YORKSHIRE WATER SERVICESLTD

PERIODIC REVIEW 2009

B3 SECTIONS 2 & 6
APPROACH TO ASSET MANAGEMENT PLANNING
(WATER & SEWERAGE)

CONTENTS:

1. INTRODUCTION

1.1. INTRODUCTION

1. The format of B3 Section 2 & 6 follows the Ofwat recommended layout of 3 main sub-headings, these being Management, Processes and Systems. Where possible we have followed the guidance for each area, however there may be overlap or the structure may differ from reporting requirements due to the way our approach has been developed.

2. **Continuous improvement** is an embedded culture within our company, and this is demonstrated through enhancements made to our Leading Edge Asset Decisions Assessment (LEADA) to progress to LEADA+. Key changes are highlighted later in this document.

3. Since 1996 we have been constantly developing and implementing improvements to the way we plan capital maintenance for the assets we operate. We have consistently pushed the boundaries of industry best practice. For PR04 we developed our LEADA process. The enhancement of LEADA's capabilities to produce LEADA+ illustrates our drive for continuous improvement. Figure 1 shows the process of asset management change and implementation over the last 13 years. During this time we have been assessed as the leading company in asset management at PR99 and PR04 .

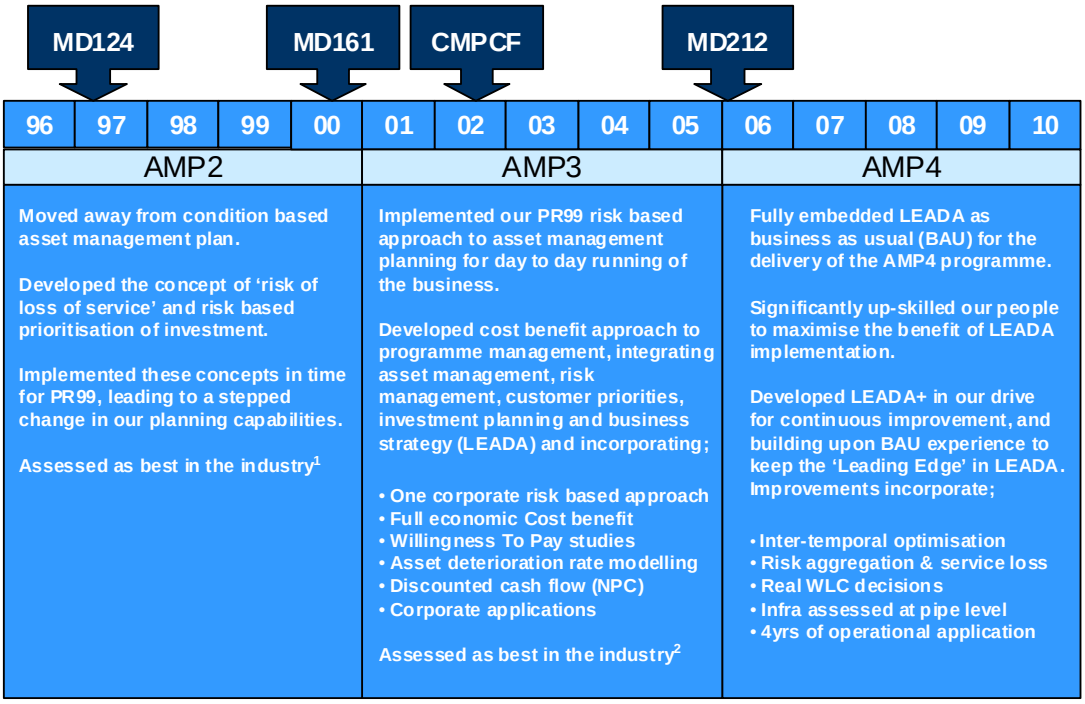

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Figure 1 – Implementation of Capital Maintenance Planning in Yorkshire

4. Our significant leap forward came in time for PR04 when the development of risk based, service orientated, cost benefit analysis tools was used to ensure we planned on the basis of "maximising the service from every pound we spend on our assets".

5. This is now embedded in our day to day activities. Part B3, Sections 1, 2, 5 and 6 outline the considerable energy we have put in to the development of our business-as-usual processes aligned with the tailored learning and development programme for our people.

6. **Our asset management approach is consistently applied to all sub-service areas of investment** and any diagrams in this section should be read as such. Where exceptions occur these are highlighted.

7. In Part B3 we intend to demonstrate the following key points;

1) Business As Usual (BAU)application of the Cost Benefit planning objective
2) System & process enhancements based on reviewing 4yrs of BAU
3) A Fair and balanced approach to determining the impact on customers' bills
4) Full alignment with UKWIR Common Framework, MD161 and MD212

8. This section contains information that is generic to many sections of the business plan and is cross referenced as such. This is due to the integrated nature of our corporate asset management processes and systems.

1.2. ASSET MANAGEMENT PLANNING ASSESSMENT PROCESS

9. Following UKWIR guidance on assessing a company's degree of maturity of its asset management planning, we have provided summary scores at the start of each business plan section. See figure 2 for B3 Sections 2 & 6 AMPAP scores.

10. These scores have been calculated following the detailed procedure described in **B3 Section 3.2.** We have exercised a high degree of rigour in our assessments, ensuring the correct people in the business have provided the evidence and that sufficient quality assurance testing has been undertaken to ensure robust and accurate scoring.

	Management	Processes	Systems
B3 Section 2 & 6			

Figure 2 - Asset Management Planning Assessment Process Scores (YW defined)

11. Figure 2 above represents the main sub-heading splits as detailed in the information requirements, at a summary level rather than split by Infra/Non-Infa. A robust assessment of our management and general (M&G) asset management planning has been undertaken and the summary table is included within **B3 Section 9.**

12. Important points for OFWAT to note when undertaking the AMPAP assessments are;

- that we have consulted with our asset management community when scoring, rather than undertaking scoring as a central function
- we assigned a full time employee to manage the process, to ensure consistency of application, internal reporting & assessment
- we have provided robust evidence for the scores produced
- we have undertaken a separate audit with our Reporter on the AMPAP process

1.3. REPORTER AND AUDITOR INVOLVEMENT

13. We have involved our Reporter and Auditor in developing our PR09 business plan, specifically the enhancements to our PR04 processes and applications. This was undertaken to ensure Reporter understanding and to enable early challenge in the development stages, with regard to what the Reporter would require as part of the Reporter Review. Three full day events were undertaken with our Reporter & Auditor to discuss & debate our LEADA+ process and systems as well as the main PR09 audits, these being;

Date	Involvement	Description
December 2006	Reporter understanding	Full day workshop with the Reporters team to highlight and debate developments proposed to the LEADA systems and processes
July 2007	Reporter understanding	Full day workshop with the Reporters team to highlight and debate ongoing developments to the LEADA systems and processes, and how this would be utilised in business planning & delivery

April 2008	Stage 1 PR09	Stage 1 Reviews were undertaken for all areas of the business, specifically to review methodologies utilised for the development of the PR09 submission
June 2008	Stage 2 PR09	Stage 2 Reviews were undertaken for all areas of the business to review table population and the supporting calculations
General	Stage 3 PR09	Stage 3 Reviews were raised to deal with specific outstanding queries, and to review text in relation to our submission and the Reporters Report.
November 2008	Reporter Understanding	Full day workshop with the Reporters and Auditors team to highlight developments to the LEADA+ systems and processes since DBP, and how this would be utilised in business planning & delivery
Dec 08 to March 09	Stage 4 PR09	Stage 4 Reviews were undertaken for all areas of the business to review table population and supporting calculations as well as text for commentaries for FBP submission

Table 1: Reporter and Auditor involvement

2. MANAGEMENT

2.1. LEADING EDGE ASSET DECISION ASSESSMENT (BAU)

14. Our current embedded approach to asset management planning (LEADA) as described in the PR04 submission, has delivered an economic assessment and optimisation of capital maintenance in line with MD161 and the UKWIR Common Framework for Capital Maintenance Planning.

