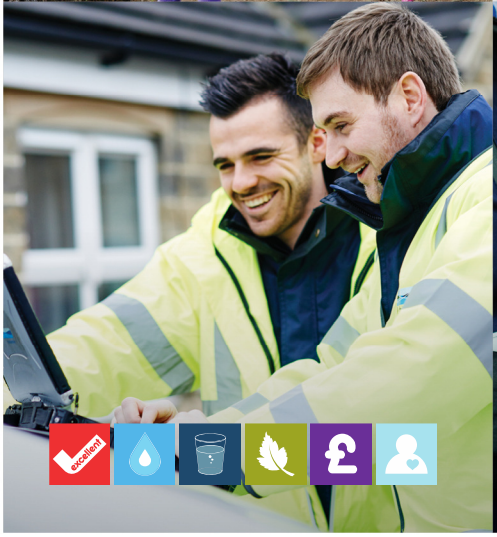
Total Impact and Value Assessment

- Methodology Report

May 2018

It's part of our Blueprint for Yorkshire



YorkshireWater

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Introduction

Total Impact and Value Assessment (TIVA) is the title for our work to push beyond traditional accounting and reporting approaches to include a much wider range of metrics and enhance the understanding of our positive and negative impact. We are using this fresh insight to shape our strategy and investment plans by responding to opportunities to grow our contribution to society and mitigate threats to the sustainability of our business and essential services.

This report describes the process taken to obtain the figures used to quantify our impact in our work to date on TIVA. Please read this report in conjunction with the accompanying *Our Contribution to Yorkshire* report, where we explain the concept for our work, and the conclusions we have drawn to date. *Our Contribution to Yorkshire* can be found at: www.yorkshirewater.co.uk/capitals

We have based our approach on the Six Capitals philosophy adopted by Yorkshire Water, grouping impacts under:

- Financial capital
- Manufactured capital
- Natural capital
- Human capital
- Intellectual capital
- Social capital

In this methodology report we first set out our overarching approach, discuss the challenges, questions and limitations arising during the assessment, and introduce the analytical tools and external partners we have used to quantify certain impacts. We then set out the specific method used to measure each impact or metric.

We are committed to further work in this field and will continue to publish our findings. Please share your thoughts with us about our work, including any questions and suggestions you may have. To discuss our TIVA, please contact:

Gordon Rogers, Head of Sustainability

Telephone: 01274 804549

Email: Gordon.Rogers@yorkshirewater.co.uk

Twitter: @GordonRogersUK

Hannah James, Lead Sustainability Adviser

Telephone: 01274 692318

Email: Hannah.James@yorkshirewater.co.uk

Glossary

The following abbreviations are used in this report:

µm	Micrometre, i.e. one millionth of a metre
A4S	Accounting for Sustainability
ARFS	Annual Report and Financial Statements
BEIS	Department for Business, Energy and Industrial Strategy
CFO	Chief Financial Officer
CH_4	Methane
CISL	Cambridge Institute for Sustainability Leadership
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
EIOA	Extended Input-Output Analysis
EMS	Environmental Management System
EP&L	Environmental Profit and Loss
ESA	Ecosystem Services Assessment
FTE	Full Time Equivalent
GHG	Greenhouse Gas
GIS	Geographical Information System
HICA	Human and Intellectual Capital Assessment
IIRC	International Integrated Reporting Council
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
MEAV	Modern Equivalent Asset Value
ML	Megalitre, i.e. one million litres
Mt	Megatonne, i.e. one million tonnes
N_2O	Nitrous Oxide
NEA	National Ecosystem Assessment
NICs	National Insurance Contributions
NMVOC	Non-methane volatile organic compound
ONS	Office for National Statistics
PAYE	Pay As You Earn
PM	Particulate Matter
$PM_{2.5}$	Particulate Matter composed of particles with a diameter of less than 2.5 µm
PM_{10}	Particulate Matter composed of particles with a diameter of between 2.5 and 10 µm
PR19	Water industry Price Review for 2020 – 2025
RCV	Regulated Capital Value
ROC	Renewable Obligation Certificate
SAP	Enterprise software which helps manage business operations
SBO	Strategic Business Objective of Yorkshire Water
SDG	Sustainable Development Goal set by the United Nations
SIC	Standard Industrial Classification
SME	Small and Medium sized Enterprises
TIVA	Total Impact and Value Assessment
UKWIR	UK Water Industry Research
UNDP	United Nations Development Programme
VAT	Value Added Tax
VoLL	Value of Lost Load

History of our work on sustainable accounting

TIVA is the latest development in our long-standing commitment to work with evolving sustainable accounting techniques. We do this to enrich our decision making to make us ever more sustainable and resilient.

Launched a new vision – Recognising the changing world and an imperative for long term sustainability in our business and services.

Launched new Strategic Business Objectives – Shaped by our assessment of future forces and leading to a programme of activity to manage short and long term opportunities and threats.

Environmental Profit and Loss (EP&L) – Monetising the costs and benefits of our environmental impact to enable comparison with our financial P&L.

Eco-footprinting – Assessing how many planets worth of resources we use to deliver our services.

Joined the Natural Capital Coalition and piloted the Protocol – One of 50 globally to test the draft Natural Capital Protocol, assessing and monetising the environmental impact of a large capital investment scheme at our Rivelin Water Treatment Works.

Capitals assessment projects – We've completed several multi-capitals assessments to inform a range of business activities and decisions.

Developing our Price Review plan and our new Decision Making Framework – We've systematised the assessment of the capitals in our new risk management and investment prioritisation system and are applying this to shape our PR19 plan.

2010 2012 2014 2016 2018 2020

Ecosystem Services pilot with Natural England – We financially valued several ecosystem services for the Keighley Moor and Watersheddles catchment to inform our approach to catchment management.

Integrated Reporting – Published our first integrated ARFS, reporting how we create value for the long term.

Joined the Accounting for Sustainability (A4S) CFO Network - Sharing our experiences, learning from others and supporting the development of a range of guidance publications.

Humberstone Bank Farm – Used the principles of the capitals to assess how we can maximise the value of our land, piloting a new approach at one of our tenanted farm sites. We have since introduced a new regime (Beyond Nature) of managing the site for nature with a young tenant farmer.

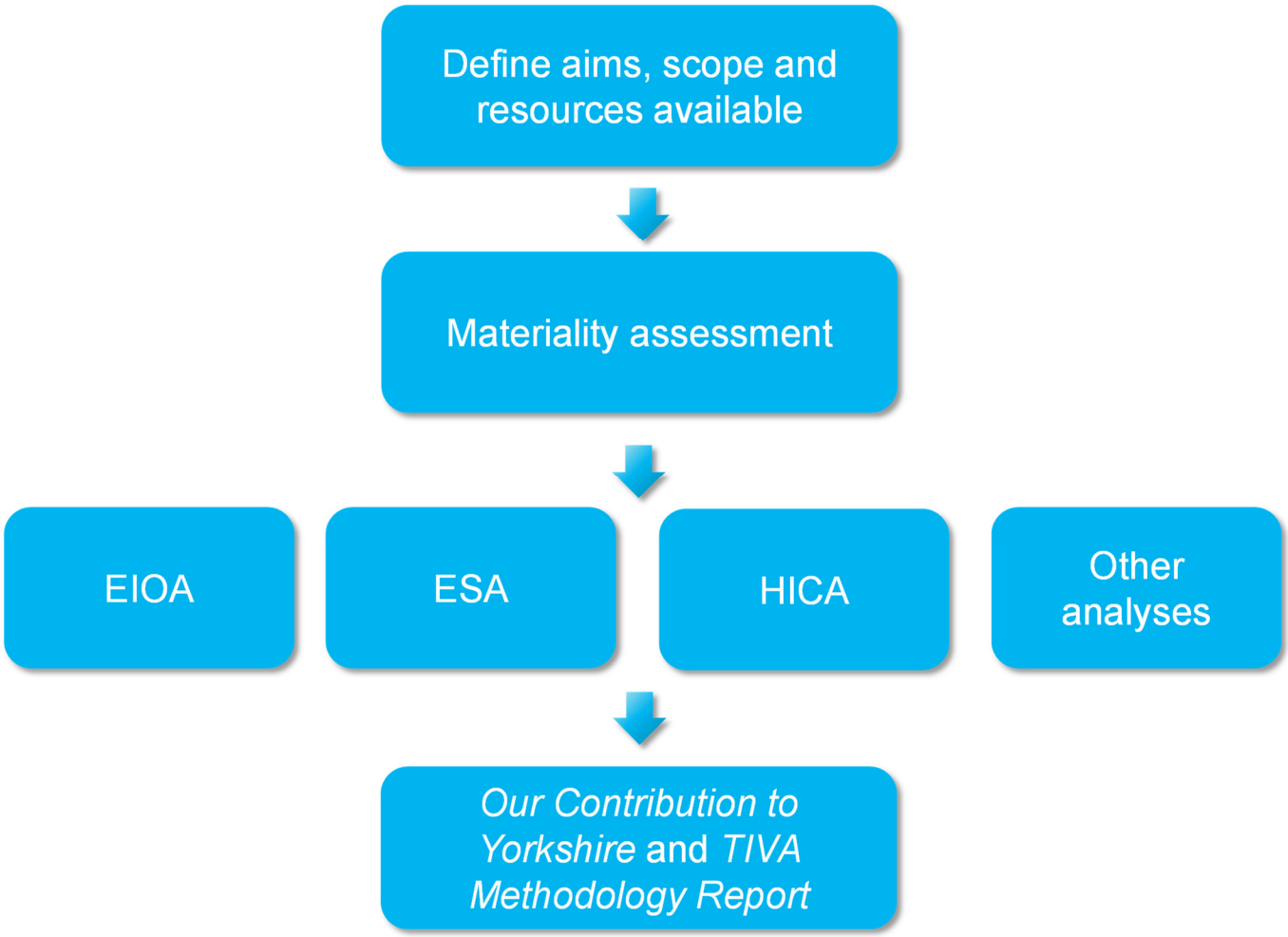
Land Strategy and Beyond Nature Implementing the learning from our pilot at Humberstone, we're working to embed the capitals in our land management decision making to enhance value for us and others.

