asset management system aimed at demonstrating continuous improvement aligned with progressing towards a Maturity Level 3 against the Institute of Asset Management's Self-Assessment Methodology – the level of maturity required to comply with requirements of ISO 55000: 2014.

22 Monitoring performance

The governance framework for the Trust includes a three-tier system of control (Canal & River Trust, March 2015). We will undertake to monitor the performance of our asset management system and the conduct of our asset management activities in line with the three-tier control model. Our activities in this area will include the development of an internal audit plan to include assessment of various elements of the asset management system.

The development of our asset management system will continue to be monitored through internal and external bench-marking. We will continue to engage with infrastructure organisations and asset management consultants in the water, power, highway and rail sectors to help us benchmark our performance. We will undertake an internal, annual review of its maturity using the Institute of Asset Management (IAM) Self-assessment Tool and identify actions to achieve continuous improvement.

We will continue to report aspects of asset condition and performance against the Publication Data, including the 'Relevant Standards'. These indicators will form part of a wider set of performance measures and targets against which we will monitor the performance of our assets and our asset management system.

23 Implementing this strategy

This Asset Management Strategy runs for the period 2017 to 2021 inclusive. Its implementation will be coordinated by the Asset Strategy team. The Head of Asset Strategy & Engineering Services has direct responsibility for ensuring the plan is implemented. The Asset Improvement Director is the Executive sponsor responsible for ensuring the plan is implemented and for ensuring its progress and outcomes are reported to the Trust's Executive.

24 Governance

The implementation and monitoring of progress of this Strategy will be managed within the Trust's governance framework. The Asset Strategy Steering Group will continue to provide direction.

External audits will be carried on various aspects of the Strategy during the period 2017 – 2021.

The Asset Management Advisory Group will be established to provide external experience to support and provide guidance on the implementation of the Strategy.

25 Review of the strategy

This Strategy will run from 2017 to 2021, inclusive. We will review it annually to evaluate our progress against it and to ensure that the approach described in it remains relevant for the management of our waterway assets and the achievement of our vision for living waterways that transform places and enrich lives.

The Strategy will be revised in response to progress we have made and any other circumstances or developments that may affect the management of our waterway assets.

References

BSI PAS 55: 2008 *Asset Management – Part 1: Specification for the optimised management of physical infrastructure assets.*

Canal & River Trust (2014) *Annual Report: Trustees' Annual Report & Accounts 2013/14.*

Canal & River Trust (2015) *Annual Report: Trustees' Annual Report & Accounts 2014/15.*

Canal & River Trust (2016) *Annual Report: Trustees' Annual Report 2015/16.*

Canal & River Trust (2017) *Annual Report: Trustees' Annual Report 2016/17.*

ISO 55000:2014 *Asset Management – Overview, principles and terminology.*

ISO 55001:2014 *Asset Management – Management systems – Requirements.*

ISO 55002:2014 *Asset Management – Management systems – Guidelines for the application of ISO 55001.*

Institute of Asset Management (2014) *The Self-Assessment Methodology – Guidance.*

Glossary

This Glossary includes terms used within this strategy. ISO 55000: 2014, the international standard for Asset Management, provides definitions for some terms relating to the subject. Several of these, and their associated notes from the standard, are included in this Glossary to aid understanding.

asset	An item, thing or entity which has potential or actual value to an organisation.	ISO 55000:2014 (3.2.1)
asset life	Period from *asset* creation to asset end-of-life.	ISO 55000:2014 (3.2.2)
asset management	Coordinated activity of an organisation to realise value from *assets*.	ISO 55000:2014 (3.3.1)
asset management plan (AMP)	*Documented information* that specifies the activities, resources and timescales required for an individual *asset* or grouping of assets, to achieve the organisation's *asset management objectives*.	ISO 55000:2014 (3.3.3)
asset management system	Management system for *asset management* whose function is to establish the *asset management policy* and asset management *objectives*.	ISO 55000:2014 (3.4.3)
asset system	Set of *assets* that interact or are interrelated.	ISO 55000:2014 (3.2.5)
capability	[*asset management*] measure of capacity and the ability of an entity (system, person, or organisation) to achieve its *objectives.*	ISO 55000:2014 (3.1.2)
competence	Ability to apply knowledge and skills to achieve intended results.	ISO 55000:2014 (3.1.3)
critical asset	*Asset* having potential to significantly impact upon the achievement of the organisation's *objectives*.	ISO 55000:2014 (3.2.7)
life cycle	Stages involved in the management of an *asset*.	ISO 55000:2014 (3.2.3)
Objective	Result to be achieved.	ISO 55000:2014 (3.1.12)
Performance	Measurable result	ISO 55000:2014 (3.1.17)
Process	Set of interrelated or interacting activities which transforms inputs into outputs	ISO 55000:2014 (3.1.19)
Policy	Intentions and direction of an organisation as formally expressed by *top management*	ISO 55000:2014 (3.2.1)
strategic asset management plan	Documented information that specifies how organisational objectives are to be converted	ISO 55000:2014 (3.3.2)

Appendix A: External Consultees

Consultees

We have carried out consultation during 2017 on AMS 2017. The feedback received has been used to inform the updating of AMS 2017 to Issue 2. The consultation was deliberately aimed at national advisory groups, rather than a wider public consultation process. The consultation primarily focused on explaining the new aspects of AMS 2017 which include:

- New asset strategies;
- New asset investment and optimisation models;
- New condition index;
- Enhancements to the assessment of consequence of failure;
- Improvements to the management of notification data; and
- Development of a rolling 10-year investment plan.

The following groups and organisations have had presentations and copies of AMS 2017.

- Canal & River Trust Heritage Advisory Group, 24 March 2017;
- Canal & River Trust Navigation Advisory Group (Operations), 14 June 2017;
- Inland Waterways Association, 12 July 2017;
- Canal & River Trust Navigation Advisory Group (Licensing and Mooring), 9 October 2017;
- Canal & River Trust Angling Advisory Group, 22 November 2017;
- Inland Waterways Association, 18 December 2017;
- North East Waterway Partnership, 10 January 2018;
- East Midlands Waterway Partnership, 16 January 2018;
- London Waterway Partnership, 18 January; and
- South East Waterway Partnership, 24 January 2018.

In addition, a presentation was made to the Waterway Press on 11 September 2018.

We have also shared AMS 2017 with the following organisations. This has been done to seek feedback and benchmark our approach and thinking with that being adopted by other similar organisations.

- Environment Agency (Water Navigations team);
- Scottish Canals;
- Port of London Authority; and
- Basingstoke Canal Authority.

During 2018, we aim to continue to consult and seek feedback. This will ensure that as we develop the new asset management capability and further enhance our approach to asset management, we will be able to have confidence that we continue to move in the right direction.

Feedback from the consultation

The feedback has been positive and we have tried to incorporate all feedback into Issue 2 as far as reasonably practicable. Generally, everyone who has been involved in one of the presentations has indicated that they support the strategy and the direction of travel it describes.

The increased focus on customer service has been well received, and there have been positive comments related to the new condition index and the new modelling capability that is being developed. Serviceability was one area where feedback indicated more explanation was required, so a new section has been added to Issue 2.