15. LEADA has enabled us to apply the Cost Benefit Objective of the Common Framework to assessing and delivering our capital maintenance needs. The only significant areas where we have been unable to apply this objective are M&G activities (particularly IT requirements), new development, sewer and mains diversions i.e. where there is no information from the 'Willingness to Pay' surveys. However, as a minimum in these cases we have fulfilled the Cost Effectiveness Objective of the Common Framework.

16. Our PR04 business plan submission saw the development of our LEADA process. This development included both changing the processes of asset management planning and programme prioritisation within AMP4 and the supporting systems. The LEADA suite of systems (figure 3) and supporting process have been embedded and business as usual for 4 years.

17. As part of the AMP4 periodic review process Ofwat gave companies feedback on the application of the Common Framework. We received **4 Band A** ratings within the Stage B assessments. This solid platform has been used as the basis for enhancements to our systems for PR09.

18. Figure 3 represents the LEADA suite of systems as developed and utilised for the PR04 submission and AMP4 delivery. The diagram represents our overall asset management process. **Significant enhancements have been made within each step of the process for PR09**. The process is now called LEADA+ and each step is described in detail in B3 Section 2.2 below.

2.2. KEEPING THE 'LEADING EDGE' IN LEADA: LEADA+

19. For PR09 LEADA+ has delivered an economic assessment and optimisation of capital maintenance which is fully compliant with MD161, the UKWIR Common Framework for Capital Maintenance Planning (Cost Benefit planning objective), MD212 and learning brought about from 4yrs of application.

20. Below we describe the enhancements within each step. One of the less visible enhancements fundamental to 'auditability', is the system's

connectivity. A new IT process called 'Baseline' has been developed, which enables an Economic Levels of Service Assessment (ELSA+) programme to be tracked back to the individual object surveyed, even though new surveys may have been created in the interim. This process ensures the basis on which programme decisions have been made are not overwritten, and enables interrogation of the controls in place within the applications.

21. As part of the Reporters' challenge with regard to system controls, we have undertaken an internal audit on the process controls, a copy of which has been supplied to the Reporter as part of the review process.

22. Our audit report confirms that sufficient controls are in place to provide assurance on data integrity.

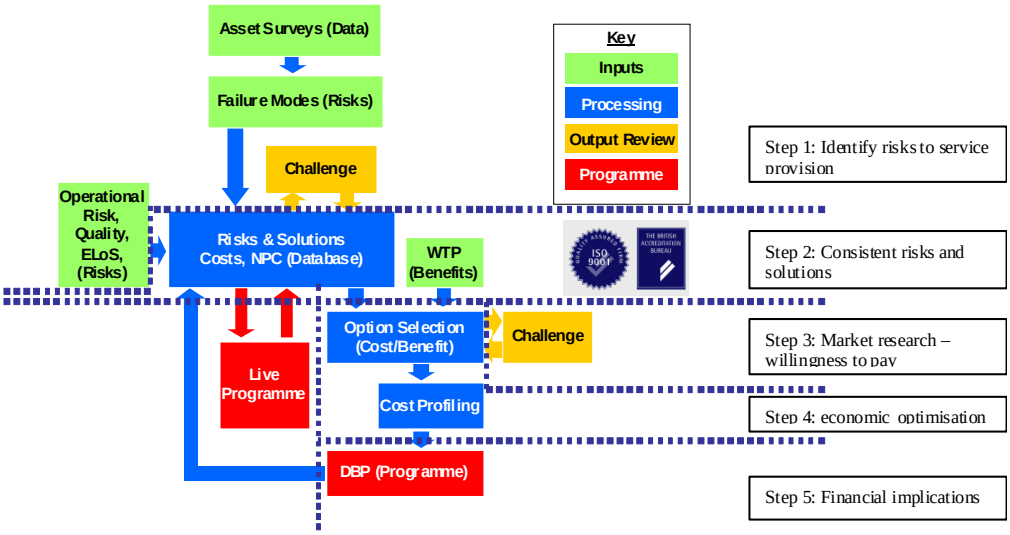


Figure 3 – The LEADA process for asset management and investment planning

23. The Business Risk Model (BRM) which contains all the company risks & solutions in a consistent format received ISO 9001 certification in 2006. this ensures the data quality and that reliability is of a consistently high standard. This is shown above within Step 2.

24. The following sections outline LEADA+ in the steps as shown in figure 3. For ease of reference, below we have highlighted the main enhancements which are keeping the leading edge in LEADA+. All the identified functionality highlighted has been developed and utilised in our Final Business Plan submission.

LEADA+ Enhancements at a Glance

a) 4yrs of business as usual operational knowledge (DBP)
b) Enhanced Whole Life Costing (DBP)
c) Pipe level assessment for water mains and sewers (DBP)
d) 2 stage probability (P of asset failure x P of service impact) (DBP)
e) Risk aggregation for increasing annual service loss over time (DBP)
f) Temporal optimisation (DBP)
g) Re-investment (for FBP)
h) Systematised bundling of investment within the same location (for FBP)

2.2.1. Step 1 – Identify risks to service provision (enhancement c,d,e)

25. We have assessed the risks to service delivery by collecting and analysing data on above and below ground assets. The data collected has allowed us to identify the probability of asset failure at given points in time using appropriate distributions. This has enabled us to identify current and future risks to service. The distributions used are generic for asset types, but are made asset specific through the collection of detailed data, through physical asset observations where possible. Figure 4 shows a cumulative probability distribution based upon Weibull.

26. In figure 4 the three lines represent the same Weibull function but reflect the fact that asset specific factors influence the rate at which probability of failure increases. For example, an asset which is working above its design capacity with limited duty rotation, may be on the steep dark blue distribution, while an identical asset with plenty of duty support could be on the shallow light blue distribution. The majority of assets will sit on distributions closer to the middle curve.

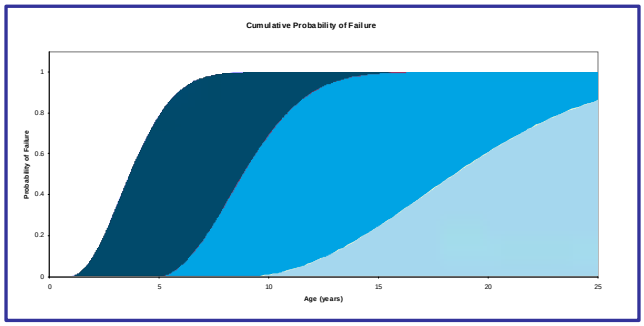


Figure 4 – Weibull Distribution for Cumulative Probability

27. We have also been involved in UKWIR project ref. 'RG/05 Deterioration models and tools for non-infrastructure assets', and considered this within our asset deterioration modelling.

28. In assessing asset deterioration and the impact on service for PR09, we have reviewed our assets at a greater level detail than that undertaken in PR04. The asset survey forms are generated by taking a snapshot of our central Asset Inventory and adding information required for deterioration modelling through asset observations. The asset observations have been undertaken at the level shown in figure 5 below.