Joined the Natural Capital Impact Group – working with the Cambridge Institute for Sustainability Leadership (CISL) to develop a Healthy Ecosystem Metric, including soil and water metrics

Our approach to TIVA

The overarching approach taken to our TIVA is shown in the figure below. Defining the aims of the assessment was an important first step to ensure that it went beyond an academic exercise and produced a report and repeatable process which would be informative and relevant, and be used to embed sustainability principles into strategic decision-making. A materiality assessment followed, described in more detail below.

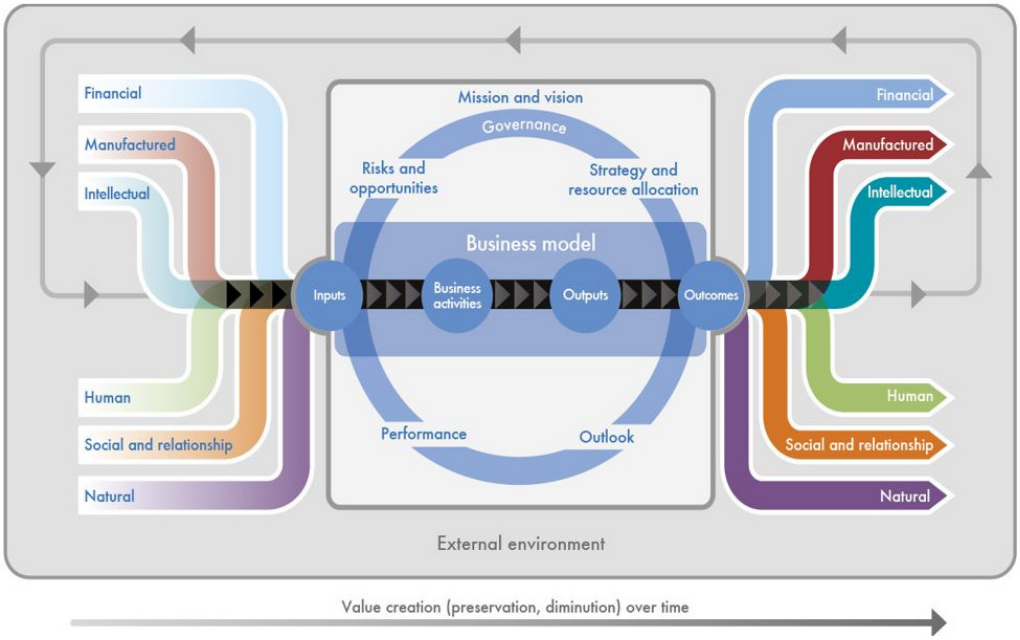
We were assisted by external consultants Route2 to produce an extended input-output analysis (EIOA), an ecosystem services assessment (ESA), and a human and intellectual capital assessment (HICA), all of which fed into the TIVA analysis. The remainder of the analysis was conducted internally.



The capitals

The International Integrated Reporting Council defines six 'capitals': stocks of resources, flows and dependencies which need to be considered to fully understand and manage an organisation's impact and value, and to support sustainable decision making. The concept is summarised in their diagram, shown below.

Forum for the Future note that "by maintaining and trying to increase stocks of these capital assets, we can live off the income without reducing the capital itself. But for this to happen, it is the responsibility of every organisation…to manage these capital assets sustainably"[1].



Six capitals diagram from IIRC[2]

To ensure a holistic assessment we are working to quantify our impact and value across these six capitals in our TIVA. This is how we define the six capitals for our organisation's focus:

[1] https://www.forumforthefuture.org/project/five-capitals/overview
[2] http://integratedreporting.org/what-the-tool-for-better-reporting/get-to-grips-with-the-six-capitals/

Scope

We have followed the three categories of impact recognised by The Crown Estate in their leading Total Contribution work[3]: Direct, Indirect and Enabled.

> **Direct –** impacts occurring as a result of activities carried out by us.
>
> **Indirect –** impacts occurring as a result of activities commissioned by us and carried out within our supply chain.
>
> **Enabled –** impacts occurring as a result of activities carried out by our customers using our services, or by our tenants occupying our land.

Since direct impacts stem from activities wholly controlled by Yorkshire Water, data on these activities is more easily sourced and generally higher confidence than data for indirect and enabled activities. For the most part, Yorkshire Water also has more influence over its direct impacts than indirect and enabled. For these reasons, this assessment has tended to focus more on direct impacts, although indirect and enabled impacts are included where considered material and feasible to measure. An Extended Input Output Analysis has helped us estimate aspects of the indirect and enabled impact, giving us fresh insight.

Our first TIVA is focused on our impact in 2014/15. This year was chosen because, when we started TIVA, financial year 2014/15 was the most recent complete year for which data were available. We have also, for the most part, assessed flows rather than stocks – that is, changes in the capitals' values rather than their total value. Where possible, we have expressed our impacts in quantified monetary values to illustrate their scale, and to facilitate direct comparison between activities. Where this has not been possible, due to a lack of either data or an appropriate method to calculate monetary values, we have expressed impacts qualitatively.

Where appropriate, we aim to eventually carry out full stock valuations for each capital, with annual opening and closing balances. We recognise that this is an ambitious goal given its complexity and the resources required to undertake full stock valuation. We therefore aim to 'learn by doing', publishing this first assessment to invite comment and feedback, and using it as a learning experience for future assessments.

Intrinsic values

It is important to recognise that, whilst this assessment attempts to capture quantified metrics and financial values for our impacts on nature and society, these figures do not represent the entire 'value' of nature, people, or any change in their wellbeing. Whilst we may express the 'value' of our colleagues' wellbeing to the company in terms of improved employee retention, reduced sickness rates etc., this does not reflect the entirety of its importance to individuals (and their families and friends), or indeed the moral imperative to ensure people's wellbeing wherever possible, regardless of any monetary gain.

Similarly, whilst sophisticated methods have been developed in the field of sustainable accounting to measure even intangibles such as 'passive enjoyment' (the satisfaction derived by people from simply knowing that natural features exist, even if they are not visiting or using them), ecosystem service assessments cannot, and do not attempt to, put a value on the intrinsic right of nature to exist.

The use of sustainable accounting techniques to value nature and society has attracted criticism from some quarters. Objections include concern that placing a financial value on the services arising from

[3] https://www.thecrownestate.co.uk/our-business/total-contribution/

natural, social and human capitals reduce nature, society and people to those values: minimising the intrinsic, unquantifiable values discussed above. Responding, in an article following the IUCN World Conservation Congress, the Executive Director of the Natural Capital Coalition argued that natural capital accounting "[does] not price nature, [it] illuminate[s] the value that we already receive from it". The point was also raised that sustainable accounting often illustrates the cost of *not* acting to protect the natural world, rather than the benefit to be gained from exploiting it.[4]

At Yorkshire Water, large- and small-scale decisions are already made on the basis of evidence that includes predicted positive and negative effects on nature and society. As a water company, our core business is inextricably linked with the human and natural spheres, as we manage catchments and water bodies to ensure that we continue to provide high quality and reliable clean water and wastewater services to our customers. We are committed to the responsible use of data on the capitals, and ensure that figures are always presented alongside the necessary narrative to place them into context. By improving our understanding of the magnitude of our impacts, we are refining an already well-established body of knowledge, ensuring that nature and people remain at the heart of our operations and decisions.

Whilst we note these cautions and limitations we find clear value in adding more knowledge to inform our decisions. We recognise that no analysis, no matter how mature, can provide the answer in its own right, it can only be an aide for decision makers.

Categorising impacts

We have categorised each impact metric under one capital. This allows us to understand where our activities are having the most positive and negative impacts, and to target strategy and communications internally and externally. We recognise however that in practice, many impacts have both positive and negative effects on one or more capitals. For example, a change in land use may reduce biodiversity (negatively affecting natural capital) but increase agricultural production (increasing the value of that ecosystem service and positively affecting social capital through food security). We also recognise that human and natural systems are incredibly complex, and almost entirely interlinked – in effect, the boundary between 'human' and 'natural' is arbitrary and arguably non-existent. However, categorising and separating impacts in this way will make explicit the difference between our impacts on our own assets and our external societal impacts and values; and will allow us to standardise metrics so that they can be monitored over time.

These issues can lead to 'double counting': where an impact is counted under two categories. For example, financial capital is largely measured by calculating annual net profit. Contributing to this figure are several aspects pertinent to other capitals and impacts, such as tax paid on landfill, and feed in tariff or ROC payments for renewable generation. Where these accounting dilemmas have arisen, we have taken a pragmatic approach, keeping in mind the purpose of TIVA, which is to inform Yorkshire Water's decisions and strategy.

Transparency

Just like others innovating in this space, we openly recognise shortcomings in our methodology and the need for further development. We publish this work to be transparent, to invite questions and feedback, and to inform debate on developing sustainable accounting approaches.

[4] http://naturalcapitalcoalition.org/when-it-comes-to-natural-capital-its-easy-to-forget-that-were-on-the-same-team/

Current limitations are not preventing us from gaining valuable insight that is informing how we can enhance value and better mitigate risk. We recognise the need to ensure a clear and open approach in the findings of our TIVA, both for internal decision making and external engagement. To ensure openness and clarity in this report, we:

- Detail our methodology and share it openly in this report, capturing our assumptions, observed weaknesses and opportunities for further improvement.
- Have asked an independent expert, Route2, to support, challenge and assess our approach. We publish their statement on the appropriateness and effectiveness of our approach in *Our Contribution to Yorkshire*, the report accompanied by this methodology.
- Round figures where needed, so as not to imply misleading levels of accuracy.
- Report confidence ratings to indicate the reliability of reported figures.