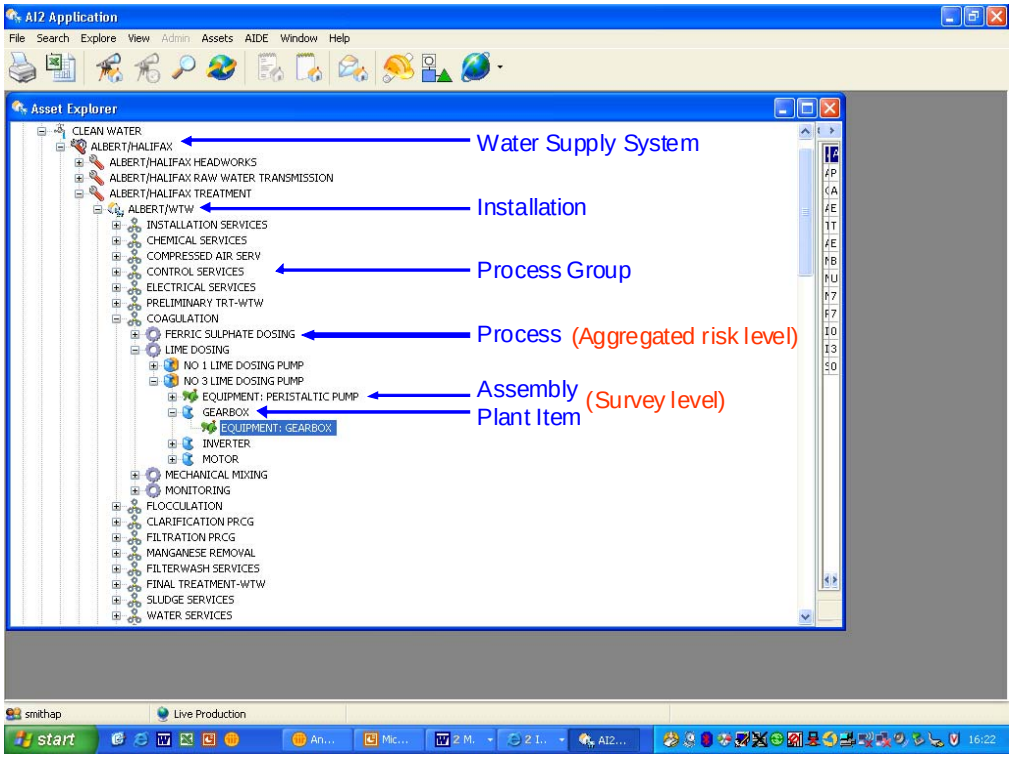


Figure 5 – Asset Inventory hierarchical representation of surveys & risk aggregation (non-Infra)

29. We have also established that a risk occurrence at the assembly/plant item level is unlikely to cause a service impact; therefore we have developed functionality to aggregate risks to process level. This enables increasing loss of functionality to be considered over time, based on the deteriorating sub-assembly. Risk aggregation ensures that the correct risk of service loss is estimated and only associated with those assets causing the potential service loss, rather than the whole process being considered. This results in focused lower cost solutions.

30. This is illustrated in figure 6 below which shows a more detailed view of the process that occurs between steps one and two of the LEADA+ five step approach. The inputs show the information that is added to the Asset Inventory generated survey form, how the information is used in deterioration modelling (both of these are AGASP functions) and how the information is generated into risks and solutions as part of the interface between steps one and two. The mitigating solution only allows for replacement of the failing assembly/plant item at the appropriate point in time and directly related to the asset causing the risk.

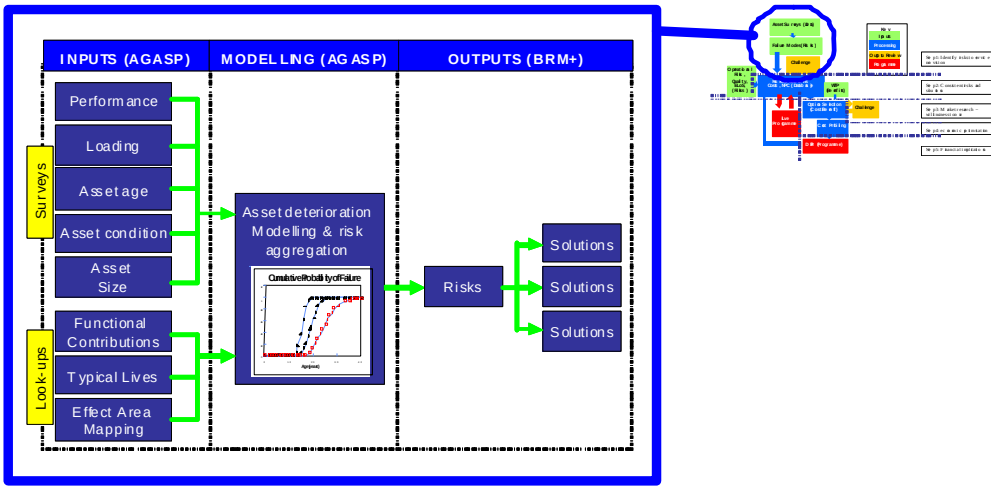


Figure 6 – Detailed Step 1 diagram & linkage to Step 2 for non-infra assets

31. Significant enhancements have also been made to asset deterioration modelling for below ground assets, where assessment has been undertaken at pipe level. Due to the large number of assets this creates, aggregation analysis has been undertaken in order to group pipes of similar characteristics e.g. the same pre & post risk levels and deterioration over time. GIS data is utilised in the below ground asset deterioration modelling process. We have also been involved with and considered the outputs of numerous UKWIR projects on distribution mains modelling e.g. 07/WM/08/36 Linking distribution mains rehabilitation to performance and 07/RG/05/20 Development of national deterioration models.

32. The process of aggregation for below ground assets is shown in figure 7.

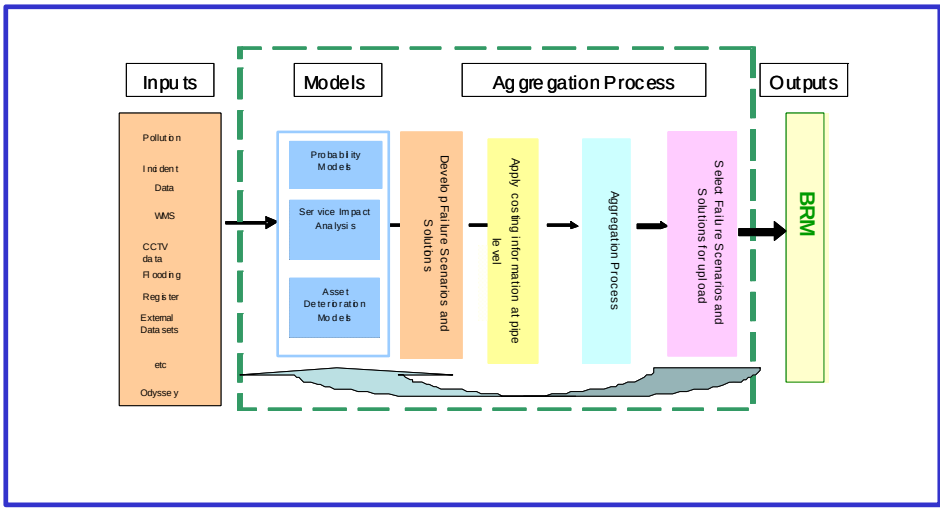


Figure 7 – Detailed Step 1 diagram and linkage to Step 2 Infra

33. We have also used 'Project Charters' (asset specific studies) as a way to ensure full asset coverage, for those assets that do not exist on the central asset inventory e.g. vans. These were based on manual surveys uploaded through an IT interface into BRM+, ensuring consistency of all risks identified by the business in one environment. Project charters also identified more strategic risks which lead to service failures against current objectives, due to issues such as asset criticality and potential up-stream and down-stream impacts i.e. how the assets sit within a Source to Tap or Sink to River representation. Operational and asset management teams have also reviewed historical data and used their knowledge to identify and challenge risks and to propose outline solutions. **Further details of project charters are given in B3 Section 3 & 7.**

34. Risk of loss of service is assessed across all areas of the business as a function of:

- probability of asset failure
- probability of failure causing defined service impact
- severity of the impact on service, and
- quantity or scale of the impact.

35. The two stage probability assessment is a development based on experience from the AMP4 application of a risk based approach. This helps asset managers think separately about the asset failing and the subsequent impact on customers. This has impacted our risk assessments

by improving the probability of our defined risks i.e. it helps understand that an asset can fail without causing a direct or immediate service impact

36. Given the complexity of the analysis we are undertaking, external validation was required of our approach to asset deterioration rate modelling. Having reviewed the skills of various Universities we chose Cranfield to undertake a review of our approach.

37. Cranfield University experts visited YW offices to receive demonstrations of the asset deterioration rate modelling techniques; including discussions on the mathematical distributions underpinning the modelling process.

38. A final report of the independent review was prepared, a copy of which has been given to our Reporters (SMC). An abstract from the management summary is shown below;

Cranfield UNIVERSITY

"Yorkshire Water has an internationally leading approach to asset deterioration modelling that, we believe is 'best in class' for the water and wastewater utility sector"
Prof. Simon Pollard, Cranfield University

39. Risk of loss of service is a continuous function, which enables the asset being considered to have many different values of risk, cost and benefit over time. Where risks are aggregated to process level, this becomes important due to more assets contributing to the mitigating solution. In summary we have modelled the volume of benefit and the associated cost change over time, on an annual basis. Figure 8 demonstrates what data would be made available for a 10yr optimisation routine, and how the same asset has 10 different annual benefit & cost to be considered in the optimisation.

Pump A		Investment period being considered in optimisation									
		yr1	yr2	yr3	yr4	yr5	yr 6	yr7	yr 8	yr9	yr10
Pre-Investment	Probability										
	Severity										
	Quantity										
Post- Investment	Probability										
	Severity										
	Quantity										
	Capex										
	Opex										
	WLC										

Figure 8 – Cost benefit parameters changing over time

40. The LEADA+ process requires that each identified investment need is given two numerical risk scores: the 'existing' risk, and the 'expected' risk following investment. A standard methodology for deriving probability has been developed as described above and we also utilise **standard Severity scales defined for each service area. (See B3 Section 3 and 7)** - an example is given in figure 9. The severity scale has been reviewed with the business to ensure they are still representative of the service levels we provide to customers.

	INCREASING SEVERITY				
	VL	L	M	H	VH
ACCEPTABILITY OF WATER TO CUSTOMERS (discolouration)	of **slight** tap water discolouration, noticed in bath water	of floating material **visible in clear tap water**	that tap water that is discoloured but that you **can** see through, **resembling orange squash**	that tap water that is discoloured and **cannot** be seen through, **resembling weak milky tea**	that tap water that is highly discoloured **resembling dark beer or stout**
INTERNAL FLOODING (overloaded sewer & other causes)	Damp patch in an unused cellar, caused by sewage & / or occasional restricted toilet use due to backing up of drains	Damp patch in a cellar used for storage caused by sewage & / or restricted toilet use a few or more times per year due to backing up of drains	Standing water from sewage in an unused cellar	Standing water from sewage within property in storage cellars, under floorboards & integral garages	Standing water from sewage within living accomodation, including converted cellars

Figure 9 – Example of water & sewerage severity scale used in defining the impact of failure

41. Risks have been categorised into three groups depending on the severity of the impact on customers or the environment and the probability of failure. The high amber & red risks, are those where the service impacts are of significant severity and the probability of failure is great enough to consider investment. Figure 10 below illustrates the amber & red risk area on the standard 5 by 5 risk matrix.

42. Due to the large number of risks generated through our LEADA+ process (**in excess of 68,500 risks and 183,700 solutions**), we have limited the number of risks available for optimisation, due to mathematical limits. This has been achieved by only optimising risks that are above a value of 14 as defined on the grid below.

PROBABILITY	IMPACT				
	VL	L	M	H	VH
VH	9	14	18	22	25
H	7	12	17	21	24
M	5	10	15	19	23
L	3	6	11	16	20
VL	1	2	4	8	13

Figure 10 – Business Risk Matrix

2.2.2. Step 2 – Consistent Risk and Solutions

43. All risks, regardless of their origin, have been stored within a risks, solutions and costs database application referred to as the Business Risk Model (BRM+). BRM+ formalises our risk methodology and ensures that all risks are stored and scored in a consistent manner. It also captures the relevant cost, output and activity information needed for effective asset management. Figure 11 gives example risk screen shots from BRM.

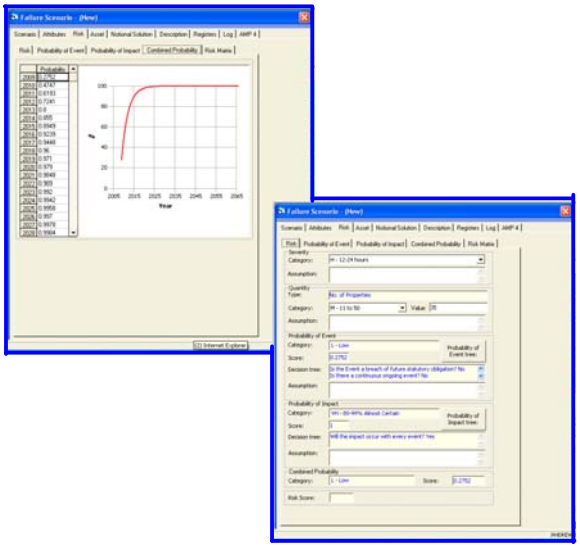


Figure 11 – BRM+ screen shots showing probability assessment

44. BRM+ has allowed us to cost solutions to risks using our cost models in our unit cost database **(see B3 Section 4.1).** These costs fully reflect our current procurement methods and the efficiencies and synergies being delivered in AMP4. They are consistent with the Cost Base Report in this submission. We have considered solutions that require CAPEX, OPEX or a combination so that we can test for the best balance of costs and service risk improvement in the subsequent economic modelling. The costs that we have used in the economic optimisation are the CAPEX and OPEX expressed as an annualised Net Present Cost to make them directly comparable with data from our 'Willingness to Pay' market research which is discussed in step 3. A detailed description of the whole life cost enhancements used for costing solutions and enabling enhanced cost benefit assessment is given in **B3 Section 4.2.**

45. We have sought to identify more than one solution to a problem where this is feasible and sensible. These solutions have to be sustainable but can be CAPEX or OPEX based, or a combination of both.

46. The key element of each solution is that it has a representation of the residual risk following investment. This reflects the fact that no solution is without its risk of failure. This is represented in figure 12.

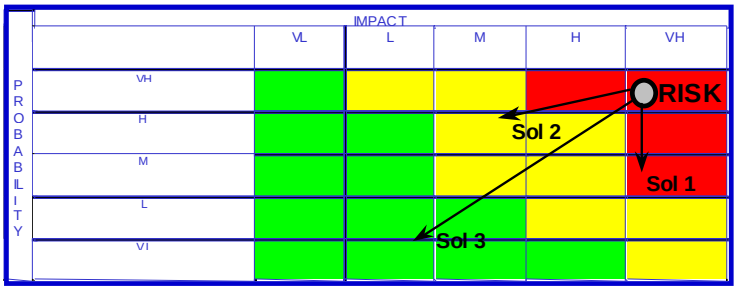


Figure 12 - Matrix Risk Representation and Risk Improvement from Planned Intervention

47. The significance of the risk improvement resulting from a solution is that it can be valued via the customer 'Willingness to Pay' data. This value is then used in the cost-benefit assessment at option selection.

48. In the case of assets identified through failure modes and asset deterioration modelling, we have built the tool to derive a standard solution to a problem using rule based methods based on experienced engineers' views.

2.2.3. Step 3 – Market Research – Willingness to Pay

49. Detail given in B3 – Section 1 & 5 and Section C1

2.2.4. Step 4 – Economic Optimisation

50. Detail given in B3 – Section 1 & 5 and Section C8

2.2.5. Step 5 – Financial Implications

51. The final stage of the process is assessing the impact on customer bills and company financing implications. ELSA+ automatically profiles schemes through time by considering the optimal point to invest. It considers the cost benefit ratio by year and output profiles for quality or levels of service solutions where end dates have been agreed with quality regulators. We have exported the resulting capex and opex profiles to the financial model to determine the impact on prices. These results have been used to determine budget and service objectives for subsequent ELSA+ runs in order to test alternative packages of serviceability and cost-benefit trade-off.