Confidence ratings used to indicate the robustness of findings		
High	**Medium**	**Low**
Using robust data and widely respected techniques which have matured to become commonly used by respected organisations.	Using data with estimation and assumptions, and using techniques which have been used by early adopters but which are still maturing.	Using data with substantial extrapolation, estimation and assumptions, and using techniques which are at the early stages of development.

Materiality Study

In 2016, using insight from past work, including our Environmental Profit and Loss Account and the 'significance evaluation' from our Environmental Management System (EMS), a group of colleagues reviewed a range of economic, environmental and social considerations associated with our business and services, and which are material in their impact on society. They also considered the scope and reliability of the existing data. The number of possible impacts to measure and report on is large, and a materiality study ensures that the subsequent assessment is well structured, and focuses our limited time and resources on the most significant and informative measures.

Prior to starting measurement and valuation of our impacts in 2017, we conducted a review of and extension to the materiality study, documented below.

Although it is designed primarily for natural capital assessments, the Natural Capital Protocol's Step 4 ('determine the impacts') template[5] provides a helpful structure for materiality studies, which we chose to follow.

Natural Capital Protocol Step 4	
Which impacts and/or dependencies are material to your assessment?	4.2.1 List potentially material natural capital impacts and/or dependencies
	4.2.2 Identify the criteria for your materiality assessment
	4.2.3 Gather relevant information
	4.2.4 Complete the materiality assessment

List potentially material impacts

A scoping workshop with members of the Sustainability and Finance teams produced a list of potentially material impacts and values for each category. The list was then reviewed against the following sources to capture any impacts or values which may have been omitted:

- Extended Input Output Analysis model produced by Route2 for Yorkshire Water
- Environmental aspects and impacts register in Yorkshire Water's EMS
- Yorkshire Water's Strategic Risk Register
- Yorkshire Water's Service Measure Framework
- Kelda Group's Ecological Footprint and Environmental Profit & Loss Account 2012
- The Crown Estate's Total Contribution Methodology 2017
- SSE's *Valuable People: Understanding Our Human Capital* report[6]
- The UNDP Sustainable Development Goals[7]

Identify criteria

The criteria for inclusion in this first iteration of TIVA were guided by the Natural Capital Protocol, Yorkshire Water's Strategic Business Objectives (SBOs), and the UNDP's Sustainable Development Goals (SDGs). As part of a five year partnership with the charity WaterAid, Yorkshire Water championed

[5] Natural Capital Coalition, 2016. *The Natural Capital Protocol*. pp. 43 - 52
[6] http://sse.com/media/306295/SSE-Human-Capital_Final_For-Web.pdf
[7] http://www.undp.org/content/undp/en/home/sustainable-development-goals.html

the 'Clean Water and Sanitation' SDG. In April 2017, a report by the Parliamentary Select Environmental Audit Committee re-emphasised the importance of action in the UK to support the SDGs, and urged the Government to do more to support and partner with businesses in implementing action plans for the goals. In recognition of the alignment between many of the goals and our business objectives, we therefore considered it appropriate to consider contributions to the SDGs as part of the materiality study.

Potential impacts for inclusion in TIVA were scored against the following criteria, all drawn from the Natural Capital Protocol with the exception of the first:

- Relevance to SDGs: the number of SDGs relevant to the impact
- Operational: the extent to which the impact could affect our operations and service delivery.
- Legal: the extent to which the impact could trigger a legal process or liability (e.g., emission fees or extraction quotas, environmental impact mitigation requirements).
- Financing: the extent to which the impact may influence cost of capital, access to capital, investor interest or insurance conditions.
- Reputational: the extent to which the impact may affect the company's image or relationship with stakeholders.
- Societal: the extent to which the impact may generate significant impacts to society.

In addition to scoring against these criteria, we made supporting notes on the availability of data and the feasibility of completing the relevant assessments within the time allowed for the first TIVA publication: recognising that in this first iteration of TIVA some of our data collection and analysis techniques may not be mature enough for robust reporting of all metrics.

Gather relevant information and complete the materiality assessment

The assessment template was produced as an editable spreadsheet, containing all potential impacts identified with notes and an indication of whether they had been scoped in or out. Keeping a record of impacts which have not been included in this TIVA publication allows them to be revisited in future iterations for consideration where techniques and data sources have matured.

Extended Input-Output Analysis

Extended Input-Output Analysis (EIOA) is a technique which is now commonly used to gain insight into the indirect impacts of business activities. Conventional Input-Output Analysis enables a quantitative understanding of the inter-industry dependencies necessary to produce goods and services. This can be used to estimate how activity by one company stimulates economic activity elsewhere in the economy. The UK Office for National Statistics (ONS) publishes annual supply and use tables[8] that underpin a national input-output table as part of their work to collect, analyse and disseminate statistics about the UK's economy and society.

To provide an indicative quantification of a range of our impacts, consultants at Route2 constructed an EIOA by combining the (then) latest ONS input-output table with a range of environmental and social multipliers The subsequent analysis offers a relative indication of tiered supply chain impacts; for example the greenhouse gas emissions resulting from £1 spent with a first tier supplier. The industry sector impact intensities, necessary for EIOA, were further employed to estimate the impacts of customers. The approach is summarised in the diagram on the following page. Following the diagram is a table showing the data we provided to input to the EIOA.

The EIOA involved a range of assumptions and limitations which are summarised below. As a consequence of these assumptions and limitations we have categorised all results taken from the EIOA as low confidence.

- Expenditure and commercial revenue data was allocated to the categories of the Standard Industrial Classification (SIC) using assumptions about best fit.
- Route2 capture multipliers (e.g. the benefits of job creation to the local economy) from latest and best available published research, with varying levels of robustness.
- All expenditure data is applied to the UK ONS input-output table and therefore represents impact as if our suppliers were all operating only in the UK economy. In reality some of the expenditure is with international suppliers where impacts would be different.
- There may be a degree of double counting between the supply chain and customer impacts because as a water company many of our suppliers are also our customers.
- Enabled impacts relating to domestic consumers is limited in this EIOA to metrics on energy, fuel, water and greenhouse gas emissions. This is because of data and time limitations.
- Enabled impact relating to tenants of our land and buildings has not been considered in this EIOA because of data and time limitations.

In reporting our direct impacts we have generally used our own data which produces results with higher confidence levels, however we have used the EIOA in areas where we had insufficient data and Route2 had relevant multipliers. The approach for each metric is described in each of the following sections throughout this report.

[8] https://www.ons.gov.uk/economy/nationalaccounts/supplyandusetables

Yorkshire Water data input to the EIOA

Description	Source	Methodology, assumptions and limitations	Confidence Grade
Direct impacts are estimated in the EIOA using the following input data:			
Number of employees	2014/15 ARFS, p18	This is a sum of figures about our workforce on the last day of the relevant business year, 31/03/15. This is the total number of employees regardless of their number of hours.	High
Employment reward costs	2014/15 ARFS, p43 and 91	This reports the cost of employee salaries including overtime, performance awards and pension contributions, but excluding NICs and employee income tax (PAYE) which are captured separately in the Tax contribution metric. Employment salary costs = wages and salaries £75.5m – employees PAYE £12.1m – employees NIC £5.8m + pension costs £24.3m.	High
Revenues	2014/15 ARFS, p86	This is the figure for Turnover, comprising charges to customers for water, wastewater and other services excluding VAT.	High
Revenue split for water and wastewater services	2014 Final Determination of price limits	The Final Determination of price limits shows the split between revenues for water and wastewater services in the period 2015 to 2020. This is based on the wholesale part of the business only, which is the vast majority.	High
Indirect impacts are estimated in the EIOA using the following input data:			
Supply chain spend, broken down into categories	A breakdown of our supply chain spend in 2014/15, from our SAP system	Total expenditure during the year allocated to SIC categories using assumptions about best fit. In the future, our new SAP system and process will remove the need for these assumptions. This excludes expenditure on debt interest and government taxes and levies.	High for expenditure Low for categorisation Overall = Low
Enabled impacts are estimated in the EIOA using the following input data:			
Non-household customer revenue	Records kept by Yorkshire Water Finance teams	Total revenue from non-household customers during the year, allocated to SIC categories using assumptions about best fit. If we continue to use the model in the future, the alignment process between our data and the SIC categories could be made more accurate.	High for revenues Low for categorisation Overall = Low
Household customer revenues	Calculation from the above data	Turnover - commercial revenue = domestic revenue.	High for revenues Low for categorisation Overall = Low

Ecosystem Services Assessment

To quantify and economically value a selection of ecosystem services emanating from our land holdings, Route2 used an approach which was also deployed in the UK's National Ecosystem Assessment (NEA)[9]. By merging the NEA dataset with GIS data on our land holdings, Route2 were able to extract location specific ecosystem service values at a resolution of 2km grid squares. The approach[10] combines econometric, regression and biophysical process models to arrive at spatially explicit monetary values for four ecosystem services, summarised in the table below.

Methodology used to complete the ESA

Ecosystem service	Metric	Main data and sources	Model	Valuation
Greenhouse gas emissions (agriculture and forestry)	Net metric tonnes of CO_2, CH_4 and N_2O per 2km grid square	Land use predictions, greenhouse gas responses	Process models for CO_2, CH_4, and N_2O; conversion to metric tonnes of CO_2 equivalents based on insulation factors	Official UK values per $MTCO_2e$
Recreation	Visitors per 2km grid square	National survey of greater than 40,000 households, census	Regression model of visit count from outset to destination as a function of characteristics of both locations, population and socioeconomics	Meta-analysis of 300 ecosystem specific valuation estimates
Urban green space amenity	Distance to green space from each 2km grid square	Digital mapping census	Regression model linking distance from households to green space sites, their size and quality	Meta-analysis of prior literature examining changes in value with respect to distance
Agricultural production	Proportion and output of land use in each 2km grid square	Land use, soils, physical environment, climate and digital mapping	Environmental-econometric regression analysis of land use decisions as a function of the local physical environment, prices, costs and policies	Market values

Annual ecosystem service values are derived by annualising the change in ecosystem service values during the period 2010-2060. The 2060 values were derived from future land cover distributions under a variety of scenarios representing a range of possible futures. Through discussions with our land management team, the following land management scenarios were selected to reflect how the land was managed at the time of the model's data collection in 2007 (past), how the land is managed today (present) and how the land is likely to be managed in the coming years (future). This is summarised in the table below.