2.3. KNOWING OUR ASSETS

52. To drive the LEADA+ process we have made ongoing assessments to understand our assets in terms of quantifying risk and development of solutions. This work is essential for developing a forward looking capital maintenance programme and is described below for each service area.

2.3.1. Water Service

53. For the water service we have been out on site to survey all 63 of our water treatment works, over 500 pumping stations and over 400 service reservoirs. These surveys have included the collection, updating and verification of age, condition, loading, duty and standby data on these assets. The data is collected at the disaggregated level as described in **Section B3 2.2.1.**

54. We have collected and summarised data on the physical assets, asset operation, topographical nature, geotechnical nature and customer consequence for our 2000+ Distribution Management Areas (DMA) and the contributing pipes therein, to identify how each part of the network contributes to service risk. This data has been utilised in the Below Ground Asset Surveyor and Predictor (BGASP) model.

55. Understanding of our risks from Source to Tap is now embedded as business as usual and used to drive Drinking Water Safety Plans. Extensive studies into non-asset failure related risks have been completed so that any fitness-for-purpose or compliance issues have also been considered.

56. In total we have identified approximately 31,000 risks and 73,000 solutions giving an indicative ratio of 2 potential options to every risk identified. This has involved more than **14,000,000** pieces of risk and solution data associated with the maintenance of serviceability of water assets. Each of these has been quantified in terms of probability of failure, the severity of the impact on the customer or environment and the quantity (or scale) of the impact. Definitions of severity and scales are included in **Part B3 Section 3**. In following this approach we now have the most comprehensive view ever of our asset and service risks and necessary costs, aligned to the delivery requirements of the business.

57. These risks have been subject to challenge on a number of occasions. Following challenge by our Reporters regarding the parameters that derive the Weibull predicted failures, a sensitivity to change exercise was undertaken with regard to the shape constant, where an average of 3 was used on a scale of 1 to 5. This demonstrated the impact of altering the parameter was marginal, and moving positively or negatively from the

defined value would increase the cost of the proposed business plan. In addition, all of the risks held in the risk and solution database (BRM+), have been reviewed at a series of specific challenge events. This review has looked at how these risks compare against the assessments we take in running our current capital programme. This was of critical importance because it was this process that has given us confidence that the investments we are seeking future funding for are those we would promote for investment through the current capital management programme. **A response on DBP Weibull Curve queries has been given in Query No. AST/YKY/014**

2.3.1.1. Asset Status Investment Plans

58. The source data for the Above Ground Asset Surveyor and Predictor (AGASP) system is collected and reviewed on an annual basis by the use of Asset Status Investment Plans (ASIPs**)** and Distribution Criticality studies, both taking into account the condition and functionality of the asset in the risk calculation.

59. The ASIP have been carried out by the Production Asset Team on all water treatment works. The main elements in the ASIP cover the following:

- Asset Inventory Data
- The Asset Shortfalls
- The risk these shortfalls pose to the C.W.B.U.
- Understand the cost to correct the shortfalls.
- Understand the proactive Work load for each production asset.
- Understand the man hours to carry out the proactive policy.

60. A process audit has also been carried out to identify any process which is not 'fit for purpose'. This has been undertaken by the Research and Development team who have been able to identify where the raw water envelope has changed from the original design specification. This has allowed understanding of where the current treatment processes installed will not be able to treat the incoming water.

2.3.1.2. Criticality Studies

61. Source to Tap (Water Supply System - WSS) Criticality Studies have been undertaken by Yorkshire Water using the associated charter and an internal desktop study of all trunk mains within the region.

62. The key objective of the process is to identify the criticality of all assets in the distribution system. This is done in a systematic way, reviewing each asset or group of assets from the source of the WSS, usually starting at

the inlet pipe work to a clean water tank (CWT) on a water treatment works (WTW), through to the inlet of all Distribution Management Areas (DMAs).

63. The criticality of each asset or group of assets should be assessed in relation to the following three parameters.

- Loss of supply
- Discolouration
- Water quality
-

64. Data has also been used from BGASP to identify the shape and size of the distribution programme at DMA level, with detailed DMA identification occurring through the Distribution Operation and Maintenance Strategy (DOMs) risk assessment process.

65. Key sections of trunk mains have been identified which require attention, based on outputs of Criticality Studies, expert opinion, local knowledge and incidents. This approach aligns with the Company's Distribution Operation and Maintenance Strategy (DOMS) principle, in terms of high-level investigations and resolution of problems. Each trunk main section has been raised with the relevant problem-driver in line with the failure modes identified from the research done through UKWIR.

66. This is a systematic analysis of a Water Supply System (WSS) from the source or sources through to the inlet meter of DMAs. The criticality of each asset or group of assets needs to be assessed against the three factors of loss of supply, discolouration and water quality. The decisions and assessments made need to be recorded and where necessary actions identified and assigned to individuals with completion dates.

67. Although the study only goes as far as the inlet to DMAs for completeness at the end of a study a simple review of the DMAs should be conducted. This comprises of a single question: 'Are there any strategic assets within the DMA, such as a single supply main, pumping station or service reservoir, that present a significant risk related to water quality problems or loss of supplies.'

2.3.1.3. Water Safety Plans

68. Water Safety plans have been introduced in the last 2 years, replacing major parts of the Source to Tap process embarked upon in the last periodic review to understand risk within a whole WSS.

69. Water Safety Plans identify all water quality hazards and have been used in conjunction with the distribution criticality work to give an overall WSS

view of risk. Further detail on Water Safety Plans can be found in **B3 Section 3.**

2.3.2. Sewerage Service

70. The majority of asset and service performance information utilised to support the business plan for the sewer network is generated through the Below Ground Asset Surveyor and Predictor (BGASP). Some information has been gathered at "catchment risk" workshops and then entered onto BRM+ as well as existing risks which will not be addressed during AMP4 which have been migrated into BRM+.

71. The collection of asset and service information for BGASP comprises data on the sewerage network which was extracted directly from Yorkshire Water corporate systems, data on historic performance of the network which was extracted directly from Yorkshire Water's Work Management Systems (WMS), data on the impact of asset failures on service to customers which comes from the pollution and flooding registers. MWH were then employed to review data and model the probability and consequence of asset failures. The probability and consequence of asset failure is assessed by BGASP which then produces failure scenarios and solutions for upload into the BRM+.

2.3.2.1. Sea Outfalls

72. Yorkshire Water owns, operates and maintains 23 sea outfalls. Sea outfalls that are totally or partially submerged were inspected during 2007 by diving contractors. Sea outfalls where the full pipe length is exposed at low tide were inspected in 2007 by Costain (our East Area Joint Delivery Team Partner).

2.3.2.2. Sewage Treatment Works and Sludge Treatment Facilities

73. The majority of asset and service performance information used to support the business plan for waste water treatment works and sludge treatment facilities is generated through the AGASP. Some information has been gathered at "catchment risk" workshops and then entered onto BRM+. Additionally, existing risks which will not be addressed during AMP4 have been migrated into BRM+.

74. Asset surveys were undertaken to collect and record key asset indicators and data for all waste water treatment works assets. Data collected at the sub-assembly level comprised asset age, condition, performance, loading, reliability and fitness for purpose. This data was then uploaded into the AGASP system where they are stored. The probability and consequence

of asset failure is assessed by AGASP which then produces failure scenarios and solutions for upload into the BRM+.

2.3.2.3. Sewage Pumping Stations

75. The majority of asset and service performance information utilised to support the business plan for Sewage Pumping Stations is generated through the AGASP. Some information has been gathered at "catchment risk" workshops and then entered onto BRM+. Additionally, existing risks which will not be addressed during AMP4 have been migrated into BRM+.