[9] https://www.gov.uk/guidance/ecosystems-services

[10] Bateman *et al*. Bringing ecosystem services into economic decision making: Land use in the United Kingdom, Science, Volume 341, 5 July 2013.

Scenarios used in the ESA

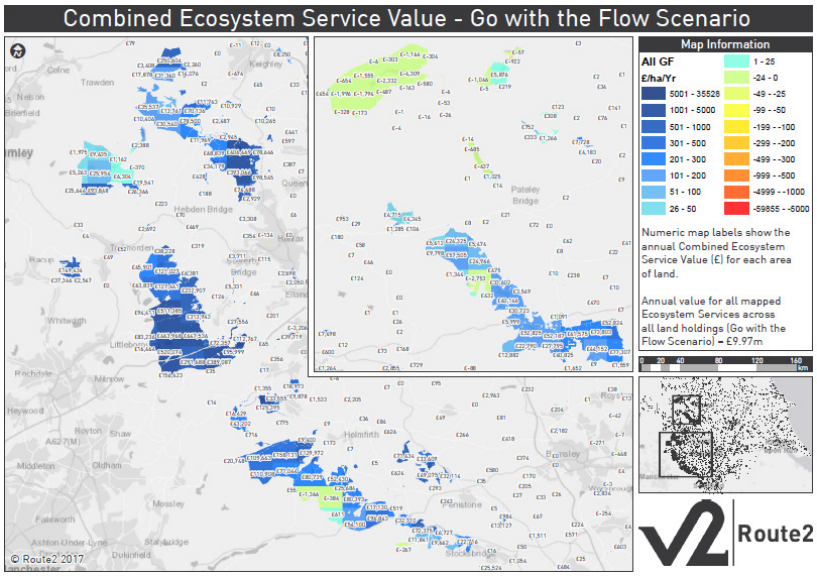
Scenario	Planning Strategy Relative To Current	Spatial Focusing Of Changes	Alignment to management approach on Yorkshire Water's estate
Go with the flow	Existing patterns of protection relaxed only when/where economics dictate	No expansion of the protected area network	Past
Local stewardship	Agri-environmental schemes strengthened with expansion of stewardship (stronger)	Increased extent of existing conservation areas. Creation of functional ecological networks	Present
Green and pleasant land	Agri-environmental schemes strengthened with expansion of stewardship (stronger)	No strong spatial component to changes but protection of areas of national significance continues	Future

The ESA involved a range of assumptions and limitations which are summarised below. As a consequence of these assumptions and limitations we have categorised all results taken from the ESA as low confidence.

- To examine our entire land holding within the time and resources available we completed a high level assessment with resolution at 2km grid squares, following the NEA approach.
- We observed counter-intuitive results at some sites when comparing modelled values with the local knowledge of our land management colleagues. For example, our most popular sites for recreational visitors sometimes had relatively low values compared to our sites which were quieter and harder to access.

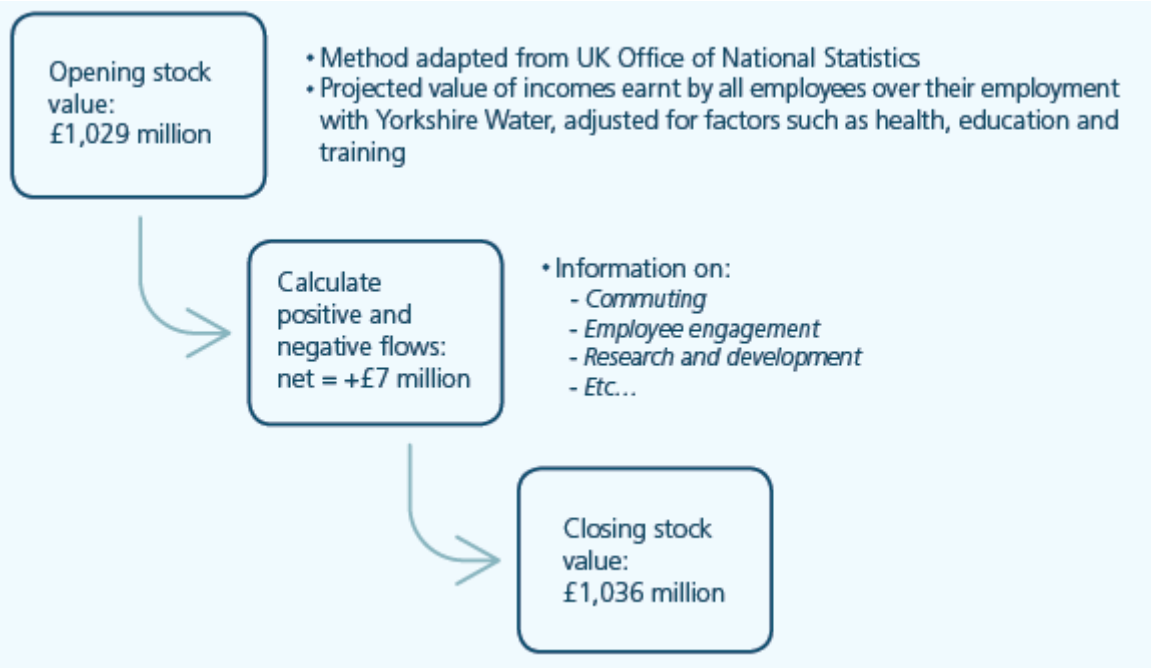
The underlying NEA data and process includes a range of assumptions and data limitations, documented in the NEA reports referenced above.

An example output from the ESA



Human and Intellectual Capital Assessment

We worked with consultants Route2 to our human and intellectual capital and the positive and negative factors influencing them. In order to do this, we adapted both balance sheet and profit and loss accounting approaches, illustrated below:



We assessed a range of metrics each, with their own specific methodologies chosen based on a review of research and academic and industry literature. This approach was applied to anonymised data from 2,398 employees for the 2014/15 financial year, including information such as gender, pay, sickness absence and tenure with the company; and other data including for example details of investments in innovation and wellbeing improvement programmes.

The approach is experimental, and in the future we aim to refine it and apply it to current data to inform our people strategies and innovation programmes.

1. Financial Capital

Metrics assessed in this section:

Taxes and license payments

Salaries and National Insurance contributions

Pension contributions

Profits (‘operating surplus’)

Taxes and license payments

Input	Value	Source	Confidence
Business rates	£58.7 million	2014/15 ARFS p44	High
Carbon taxes	£7.6 million	2014/15 ARFS p43	
Fuel duty	£1.3 million		
Abstraction and discharge licenses	£10.1 million		
Employee PAYE contributions	£12.1 million		
VAT collected from business customers	£13.3 million		
Method			
Direct impact = Business rates + Carbon taxes + Fuel duty + Abstraction and discharge licenses Indirect impact = Employee PAYE contributions Enabled impact = VAT collected from business customers			
Result			
Direct = £77.7 million **Indirect = £12.1 million** **Enabled = £13.3 million**			
Notes			

Salaries and National Insurance contributions

Input	Value	Source	Confidence
Salaries	£75.5 million	2014/15 ARFS p91	High
Employer's NICs	£6.7 million		
Employee NICs	£5.8 million	2014/15 ARFS p43	
Method			
Direct impact = Salaries + Employer's NICs Enabled impact = Employee NICs			
Result			
Direct = £82.2 million **Enabled = £5.8 million**			
Notes			

Pension contributions

Input	Value	Source	Confidence
Employer's pension contributions	£24.3 million	2014/15 ARFS p91	High
Method			
Direct impact = Employer pension contributions			
Result			
Direct = £24.3 million			
Notes			

Profits ('operating surplus')

Input	Value	Source	Confidence
Gross operating surplus	£122.4 million	2014/15 ARFS p86	High
Method			
Direct impact = Gross operating surplus			
Result			
Direct = £122.4 million			
Notes			
Yorkshire Water net profit is not the same as the dividend paid to shareholders. As part of Kelda Group, Yorkshire Water profit/loss is added to Group accounts with profit/loss in other Group companies to determine the ultimate dividend to shareholders.			

2. Manufactured Capital

Metrics assessed in this section:

Fixed asset value

Energy generated

Fixed asset value

Input	Value	Source	Confidence
2013/14 Modern Equivalent Asset Value (MEAV)	£51,213.6 million	Calculated from primary data by UKWIR and Yorkshire Water	Medium
2014/15 MEAV	£51,282.5 million		Medium
2013/14 Net debt	£4,560.4 million	2013/14 ARFS p34	High
2014/15 Net debt	£4,491.1 million	2014/15 ARFS p40	High
Spend in supply chain broken down by SIC, in EIOA	Various	A breakdown of our spend in 2014/15, from our SAP system	High for spend amounts Low for categorisation Overall = Low
Revenues from non-household customers broken down by SIC, in EIOA	Various	Records kept by Yorkshire Water Finance teams	High for revenues Low for categorisation Overall = Low

Method

Net change in MEAV = (2014/15 MEAV – 2014/15 Net debt) - (2013/14 MEAV – 2013/14 Net debt)

For capital formations, see EIOA methodology

Direct impact = Net change in MEAV

Indirect impact = Capital formation in supply chain

Enabled impact = Capital formation by non-household customers

Results

Direct = £138.2 million
Indirect = £154.2 million
Enabled = £81.4 million

Notes

MEAV is an estimate of the cost required to build the existing infrastructure and asset base if starting today using latest technology. We invest substantial amounts in maintaining, improving and adding to our infrastructure, some of which is funded by borrowing from investors. We therefore calculate the MEAV minus net debt. Net debt represents the value of loans and financial leases owed to third parties and other companies in the Group, offset by available cash and short term deposits. The change in MEAV is due to a combination of our investment in infrastructure, and inflation (since the MEAV is expressed in today's prices). The proportional change in net MEAV in 2014/15 was 0.29%. Inflation in the UK between March 2014 and March 2015 was 0%.