76. Over 70% of sewage pumping stations were physically surveyed on site to collect, and record, key asset indicators and data, with the remainder being completed as a desktop exercise and verified by a sample of site visits. Data collected at the sub-assembly level comprised asset age, condition, performance, loading, reliability and fitness for purpose. This data was then uploaded into the AGASP system where they are stored. The probability and consequence of asset failure is assessed by AGASP which then produces failure scenarios and solutions for upload into the BRM+.

77. In total we have identified approximately over 39,000 risks and 66,000 solutions giving an indicative ratio of 3 potential options to every risk identified. This has entailed over **18,500,000** pieces of risk and solution data associated with the maintenance of serviceability of waste water assets. Of the total number of risks identified against sewerage service assets over 6,000 (1%) have been identified as "red risks" and nearly 7,000 (1%) as "amber risks" with the remainder (98%) identified as "green risks".

3. PROCESSES

3.1. ASSET MANAGEMENT PLANNING AND INVESTMENT CYCLE (AMPIC)

78. During AMP3 the LEADA systems were developed and were first used in the creation of PR04, being business planning tools with the potential to be used to optimise actual delivery of schemes throughout the AMP period. Therefore, in order to maximise the full potential of LEADA, its systems and process needed to become part of day to day investment decision making, thereby integrating the capital maintenance planning and capital delivery business processes. In other words LEADA needed to become 'business as usual' (BAU). It was therefore decided to launch a strategic business project (LEADA Integration) to embed the LEADA systems in the day to day asset management process.

79. At the heart of the LEADA Integration project was the development of the AMP4 asset management end to end business process – which later became known throughout the business as simply 'the AMP4 e2e process'. During the latter part of 2004 a cross business project team developed the original e2e process along side teams that were developing the AMP4 contract strategy. By the end of December 2004, the first version of the e2e process had been developed in readiness for business as usual deployment at the start of AMP4.

80. For the first time, LEADA systems were integrated within the asset management cycle and started to be used in day to day investment decision making. The e2e process was and continues to use the LEADA systems to identify asset performance and service shortfalls and maintain a 'rolling' programme of investment prioritised on service risk and optimised on cost-benefit. The e2e process coherently ties together asset management data, systems, people and processes, enabling them to operate in an effective and efficient way.

81. To fully realise the potential of LEADA it was recognised early on that a cultural shift was required. Asset managers would need a lot of support to change and adopt certain new working practices. During the first year of AMP4 a major e2e process training programme was delivered to around 500 staff to familiarise them with LEADA systems and the risk based cost-benefit approach to capital investment. This was in advance of the technical development programme now in place and was part of the integration project.

82. Regular monitoring of the process was carried out to see how embedded the LEADA systems and processes were. A quarterly 'reality check'

sought responses from those required to operate the process and their feedback was used to drive a series of improvements during the early part of AMP4. LEADA integration therefore required significant cross business buy in at senior levels and progress was reported regularly to senior managers and directors.

83. The AMP4 End to End Process for implementation, now known as the Asset Management Plan and Investment Cycle (AMPIC) comprises 5 main stages, at the highest level, as set out in figure 13 below. Stages 1 to 4 can be associated with planning undertaken for PR04, with stage 5 associated with AMP4 asset management. We have implemented business as usual processes for all stages in AMP4 and have reviewed areas for improvement, not only in AMP4 but also to PR09 planning. Further detail of each stage as used in delivery of our AMP4 capital programme is set out in Appendix 1.

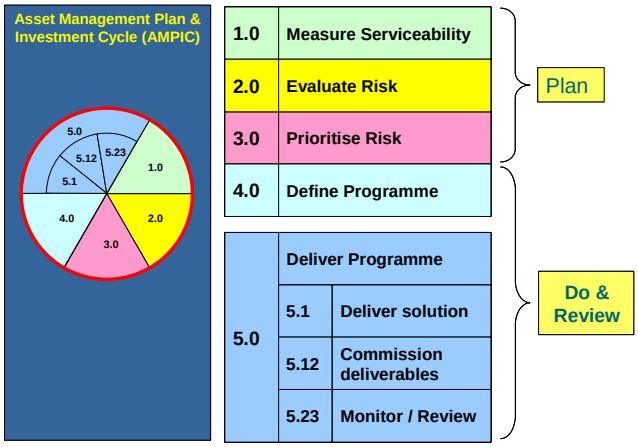


Figure 13 - Asset Management Plan & Investment Cycle – Level 0.

3.2. ASSET MANAGEMENT PLANNING ASSESSMENT PROCESS (AMPAP)

3.2.1. Introduction

84. In the run up to the 2004 Periodic Review (PR04), OFWAT initiated the Capital Maintenance Planning Common Framework (CMPCF) which was developed by UKWIR. OFWAT developed an 18 criteria assessment process based on CMPCF which they used to assess final business plans submitted by all water companies. The results of the assessments were then used to band companies and contributed to final determinations.

85. For PR09, Mott MacDonald was commissioned by UKWIR, to develop AMPAP as a self-assessment process and spreadsheet tool which the water industry could use to assist in improving asset management planning by providing evaluation of the effectiveness of their approaches. Following the industry testing of AMPAP and its subsequent release by UKWIR, Yorkshire Water's PR09/AMP5 Management Team made a decision to include AMPAP self-assessment in Yorkshire Water's PR09 Business Plan submission.

86. A member of our Risk and Process Improvement Team was assigned to co-ordinate AMPAP assessments. Since the company had not been involved in the testing of the AMPAP tool, Mott MacDonald (the developers of AMPAP) were contacted to provide some background and guidance on its development and intended use. In addition, copies of the 2 UKWIR reports on AMPAP, the latest version of the AMPAP tool and associated pairwise comparison tool were acquired by Yorkshire Water.

87. Once the Co-ordinator was sufficiently familiar with the tools and requirements for AMPAP, an outline process was defined (see Appendix 2), a timeline plan developed and potential assessment team members identified from those most closely involved with Asset Management Planning.

3.2.2. Set Up Process

88. Primarily, the background to AMPAP, the process to be followed, timeline plan and an introduction to the tool itself was communicated to all concerned in PR09 reporting. A presentation was developed for this purpose, together with documentation giving more detail and guidance on the background to AMPAP and the process to be followed by Yorkshire Water. Assessment team members were provided with copies of the AMPAP assessment tool and associated guidance documents and allowed a period of familiarisation prior to workshops to set up the tool and commence assessments.

89. Initial workshops for Water and Sewerage Infrastructure/Non-infrastructure determined the component and high level area weightings using the pairwise comparison tool provided by UKWIR. This was done partly to help with familiarisation with the tool and guidance and partly to save time later should it be decided to undertake any assessment at Criteria level. It was expected that the M&G assessment would be undertaken at Component level throughout, therefore, component weightings would not be required (Component weightings are only applied when assessments are undertaken at criteria level). No Criteria level weightings were defined at this time, as it was more logical to determine these only if and when they were required. No tool was provided by UKWIR to undertake pairwise

comparison at criteria level, but Yorkshire Water has now developed its own for this purpose.

90. Because there is significant difference in the Asset Management Planning processes of the 10 M&G areas (IT; Fleet; Research & Development; Land, Property & Planning; Facilities; Security; Asbestos; Renewable Energy; Biodiversity; Carbon) it was decided to undertake M&G assessments at Asset Type level for the majority of components. This required 10 Asset Types, however, the AMPAP tool only allowed for 5 Asset Types and so had to be adapted to accommodate more.

91. A Yorkshire Water master copy of the AMPAP tool, containing identified weightings and required adaptations was created and checked to ensure all cells were formatted correctly and contained the required formulae. In order to simplify assessments and facilitate user familiarisation, the master copy was broken down into 3 AMPAP spreadsheets, one each for Environmental Business Unit (EBU), Water Business Unit (WBU) and Management & General (M&G). These and all other associated documents were co-ordinated and managed through a systematised approach using SAP Enterprise Content Management (ECM), our corporate document management system.