The water industry uses the Regulated Capital Value (RCV) to represent the value of the infrastructure in its statutory financial accounting. The RCV reflects the discount shareholders received on the MEAV at the time of privatisation and is therefore notably less, £5,920.9m in 2014/15.

Energy generated

Input	Value	Source	Confidence
Renewable electricity generated and used on site	65,502,126 kWh	Yorkshire Water UKWIR 2014/15 Carbon Accounting Workbook	High
Renewable electricity generated and exported	1,752,936 kWh		
Renewable heat generated and used on site	101,508,003 kWh		
Renewable heat generated and exported	0 kWh		
Average price paid by Yorkshire Water for grid electricity	9.8p/kWh	Total cost of electricity purchased / Volume of electricity purchased from Yorkshire Water accounts	High
Value of exported grid electricity (from exports and renewable incentives)	£2.7 million	Yorkshire Water UKWIR 2014/15 Carbon Accounting Workbook	High
Market value of security of electricity supply	£1,433.06/MWh	London Economics (2013)[11] value of £1,400 inflated to 2014 prices using Bank of England inflation calculator	Low
Average unit cost of gas for 'large' non-domestic consumer	2.244p/kWh	BEIS quarterly gas and electricity prices for non-domestic sector[12]	Medium

Method

Value of heat:

Assuming an 85% efficient conversion method[13], 101,508,003 kWh heat = 119,421,180 kWh gas
119,421,180 kWh * 2.244p = £2,679,811

Value of electricity:

Electricity exported * Market value of security of electricity supply = £2,512,154
Avoided cost of purchasing electricity: Electricity generated and used on site * average price paid for grid electricity = £6,419,208
Value of exported grid electricity = £2.7 million
Total = £11,631,363

[11] London Economics, 2013. The Value of Lost Load (VoLL) for Electricity in Great Britain - Final report for OFGEM and DECC (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/224028/value_lost_load_electricty_gb.pdf)
[12] https://www.gov.uk/government/statistical-data-sets/gas-and-electricity-prices-in-the-non-domestic-sector
[13] This is a conservative estimate based on Yorkshire Water's previous experience. For example, the Energy Saving Trust assumes a typical boiler efficiency of 81%, which if used in this calculation would give a slightly higher value for our heat generation.

Result
Direct: **Total energy generated (electricity and heat) = 168.8 GWh** **Total value of energy generated = £14,311,174**
Notes
We have not included the avoided cost due to reduced CO_2 emissions, since this factors into the net emissions calculated in Section 3. Research published in 2013 by London Economics for Ofgem and DECC estimated the Value of Lost Load (VoLL) for consumers in Great Britain. The research included choice experiments where participants stated their willingness to accept (or pay to avoid) an electricity outage by choosing between scenarios. The report states that VoLL "is likely to be used as a substitute for a market price for security of supply". The authors concluded that a variety of approaches suggested an average VoLL of about £1,400/MWh (£1.4m/GWh) for the industrial and commercial sector, and notably higher for peak winter workdays and for domestic and SME users.

3. Natural Capital

Metrics assessed in this section:

Water consumption

Water saving support

Leakage

Bathing water quality

River quality

Water pollution

Biodiversity

Greenhouse gas emissions

CO_2 absorbed in our land

Pollutants absorbed on our land

Atmospheric pollution

Recreation and amenity

Waste

Water consumption

Input	Value	Source	Confidence
Water delivered to all customers	374,589 ML	Yorkshire Water's Company Compliance Certification June 2015	High
Yorkshire Water's own consumption	1,815 ML	Self-billed consumption figures	High
Water lost to leakage from Yorkshire Water distribution network and customer pipes	288.32 ML/day * 365 days = 105,237 ML	Yorkshire Water's Company Compliance Certification June 2015	Medium
Spend in supply chain broken down by SIC, in EIOA	Various	A breakdown of our spend in 2014/15, from our SAP system	High for spend amounts Low for categorisation Overall = Low
Impact multipliers in EIOA	See EIOA methodology		Low
'Raw' estimated costs to Yorkshire Water of collecting, treating and supplying water (excludes all other operational activities such as business continuity, security, education, customer service etc).	Various	Yorkshire Water cost models	Low

Method

Direct consumption = Yorkshire Water's own consumption

Indirect consumption: See EIOA methodology

Enabled consumption: Water supplied to customers – Yorkshire Water's own consumption

Cost = consumption x raw costs of collecting, treating and supplying water

Result

Direct = 1,815 ML = -£2.7 million
Indirect = 189,095 ML = -£283.6 million
Enabled = 372,774 ML = -£559.2 million

Notes

There is some potential for double counting between indirect and enabled impacts here, as some of our suppliers may be Yorkshire Water customers.

Since water cycles through the human and natural environments, with a core part of our business being the treatment and return of wastewater to the environment, the concept of water 'consumption' is difficult to quantify. A better term might be 'water use', since although water is returned to the environment eventually, its collection and treatment incurs costs and benefits across the six capitals. Without careful management, there is also the potential for natural sources to become depleted as water use increases, causing detrimental environmental effects.

In order to provide clean, safe water, we draw water from the environment (abstraction) and treat it before supplying it to our customers. We then treat the resulting sewage and wastewater to bring it to the right standard to return to the environment (discharge). The Environment Agency regulates these activities, by providing abstraction licenses and discharge permits to ensure that the environment is not harmed. In 2014/15, our abstraction license compliance rate was 100% and our discharge permit compliance rate was 99.32%, compared with an industry average (across both) of 98.9%[14]. In complying with these licenses and permits, we are using and managing water in a maner which the Environment Agency deems not to be causing environmental pollution.

The 'water use' figure quoted above represents the water which we have billed ourselves for, that is, the water we use ourselves in our operations, rather than the total amount of water we abstract. We do measure site-specific abstraction, which we aim to incorporate into our natural capital valuations for the next iteration of TIVA.

[14] https://discoverwater.co.uk/environmental-performance

Water saving support

Input	Value	Source	Confidence
Total savings from cistern devices	0.02 ML/day	Yorkshire Water's Company Compliance Certification June 2015, using Ofwat's methodology to calculate water savings	Low
Total savings from tap and shower devices	<0.01 ML/day		Low
Total savings from hose trigger guns and crystal packs	0.01 ML/day		Low
Total savings from 'additional activity'	1.31 ML/day		Low
Total savings from education and activities on behavioural change	0.21 ML/day		Low
Total savings from other non-household activity	2.12 ML/day		Low
Number of water butts sold discounted	1,805		High
Number of water saving packs distributed	26,439	Records kept by Yorkshire Water's Asset Management team	High
Amount spent by Yorkshire Water on water saving packs	£143,000		High
Amount spent by Yorkshire Water on information and education campaigns relating to water efficiency and water saving	£142,500		High
'Raw' estimated cost to Yorkshire Water of collecting, treating and supplying water (excludes all other operational activities such as business continuity, security, education, customer service etc).	Various	Yorkshire Water cost models	Low
Method			
Water per year saved = total savings per day * 365 = 1,338 ML 1,338 ML * raw costs of collecting, treating and supplying water = £2,007,000			
Result			
Total spent on water saving: £285,500 **Enabled = 1,338 ML/year saved = £2,007,000**			
Notes			

Leakage

Input	Value	Source	Confidence
Water leakage from Yorkshire Water distribution network	209.76 ML/day	2015 Company Compliance Certification data submitted to Ofwat (Table 10)	Medium
Water leakage from customer pipes	78.56 ML/day		Medium
'Raw' estimated costs to Yorkshire Water of collecting, treating and supplying water (excludes all other operational activities such as business continuity, security, education, customer service etc).	Various	Yorkshire Water cost models	Low
Method			
Direct = (leakage from distribution network) * 365 days * raw costs of collecting, treating and supplying water Enabled = (leakage from customer pipes) * 365 days * raw costs of collecting, treating and supplying water			
Result			
Direct = -£114.8 million **Enabled = -£43.0 million**			
Notes			

Bathing water quality

Input	Value	Source	Confidence
Bathing water quality scores	Scale values from the Revised EU Bathing Water Directive: Poor, Sufficient, Good or Excellent	Defra: Bathing waters in England: 2015 compliance report[15] 2014/15 ARFS	High
Investment in bathing water quality	£110 million	Yorkshire Water business plans and accounts	High

Method

Result

Direct:

Bathing water quality scores:
10 x Excellent
8 x Good
1 x Sufficient
1 x Poor

Investment in bathing water quality = £110 million

Notes

Quality scores are for the 2015 calendar year, rather than financial year 2014/15, according to Defra's method. Classifications are linked to numerical standards for bacterial presence and concentration, defined by the EU Revised Bathing Water Directive. The classifications from the Revised version of the directive (which tightened standards) were used for the first time in 2015, prior to which bathing waters were classified as 'Guideline', 'Mandatory' or 'Fail'.

Classifying our impact on bathing water quality is challenging, since some of our activities do impact on bathing waters but they are also subject to external factors including the activities of other organisations operating within the catchment. For example, an investigation in 2016 into bathing water quality in Scarborough South found evidence of illegal activity by a food processing facility which was causing downstream impacts (this has since ceased).

Whilst the rating indicates the outcome of all factors, our direct input can be reported as the £110 million worth of investment in bathing water quality improvement measures which was finalised in 2014/15. This is reported as a £110 million investment explicitly in the main TIVA report to avoid misleading claims regarding benefits.