3.2.3. Assessment Process

92. Assessment sessions, each lasting about 1 - 2 hours, were arranged with the identified assessment teams. All Water and Sewerage sub-service assessments were facilitated by the AMPAP Co-ordinator to maintain consistency of approach. M&G assessments were also facilitated by the Co-ordinator and attended by the Investment Planner responsible for M&G. Component assessments at M&G Sub-service level (not asset type) were made by the M&G Investment Planner. All assessments followed the following procedure:

- Assessment team agree level of assessment for each High Level Area Component:
- Sub-service/Component
- Sub-service/Criteria
- Asset Type/Component
- Asset Type Criteria
-

93. Where criteria level is selected, criteria level weightings are defined and entered in appropriate cells on AMPAP spreadsheet. Where Asset Type is selected then forecast expenditure for each Asset Type is entered on in appropriate cells on AMPAP spreadsheet

- Assessment team examine each Component/Criteria test statement, as defined in UKWIR guidance.
- Assessment team list all applicable evidence to support the Component/Criteria statement for the sub-service area or asset type
- Assessment team score each Component/Criteria against AMPAP scoring system (0 to 5), based on evidence listed
- At end of each assessment session, the Co-ordinator completes version control information on AMPAP spreadsheet.
- AMPAP Co-ordinator checks completed assessments to ensure consistency.
-

94. Two review teams were formed to challenge and review the assessments, one team to review M&G assessment and another to review Water & Sewerage assessments. In addition, the IT Asset Type assessments were reviewed and agreed by a group of IT Senior Managers following the initial assessments. The AMPAP tool was considered too unwieldy to be used in the reviews and instead a word document consolidating the identified evidence and scores was developed for this purpose. During reviews, any amendments to scores/evidence were made on this document and subsequently transferred to the appropriate AMPAP spreadsheet. The 3 AMPAP spreadsheets were then combined to a single Yorkshire Water assessment spreadsheet in preparation for approval and audit. An additional radar plot, showing combined scoring of all 5 sub-service areas, has been included by Yorkshire Water on this assessment. This spreadsheet will form the basis of future assessments and will be the only copy of the AMPAP tool to be used throughout AMP5 by Yorkshire Water.

95. The following appendices contain data in relation to the above process and assessments that have been made

96. Outcomes of this and subsequent Company assessments will be used, in conjunction with other process analysis, to help evaluate and define further business process improvement initiatives. All improvement proposals will be presented to the management tam for their approval and support in implementation.

97. It is intended that future AMPAP assessments will be undertaken, on an annual basis, throughout AMP5 as part of June Return submissions. This initial assessment will be the baseline against which these future assessments will be measured.

98. Important points for OFWAT to note when undertaking the AMPAP assessments are;

- that we have consulted with our asset management community when scoring, rather than taking scoring as a central function
- we have assigned a full time employee to manage the process, to ensure consistency of application, internal reporting & assessment
- we have provided robust evidence for the scores produced
- we have undertaken a separate audit with our Reporter on the AMPAP process.

3.2.4. Outcomes Clean & Waste Water

99. Whilst the evidence indicated that Yorkshire Water is strong in many of the 9 High Level Areas, it was acknowledged that investigation into the improvement of some further areas would be advantageous. In particular increasing the extent of network analysis to provide a better understanding of the effects of asset failures and forecasting service at system level.

100. The outcomes of the assessment were presented to the management team by the AMPAP Co-ordinator, who is responsible for ensuring any actions required to gain approval are undertaken within identified timescales.

101. Water and Sewerage scores were aggregated, using Company defined weightings (see Appendix 4), to provide a score for each high level area. A brief outline of key evidence leading to each high level score is given below, the high level score is given in brackets:

3.2.4.1. Stakeholder Engagement

102. Stakeholder consultation is carried out as part of asset management planning, including panel events, meetings with CCWater, Environmental Advisory Panel and large business customers and quadripartite events with all regulators. Research has been undertaken to gain a better understanding of the views of MP's, Local Authorities and media organisations, domestic and business customers as part of both AMP4 and AMP5 planning, the results of which form an integral part of Yorkshire Water's LEADA systems for investment decisions.

103. The Reporter has been kept informed of developments in Yorkshire Water's Asset Management Planning process with their early involvement from 2006, including the improvements made in LEADA systems for AMP5 planning.

104. The applied valuation methods, including cost of carbon, social environmental costs, cost of failure and whole life costing methodology, were reviewed and validated to ensure there is no over estimating or double counting involved in calculations.

3.2.4.2. Leadership, Policy & Strategy

105. There is strong governance from the Board and this is demonstrated by Directors' membership of Board Capital Investment Committee (BCIC). The support of all Directors has been gathered for initiatives to improve the Asset Management Planning & Investment Cycle (AMPIC) process. Directors have also been actively involved in communicating the benefits and purpose of improvements throughout the Business. Additional evidence can be found in Business Unit strategies, Clearwater and 20/20, aimed at improving efficiency and serviceability targets through integrated management and asset operation (refer to B3 Section 1 and 5).

106. Asset Management Planning policy is integrated with procurement frameworks, engineering specification, health & safety and contract policies and is disseminated to all appropriate areas through a database, which provides access to documentation relating to the AMPIC process. This is underpinned by the Yorkshire Water Asset Management book, which outlines the Company's approach to asset management, and supported by regularly run training modules, relating to aspects of the AMPIC process, asset management policy and strategy. All modules are introduced by senior (Tier 2) management. The score for this high level area reflects the view that some sections of the Asset Management book are in need of review and updating in relation to improvements made in preparation for AMP5.

107. There are a number of strategies associated with the various aspects of Asset Management Planning, including supply pipe repairs and the creation of 'Shining Star' waste water treatment plants.

3.2.4.3. Management (5)

108. Roles, responsibilities and procedures associated with the AMPIC process are documented and can be found on the AMP4 database. Other documentation relating to processes and roles can be found on QMS databases, which comply to ISO9001:2000 standards. ISO certification has been achieved in key areas of the Business including:

1) the use and application of the BRM system.
2) Water Asset Quality Management System
3) Environmental Management System
4) Asset Records
5) Regional Operations Control Centre
6) June Return processes
7) Management & operation of waste water assets

109. All staff are subject to quarterly performance reviews, which reinforce clear role statements and organisational structures through agreed personal priorities. External partners are provided with clearly defined procedures for providing asset data through YW systems.

3.2.4.4. People

110. Role descriptions and job interviews are competency based to ensure the person appointed has the capabilities to match the role requirements. Employees are subject to quarterly reviews which provide regular evaluation of performance against progression plans, role statements and agreed personal priorities, identifying skill gaps and providing opportunity to identify further training requirements through personal development plans. These are all aimed at ensuring our people are equipped to carry out their function and have access to the learning and development they need. Yorkshire Water runs a variety of 'in house' training courses, which can be booked by managers through SAP. Records of attendance on these courses are held centrally on SAP, whilst other external training course attendance and examination results may be held locally by managers and individuals. The Company's tendering process provides for checks on qualifications and certification in relation to the suitability of consultants or contractors.

111. A wide range of people representing all areas of the AMPIC process, including contract partners, are involved in process improvement projects and development/delivery of training modules. This demonstrates their clear understanding of their own and others' roles in the process. This together with clear management structures helps to ensure that any issues are quickly directed to the appropriate people.

112. The difficulties encountered in finding suitably qualified and experienced people for waste water management in the external job market is reflected in the score for this high level area.