[15] https://www.gov.uk/government/publications/bathing-waters-in-england-2015-compliance-report

River quality

Input	Value	Source	Confidence
Total length of river improved over 5 year period 2015 - 2020	440km	Yorkshire Water business plan, performance commitment and models	Medium
Method			
Length improved over a 5 year Asset Management Period, divided by 5 to give average annual improvement.			
Result			
Direct: **Length of river improved in 2014/15 = 88km**			
Notes			
'River quality' is determined by the Environment Agency, which takes thousands of samples a year to measure levels of phosphorus, ammonia and Biological Oxygen Demand (BOD). Examples of activities we undertake to improve river environments include upgrades to our wastewater treatment works to serve an increasing population, infrastructure upgrades to reduce the frequency and impacts of sewer overflow discharges, construction of fish passes, and river restoration programmes.			

Water pollution

Input	Value	Source	Confidence
Spend in supply chain broken down by SIC, in EIOA	Various	A breakdown of our spend in 2014/15, from our SAP system	High for spend amounts Low for categorisation Overall = Low
Impact multipliers in EIOA	See EIOA methodology		Low

Method

See EIOA methodology

Result

Results were calculated for a very large number of pollutants: the full lists are shown in Appendix B.
Note: 'direct' impacts from chlorides were excluded as this is a data artefact caused by our intentional use of chlorine in our water treatment works.

Top 5 pollutants

Direct

Pollutant	*Amount released (tonnes)*
Total organic carbon (TOC)	3,610
Phosphorus - as total P	745
Fluorides - as F	68
Halogenated organic compounds - as AOX	29
Zinc	12

Indirect

Pollutant	*Amount released (tonnes)*
Chlorides - as Cl	299
Nitrogen - as total N	29
Total organic carbon (TOC)	20
Phosphorus - as total P	3
Fluorides - as F	1

Enabled

Pollutant	*Amount released (tonnes)*
Chlorides - as Cl	46
Total organic carbon (TOC)	17
Nitrogen - as total N	1
All others	<0.5

Top 5 spend or revenue categories giving rise to the greatest quantity of pollutants

Direct

Category	*Total pollutants (tonnes)*	*Percent of total*
Natural water; water treatment and supply services	19,766	52%
Sewerage services; sewage sludge	18,605	48%

Indirect

Category	*Total pollutants (tonnes)*	*Percent of total*
Natural water; water treatment and supply services	85	25%
Other chemical products	85	25%
Electricity, transmission and distribution	69	20%
Other professional, scientific and technical services	29	9%
Machinery and equipment n.e.c.	29	9%

Enabled

Category	*Total pollutants (tonnes)*	*Percent of total*
Other chemical products	43	80%
Other food products	5	10%
Electricity, transmission and distribution	3	6%
Dairy products	2	4%
Textiles	<0.2	<0.5%

Notes

These results are calculated from UK average values provided by the ONS. They do not take account of our specific business practices and as such, they should not be considered to represent Yorkshire Water's actual impact on water pollution. We therefore have not included them in the *Our Contribution to Yorkshire* report. However we have included them here as they provide a useful indication of which processes, spending categories and enabled activities are likely to have the greatest impact in this area: highlighting where interventions may be most usefully deployed.

We treat sewage and wastewater to bring it to the right standard to return to the environment (discharge). The Environment Agency regulates these activities by providing discharge permits to ensure that the environment is not harmed. In complying with these permits, we are using and managing water in a maner which the Environment Agency deems not to be causing environmental pollution. In 2014/15, our discharge permit compliance rate was 99.32%. In 2014/15 we had 4 Category 1 (most serious) and Category 2 pollution incidents, and 191 Category 3 (least serious) pollution incidents, down from 8 Category 1 and 2 incidents and 272 Category 3 incidents in 2013/14.

Biodiversity

Input	Value	Source	Confidence
SSSI status	Various	Yorkshire Water records and Natural England classifiations	High

Method

Status of SSSIs from March 2014 to May 2015.

Result

Status	March 2014	May 2015	Change
Favourable	2.71%	2.67%	-0.04%
Unfavourable Recovering	95.95%	95.49%	-0.46%
Unfavourable No Change	0%	0.5%	+0.5%
Unfavourable Declining	1.34%	1.34%	0%
Destroyed or partially destroyed	0%	0%	0%

Notes

Biodiversity is one of the hardest metrics to quantify, as it describes inter- and intra-species variance of living organisms, rather than the quantity of fauna and flora present. Although not explicitly captured in the definition, it can usually be assumed that the quality of an area's 'biodiversity' also relates to indigenous species: although an area with many types of invasive species could technically be considered 'biodiverse'; this state of affairs would not be desirable, as native species would likely be suffering as a consequence.

Ecosystems are also subject to numerous threshold and balancing considerations: whilst the preservation of an endangered species may usually take precedence over a non-endangered one; if local populations of a non-endangered species were to collapse, the effects on the local ecosystem could be devastating.

In 2014/15, Yorkshire Water did not have a unified measure of biodiversity in use across its land holdings. We have therefore considered the status of our Sites of Special Scientific Interest, since these represent areas of particular ecological richness and importance for the UK. Yorkshire Water owns 11,400 ha of SSSIs, representing approximately 46% of our land.

Previously, Defra's 'biodiversity units' have been used to measure the impact of individual projects. At present, we are working towards measuring and monitoring biodiversity across our entire land holdings using Defra's biodiversity offsetting units, with the aim of completing this by 2020.

Greenhouse gas emissions

Input	Value	Source	Confidence
a: Scope 1 emissions - operational	85,880 tCO_2e	The Carbon Accounting Workbook used by the UK water industry, which follows Defra carbon accounting guidelines and uses latest conversion factors.	Medium
b: Offset emissions from renewable energy export	866 tCO_2e		
c: Scope 2 emissions - operational	252,034 tCO_2e		
d: Scope 3 emissions – operational	31,824 tCO_2e		
e: Emissions embedded in capital investment activity	0.35kg CO_2e/£	Internal cost and carbon models	Low
f: Capital investment in 2014/15	£285.7 million	2014/15 ARFS	High
g: Emissions from manufacture and treatment of chemicals purchased and waste disposed (excluding sludge which is captured in our scope 1 operational emissions)	59,533 tCO_2e	Figure calculated by WSP in 2012 in a project called 'Kelda Group's Road to Carbon Neutrality'. The figure was produced in 2011 for the year 2015, using data obtained from our buying team's inventories and applying emissions factors per tonne of product manufactured.	Low
h: Enabled emissions (household only)	53,838 tCO_2e	EIOA	Low
i: Central non-traded price of carbon	2014: £61/tCO_2e 2015: £62/tCO_2e (average £61.50/tCO_2e)	HM Treasury Green Book data table 3[16]	High
j: Central traded price of carbon (applies to grid electricity use)	2014: £4/tCO_2e 2015: £5/tCO_2e (average £4.50/tCO_2e)		

Method

Direct emissions = a

Indirect emissions = c + d + ((e * f)/1000) + g - b

Enabled emissions = h

Annual cost = (total emissions in non-traded sector * i) + (total emissions in traded sector * j)

[16] https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal

Result
Direct = 85,880 tCO_2e = -£5,821,620 **Indirect = 442,520 tCO_2e = -£12,898,404** **Enabled = 98,594 tCO_2e = -£6,036,531**
Notes
Scope 1 operational emissions include the emissions from burning fossil fuels on our sites, driving company vehicles and gasses emitted during biological treatment processes. Scope 2 operational emissions arise from our procured electricity Scope 3 operational emissions include emissions from our business travel on public transport and in private vehicles, activities from outsourced core business operations, and emissions from the transmission and distribution of the grid electricity we purchase. The indirect emissions figure excludes Yorkshire Water's supply chain spend on products other than for capital investment, electricity procurement and chemicals. Whilst this spend is included in the EIOA calculation, the addition of the indirect figure from the EIOA would cause double-counting since capital investment and energy and chemicals procurement is also included. Since the latter account for the majority of our indirect emissions, and more accurate estimates than the EIOA are available from our modelling and the WSP study, it was decided to use these for the indirect figure.

CO_2 absorbed in our land

Input	Value	Source	Confidence
Surface area of land type	See table below	Yorkshire Water GIS data and some assumptions regarding management regimes based on interviews with Yorkshire Water colleagues	Low
Carbon sequestration rate by land type	See table below	Alonso et al. (2012)[17] Forestry Commission[18]	Low
Central non-traded price of carbon	2014: £61/tCO_2e 2015: £62/tCO_2e (average £61.50/tCO_2e)	HM Treasury Green Book data table 3[19]	Medium

Method

Sequestration rate for each land type was multiplied by its area to give the total annual sequestration rate.

Land Cover Type	Area (ha) of YW Land Ownership	CO_2 Sequestration (tonnes/ha/year)	CO_2 Sequestration (tonnes/year)
Heathland	5,104	-0.07	-357
Bog/Peatland	4,847	0.86	4,168
Grassland	11,940	2.20	26,268
Broadleaved & Mixed Woodland	670	5.40	3,618
Coniferous Woodland	885	14.00	12,390
Total	-	-	**46,088**

The annual value of CO_2 sequestered was obtained by multiplying the amount sequestered by the average of the Government's 2014 and 2015 central non-traded carbon prices.

Result

Direct = 46,088 tCO_2e sequestered annually = £2.83 million annually

Notes

This calculation was conducted by an MSc student from the University of Leeds, supervised and checked by Yorkshire Water.

[17] Alonso, I., Weston, K., Gregg, R. and Morecroft, M. 2012. Carbon storage by habitat - Review of the evidence of the impacts of management decisions and condition on carbon stores and sources. Natural England Research Reports, Number NERR043

[18] Forestry Commission. [no date]. *Mitigation: Planting more trees*. UK: Forestry Commission. Available from: https://www.forestry.gov.uk/pdf/6_planting_more_trees.pdf/$file/6_planting_more_trees.pdf

[19] https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal

Pollutants absorbed on our land

Input	Value	Source	Confidence
a_{on}: Deposition velocity of pollutant when land type x is on leaf	See tables below	Powe and Willis (2002)[20]	Medium
a_{off}: Deposition velocity of pollutant when land type x is on leaf			
b: Proportion of on leaf days in 2014		Woodland Trust: Nature's Calendar average tables[21]	Low
c: Pollutant background concentration in 2014		Defra: Modelled background pollution data[22]	Medium
d: Surface area index		Powe and Willis (2002)	Medium
e: Surface area of land type		Yorkshire Water GIS data	Medium
f: Damage cost of emissions of pollutant		Defra (2015) Air quality economic analysis: Damage costs by location and source[23]	Medium
g: Proportion of dry days in 2014		Met Office regional climate summaries[24]	Medium
x: Land type		Yorkshire Water GIS data	Medium
y: Pollutant type		n/a	n/a

Method

SO_2

Pollutant concentration (µg/m³)	2.710518
Pollutant damage cost (£/tonne)	1936.82
Proportion dry days 2014/15	0.565753425
Proportion on-leaf days 2014/15	0.614794521
Period (days)	365

[20] Powe and Willis (2002), Mortality and morbidity benefits of air pollution (SO2 and PM10) absorption attributable to woodland in Britain. Report to Forestry Commission, Edinburgh
[21] http://www.naturescalendar.org.uk/findings/datatables.htm
[22] https://uk-air.defra.gov.uk/data/pcm-data
[23] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/460398/air-quality-econanalysis-damagecost.pdf
[24] http://www.metoffice.gov.uk/climate/uk/summaries/datasets

Land Cover Type	Area (ha) of YW land Ownership	Deposition velocity (m/s) on leaf	Deposition velocity (m/s) off leaf	Surface area index on leaf (m2/m2)	Surface area index off leaf (m2/m2)
YW Open Dwarf Shrub Heath	1,899.37	0.001	0.001	2.5	1.7
YW Dwarf Shrub Heath	3,204.98	0.001	0.001	2.5	1.7
YW Bracken	300.48	0.001	0.001	2.5	1.7
YW Inland Bare Ground	560.75	0	0	0	0
YW Bog	4,847.03	0	0	0	0
YW Fen or Marsh or Swamp	6.81	0	0	0	0
YW Acid Grass	2,446.57	0.001	0.001	2.5	1.7
YW Calcareous Grass	861.60	0.001	0.001	2.5	1.7
YW Neutral Grass	6,080.46	0.001	0.001	2.5	1.7
YW Setaside Grass	2.03	0.001	0.001	2.5	1.7
YW Improved Grassland	2,549.51	0.001	0.001	2.5	1.7
YW Broad-Leaved Woodland	1,589.43	0.0526	0.01	6	1.7
YW Coniferous Woodland	1,261.46	0.0816	0.0816	9	9
YW Inland Water	1,853.04	0	0	0	0
YW Arable Cereals	180.41	0.001	0.001	2.5	1.7
YW Arable Horticulture	532.65	0.001	0.001	2.5	1.7
YW Littoral Sediment	0.13	0	0	0	0
YW Littoral Rock	0.04	0	0	0	0
YW Continuous Urban	370.04	0	0	0	0
YW Suburban or Rural Developed	424.09	0	0	0	0

PM_{10}

Pollutant concentration (µg /m^3)	12.18246
Pollutant damage cost (£/tonne)	17843.33
Proportion dry days 2014/15	0.565753425
Proportion on-leaf days 2014/15	0.614794521
Period (days)	365

Land Cover Type	Area (ha) of YW land Ownership	Deposition velocity (m/s) on leaf	Deposition velocity (m/s) off leaf	Surface area index on leaf (m^2/m^2)	Surface area index off leaf (m^2/m^2)
YW Open Dwarf Shrub Heath	1,899.37	0.001	0.001	2.5	1.7
YW Dwarf Shrub Heath	3,204.98	0.001	0.001	2.5	1.7
YW Bracken	300.48	0.001	0.001	2.5	1.7
YW Inland Bare Ground	560.75	0	0	0	0
YW Bog	4,847.03	0	0	0	0
YW Fen or Marsh or Swamp	6.81	0	0	0	0
YW Acid Grass	2,446.57	0.001	0.001	2.5	1.7
YW Calcareous Grass	861.60	0.001	0.001	2.5	1.7
YW Neutral Grass	6,080.46	0.001	0.001	2.5	1.7
YW Setaside Grass	2.03	0.001	0.001	2.5	1.7
YW Improved Grassland	2,549.51	0.001	0.001	2.5	1.7
YW Broad-Leaved Woodland	1,589.43	0.005	0.0014	6	1.7
YW Coniferous Woodland	1,261.46	0.008	0.008	9	9
YW Inland Water	1,853.04	0	0	0	0
YW Arable Cereals	180.41	0.001	0.001	2.5	1.7
YW Arable Horticulture	532.65	0.001	0.001	2.5	1.7
YW Littoral Sediment	0.13	0	0	0	0
YW Littoral Rock	0.04	0	0	0	0
YW Continuous Urban	370.04	0	0	0	0
YW Suburban or Rural Developed	424.09	0	0	0	0

$$Avoided\ damage\ cost\ of\ sequestration = \sum_{x \in S, y \in S'} \left(\left(a_{on_x} * b \right) + \left(a_{off_x} * (1 - b) \right) \right) * c_y * d_x * e_x * f_y * g * 365\ days * 84{,}600\ seconds$$

Result

Amounts sequestered:
PM_{10}: 337.66 tonnes/year
SO_2: 587.98 tonnes/year

Direct = £7,163,820

Notes
The damage cost applied here refers specifically to PM_{10}, rather than the total PM damage cost applied for the 'atmospheric pollution' calculations. Costs are calculated for PM_{10} and SO_2 only due to the availability of data on deposition rates and damage costs. The discrepancy between the land cover figures used here, and those for the CO_2 sequestration calculations is due to differences in habitat classification methods, and annualised averaged assumptions about Yorkshire Water's past and future woodland management regimes which were applied to the latter. The discrepancy will be rectified in the next iteration of TIVA.

Atmospheric pollution

Input	Value	Source	Confidence
Spend in supply chain broken down by SIC, in EIOA	Various	A breakdown of our spend in 2014/15, from our SAP system	High for spend amounts Low for categorisation Overall = Low
Impact multipliers in EIOA	See EIOA methodology		Low
Damage cost per tonne of particulate matter (PM)	£30,225	HM Treasury Green Book: Air quality damage costs per tonne, 2015 prices[25] (central industrial value)	Medium

Method

Cost = damage cost per tonne of PM * tonnes PM emitted

Result

Direct

Pollutant	*Amount released (tonnes)*
PM_{10}	26.90
$PM_{2.5}$	22.22
CO	358.03
NMVOC	23.33
1-3 Butaeidine	0.08

Indirect

Pollutant	*Amount released (tonnes)*
PM_{10}	26.49
$PM_{2.5}$	24.32
CO	454.40
NMVOC	133.15
1-3 Butaeidine	0.07

Enabled

Pollutant	*Amount released (tonnes)*
PM_{10}	36.16
$PM_{2.5}$	20.63
CO	196.62
NMVOC	177.01
1-3 Butadiene	0.07

Direct = -£1,484,652
Indirect = -£1,535,732
Enabled = -£1,716,478

Notes

The air quality guidance document referenced above does not provide damage cost values for CO, NMVOC (Non-methane volatile organic compounds) or 1-3 butadiene, so the resulting costs here are only for PM.

[25] https://www.gov.uk/guidance/air-quality-economic-analysis

Waste

Input	Value	Source	Confidence
Direct waste: this includes waste from offices, clean water sludge, etc.	Landfilled: 3,619.64 tonnes	Data from our monthly waste report (Aggregates of all months in 2014/15)	High
	Reused/recycled: 42,706.89 tonnes		
	To energy: 253.39 tonnes		
Construction and demolition waste generated by activities of our partners working on our behalf	Landfilled: 17,544.91 tonnes		
	Reused/recycled: 128,811.36 tonnes		
Waste generated as a consequence of the activities of our supply chain in producing the goods and services that we purchase	15,608 tonnes	EIOA: see EIOA methodology	Low
Enabled waste: enabled by the services that we provide to our customers i.e. sludge and screenings from wastewater treatment.	Total waste generated from wastewater treatment: 316,254.81 tonnes	Data from Yorkshire Water's Sludge Recycling Team for 2014/15	Medium
	Total sent to landfills[26]: 15,590.81 tonnes		Medium
Direct: cost of waste management	£733,570.75	Data from our monthly waste report (Aggregates of all months in 2014/15)	High
Indirect: cost of waste management	£1,917,922.64		
Enabled: cost of sludge management	£3,399,432.25	Data from Yorkshire Water's Sludge Recycling Team for 2014/15	High
Enabled: income from sludge disposal (from sales as fertiliser)	£91,891.80		
Disamenity value of landfilled waste	£2.46/tonne	Defra study (2003) price[27] inflated to 2014 prices using Bank of England inflation calculator	Low

[26] Mainly grit and screening

[27] http://webarchive.nationalarchives.gov.uk/20130403044452/http://archive.defra.gov.uk/environment/waste/strategy/legislation/landfill/documents/landfill_disamenity.pdf

Method

For the indirect waste figure from the EIOA, the same split of landfill/recycled as the known indirect waste figure from the waste reports was assumed.

Enabled waste not sent directly to landfill was processed by digestion or incineration, then either sent to landfill, used for land remediation or used as fertiliser. In many cases heat or electricity is generated during the digestion or incineration process. To avoid 'double counting' where waste has been both used to generate energy *and* e.g. reused as fertiliser, all non-landfilled waste was reported as "Recycled/reused".

Disamenity values = disamenity value per tonne * tonnes of waste sent to landfill

Net cost =cost of waste disposal – profit from waste disposal + disamenity value of landfill

Result

Total waste to landfill
Direct: 3,620 tonnes
Indirect: 19,418 tonnes
Enabled: 15,591 tonnes

Total waste reused/recycled
Direct: 42,960 tonnes
Indirect: 142,546 tonnes
Enabled: 300,664 tonnes

Total net
Direct = -£742,475.05
Indirect = -£1,965,690.61
Enabled = -£3,345,893.83

Notes

Avoided CO_2 emissions and energy costs due to the use of waste in waste to energy plants are calculated in the Greenhouse Gas Emissions section of this report.

Several potentially material impacts of our waste management processes are unknown at this time:

Emissions from landfill:
Calculating emissions of greenhouse gases and other pollutants from landfill sites is complex, and emissions cannot be measured directly. In the UK, national annual GHG emissions from municipal solid waste landfill sites are modelled using an IPCC model with UK-specific modifications, based on a number of factors including waste inventories, estimates of degradeable organic carbon content and the physical chemistry of gases in landfills. The number of unknowns for the case of Yorkshire Water's landfilled waste is therefore such that we consider that any estimated

quantification would have extremely large error margins and would not be useful in business decision making.

Indirect cost of waste disposal:
Our suppliers and contractors will incur costs in managing and disposing of the waste arising from their activities whilst supplying goods and services to Yorkshire Water. In the absence of information on the breakdown of waste types and costs by supplier, these cannot be estimated with a practical degree of accuracy. Whilst some may be assumed to be similar to those incurred by Yorkshire Water on a per-unit basis, savings due to economies of scale or other arrangements etc. are not known. It should also be noted that some of the costs incurred by our suppliers will be indirectly covered by the price paid for their services, which in turn affects Yorkshire Water's net profit reported under the Financial Capital section of this report.

Job creation:
Landfill diversion activities such as recycling create jobs, add revenues, and help stimulate other economic sectors. For example, every tonne of waste diverted into activities involving reuse recycling or energy recovery has the capacity to generate new jobs, since these activities are generally more resource-intensive than operating a landfill[28]. A study by Friends of the Earth assessed the potential for job creation through higher rates of recycling in the UK. The study estimated the potential incremental direct employment opportunities in the recycling sector, based on the lowest estimates for full time equivalent jobs for diverting 1,000 tonnes of key recyclable materials from landfill or incineration derived from the UK. The multiplier is estimated as 6.2 FTE[29] jobs created per 1000 tonnes of waste diverted from landfills and incinerators[30].

[28] LEPU, 2004, *Jobs From Recycling: Report on Stage II of the Research*, London South Bank University)
[29] Full Time Equivalent (FTE) is a unit to measure employed persons in a way that makes them comparable although they contribute a different number of hours per week.
[30] https://www.foe.co.uk/sites/default/files/downloads/jobs_recycling.pdf

Recreation and amenity

Input	Value	Source	Confidence
Calculated annualised value of recreation from Route2's ESA under the 'Local Stewardship' scenario	£7.47 million	Route2's ESA for Yorkshire Water	Low
Calculated annualised value of amenity from urban green space from Route2's ESA under the 'Local Stewardship' scenario	£0.79 million		
Method			
See the Ecosystem Services Assessment section of this report			
Result			
Direct = £8.26 million			
Notes			
See the Ecosystem Services Assessment section of this report			

4. Human Capital

Metrics assessed for human capital:

Employee engagement

Engagement in performance reviews

Apprenticeships

Employee volunteering

Health benefits

Succession programmes

Injuries

Commuting

Protracted paid overtime

(Un)equal opportunity

Wage inflation

Turnover

Sickness absence

See the appendix to this report for methodologies used for human capital metrics.

5. Intellectual Capital

Metrics assessed for intellectual capital:

Research and Development

Employee training

Public information

Knowledge decay

See the appendix to this report for methodologies used for intellectual capital metrics.

6. Social Capital

Metrics assessed in this section:

Supporting customers

Customer satisfaction

Education

Charity and volunteering

Late payments to suppliers

Supporting our customers

Input	Value	Source	Confidence
Number of customers supported by scheme	See below	Yorkshire Water records	High

Method

Customer numbers are rounded to the nearest 100, or 10 when the total is less than 1,000
Financial figures are rounded to the nearest £100,000, or £1,000 when the total is less than £1,000,000

Result

Direct:

Scheme	Description	Number of customers	Value
WaterSure	Bills are capped at a certain figure for customers who receive income-based benefit and have either a qualifying medical condition or three or more children under the age of 19 living at home	5,800	£2,300,000
WaterSupport	Payments toward water bills for customers with a low household income who pay more than £425 a year for their water bill. This scheme commenced in December 2014	760	£188,000
Community Trust Award	Customers in arrears with at least one other 'priority' debt (e.g. rent, mortgage, energy) receive an award to pay towards their debt	2,200	£880,000
Resolve	Customers with over 12 months of arrears agree a regular payment plan, with awards towards the arrears paid by Yorkshire Water for every three months' worth of payments made	5,500	£3,400,000
Water Direct	Metering and direct benefit deduction scheme to help customers who are in receipt of income-based benefit manage their payments	1,200	n/a

Total value = £6,768,000

Notes

Customer satisfaction

Input	Value	Source	Confidence
Results of customer surveys	See below	Yorkshire Water customer survey tracker	High
Service Incentive Mechanism (SIM) score	See below	Ofwat reports	High

Method

The SIM score is measured by Ofwat, led by an independent third party, and takes into account the results from customer surveys and the total number of complaints received.

The other scores are from our own surveys: we survey a representative sample of our customers each month, with respondents from different demographics and different geographic areas. We survey both customers who have contacted Yorkshire Water with a question or issue, and those who haven't.

Result

SIM score in 2014/15: 84.73 / 100

	April 2014 score	March 2015 score	Year average
Brand perception (out of 10)	7.53	8.27	7.79
Quality of water supplied (out of 5)	4.48	4.47	4.45
Reliability of continuous water supply (out of 5)	4.71	4.70	4.70
Overall satisfaction (out of 5)	4.46	4.59	4.51
Value for money 'Good' or 'Very Good'			87%
Met or exceeded expectations			69% (25% 'no opinion')

Notes

Education

Input	Value	Source	Confidence
Number of events, visits and visitors	See below	Records kept by Education programme team at Yorkshire Water	High
Amount spent on education in 2014/15	£54,000		

Method

Result

Direct:

Amount spent on education in 2014/15 = £54,000

Event	Number of events	Number of visitors – children	Number of visitors – adults	Number of visitors - total	Number of schools reached
Speakers Panel	134	5,285	1,947	7,232	58
Education centre visits	380	5,197	1,823	7,020	142
Outreach presentations	10	-	-	1,159	
Green Classroom booklets	4,681 (number of booklets distributed)	-	-	-	113

Notes

Spending on education includes the salaries of guides and educators who work at our education centres, but not the salaries of people within Yorkshire Water who plan and oversee our education activities. It also excludes the other education activities we undertake such as public information campaigns on water saving, responsible disposal of fats, oils and grease, and environmental/recreation campaigns.

As part of this study, we undertook some research on the human and social capital value of environmental education, extra-curricular environmental and science-based education, and learning outside the classroom. At present, the data available is highly sector-specific, with little information relating to the water/utilities sector; and studies on this topic have yielded very variable results. We therefore decided not to monetise the social/human 'added value' of out education programme in this iteration of TIVA. We plan to explore this topic further in the next iteration.

Charity and Volunteering

Input	Value	Source	Confidence
Money raised for WaterAid by Yorkshire Water	£279,000	2014/15 ARFS and Yorkshire Water's WaterAid treasurer	High
Time spent volunteering by Yorkshire Water staff, broken down by department	Work days: 849 Non work days: 1901	Records kept by Yorkshire Water's Sustainability team	Low
Mean average effective daily salary by department	Various		High
Estimated mean average daily value of non-working time by department	30% of effective daily salary	Forsyth (1980)[31] Hensher (1978)[32]	Low

Method

Calculation of value of working time volunteered:

$$\sum_{x \in S} Average\ salary_x * Number\ of\ work\ days\ volunteered_x$$

Calculation of value of non working time volunteered:

$$\sum_{x \in S} Average\ salary_x * Number\ of\ non\ days\ volunteered_x * 0.3$$

Direct = value of working time volunteered

Indirect = value of non-working time volunteered + money raised for WaterAid by Yorkshire Water

Result

Direct = £102,971

Enabled = £291,214

Notes

[31] Forsyth, P.J., 1980. The value of time in an economy with taxation. *Journal of Transport Economics and Policy*

[32] Hensher, D.A., 1978. Valuation of journey attributes: some existing empirical evidence. In: D.A.Hensher and M.O. Dalvi (eds.), *Determinants of Travel Choice*. Farnborough, Saxon House, 1978

Late payments to suppliers

Input	Value	Source	Confidence
Invoice amount and number of days to payment for all business to business procurement in 2015/16	Various	Yorkshire Water procurement team records in SAP	High
Statutory interest on late commercial payments	8% + Bank of England Base Rate (0.5% in 2015/16) = 8.5% per annum	Gov.uk: Interest on late commercial payments Bank of England Statistical Interactive Database - official Bank Rate history	High

Method

$$\sum \frac{£\ late\ payment\ amount * 0.085}{365} * number\ of\ days\ late$$

Result

Direct = -£649,059

Notes

Year 2015/16 was used for this analysis. In 2016 reporting rules for late payments changed, hence 2015/16 will be in line with future years and will allow easier comparison, whereas 2014/15 was calculated differently.

73% of invoices were paid on time in 2015/16. Since then, we have revised our payment processes in several ways, including introducing virtual cards to reduce the time between invoicing and payment, and reducing our standard payment terms.

Statutory interest is simple rather than compounding. Debt recovery costs are not included.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