3.2.4.5. Process

113. Documentation relating to roles, responsibilities and guidance for the AMPIC process used in AMP4 is located and maintained on a central database, where it can be viewed by all, including contract partners. Regular training modules relating to the process are available and these are reviewed and updated as required by practitioners of the process. Yorkshire Water has an environmental policy supported by Environmental Management System which has achieved ISO14001 certification. Additionally, a number of business areas, including BRM processes, have ISO9001 certification. As such these systems are subject to routine internal and external compliance audits.

114. Below Ground and Above Ground Asset Surveyors & Predictors (BGASP/AGASP) provide predictions of future risk which is based on validated models and calculations using asset survey data to facilitate short, medium and long-term asset management planning.

115. Data capture processes exist for operators, field technicians, maintenance providers or contract partners to supply data required for effective planning and decision making.

3.2.4.6. Systems

116. Yorkshire Water's Integrated Customer & Operations Management (ICOM) systems are used to record and manage customer contacts and maintenance work on assets using customer reference and unique asset reference (functional location). All asset data, regardless of system, uses the assets unique reference, including the LEADA suite of systems for asset management planning and business as usual risk assessment, solution costing and programme management. Data can be linked through the unique referencing to facilitate internal and external reporting. The unique asset referencing is given through our corporate Asset Inventory (AI2), which catalogues assets in a hierarchical form, ensuring understanding of the assets relationship to the water supply system within which it exists.

117. Most applications include 'Audit Logs' which date and time stamp any changes made to data, enabling audit of historic data amendments.

3.2.4.7. Data

118. Current and historic asset performance and observation data is available for all asset types from a variety of sources and this is used for risk identification. BGASP and AGASP uses data gathered through asset surveys to map probability, impact and quantity to failure types. Whilst

data coverage is very high and available through corporate applications for many asset types, for others data may only be gathered to drive further investigation. There is significant data available regarding capex interventions and impacts, but improvement can be made in quantity and quality of data regarding opex interventions in all areas.

119. There is strong agreement that the appropriate serviceability, sub-threshold and environmental sustainability indicators have been gathered for all areas and used to support asset management planning. However, it is believed that for some infrastructure assets there are insufficient historic records at this time.

120. Information with regard to the thousands of samples that are taken each year by the company, are also contained within a corporate application known as the Regional Operations Database (ROD)

121. Yorkshire Water has a data capture process in place, supported in its Capital Management System (CMS), which collects cost data from contract partners on individual scheme delivery to build unit cost models. Such data capture has been undertaken throughout AMP3 and AMP4.

3.2.4.8. Analysis

122. Valuation methods, including cost of carbon, social environmental costs, cost of failure and whole life costing methodology, have been validated to ensure over estimating or double counting is not occurring.

123. Yorkshire Water recognises that there are areas of analysis which can be improved, such as understanding inter-dependencies between interventions and the effects of asset failures upon forecast service at system level (source to tap & sink to sea).

3.2.4.9. Reporting

124. Yorkshire Water believes some improvement could be made to its internal reporting through review and re-assessment of the requirements of the various teams and groups. Existing reporting is strong, with other organisations (national & international) visiting us to understand how we manage internal reporting of the capital programme. The reporting is undertaking at varying frequencies including daily, weekly, monthly, quarterly and annually.

125. We have also achieved ISO 9001 certification for our June Return reporting processes undertaken on an annual basis.

3.2.5. Outcomes Management & General

126. M&G high level scores were calculated based on default weightings, as no Company weightings were defined (see Appendix 4), to provide a score for each high level area and an explanation of the reasons for each high level score is given below. It should be noted that the developers of AMPAP have stated that Yorkshire Water M&G asset types are more like interventions (e.g. asbestos removal, or R&D) or costs and benefits (Carbon and Biodiversity) that are inputs to the asset management planning process and vary from the asset types they had anticipated would be used in self-assessments.

3.2.5.1. Stakeholder Engagement

127. Most areas of M&G did not consider that valuation of service benefits was particularly relevant to them, although customer and stakeholder involvement had been undertaken in asset management planning for R&D and Land, Property & Planning. The selected planning objective for M&G is cost effectiveness and additional AMPAP scoring guidance for M&G provided by UKWIR suggests that where the this objective is selected, valuation of service benefits may not be appropriate to M&G. Unless the planning objective or AMPAP scoring criteria changes, it is unlikely that this high level area will warrant a higher score.

3.2.5.2. Leadership, Policy & Strategy

128. There is strong governance from the Board and this is demonstrated by Directors' active membership of Board Capital Investment Committee (BCIC). There is strong Board support and commitment to all areas of M&G and Carbon and Biodiversity form key parts of Yorkshire Water's Strategic Direction Statement. Biodiversity and Carbon form part of the YW Environment Policy, which is reviewed and agreed annually. Policy is under development for Renewable Energy.

3.2.5.3. Management

129. All staff are subject to quarterly performance reviews, which reinforce clear role statements and organisational structures through agreed personal priorities.

3.2.5.4. People

130. Role descriptions and job interviews are competency based to ensure the person appointed matches the requirements of the role. Quarterly reviews provide regular review of performance against job ladders and agreed personal priorities linked to business plan objectives, identifying skill gaps

and providing opportunity to identify further training requirements through personal development plans. Yorkshire Water runs a variety of 'in house' training courses, which can be booked through SAP. Records of attendance on these courses are held centrally on SAP, other external training course attendance and examination results may be held locally by Managers and individuals. Some areas of M&G, for example Asbestos, require highly qualified and skilled consultants, the tendering process operated by Yorkshire Water provides for checks on qualifications and certification in relation to the suitability of such consultants or contractors.

3.2.5.5. Process

131. Yorkshire Water's asset management planning, business as usual and information management processes cover M&G, however whilst IT and other areas have established robust processes for this the areas of Biodiversity and Carbon are relatively new and processes may not be fully developed at this time. All areas of M&G take account of quality, safety and environmental plans and a number are linked to the delivery of these policies.

3.2.5.6. Systems

132. There are various systems and databases to support M&G asset management planning processes, some may not be integrated with corporate systems, but where unique asset or customer reference is available this is used to identify assets. Some newer areas of M&G are in the process of developing systems to support investment planning and historic data storage. It was not thought that monitoring of serviceability was applicable to some of the M&G areas identify by Yorkshire Water, for instance Renewable Energy. Risk management in relation to asset management planning is undertaken through BRM+ for all areas of the Business, including M&G.

3.2.5.7. Data

133. There are large amounts of high quality data for most areas of M&G, however, there may be more reliance on expert views in some areas, particularly as newer areas have minimal historic data at this time. It was not thought that serviceability data was relevant to some of the M&G areas identify by Yorkshire Water, in particular Biodiversity.

3.2.5.8. Analysis

134. The current scarcity of historic data in some new areas of investment on which to base analysis and modelling and the lack of relevance of historic

data analysis to replacement of IT assets due to withdrawal of support for current technologies (eg. Microsoft) is reflected in this score.

3.2.5.9. Reporting

135. M&G internal and external reporting for asset management planning is generally good, with reporting processes in place to provide the necessary information to the relevant people when required.

3.3. AMP4 COMMITMENT TO CONTINUOUS IMPROVEMENT

136. The Company understands the importance of continuous improvement and the benefits it brings. Planning for and implementing proactive change of all kinds is firmly embedded in the culture of the organisation and is clearly demonstrated by the number and scale of initiatives that are ongoing at any point in time. However change for change sake has to be guarded against and Yorkshire Water avoids this by ensuring all change initiatives are clearly linked to its central vision of being 'Clearly the best water company in the UK'.

137. Early during the start of AMP4 it was recognised by the Directors that to ensure delivery of target capital efficiencies, out-performance of the AMP4 programme was crucial and the drive for efficiencies had to begin straight away. In July 2005 a strategic initiative called Capital Transformation was launched and sponsored by the Director of Regulation and Investment. A core team steering group was formed consisting of senior managers from across the business and their initial task was to develop the Capital Transformation strategy. By November 2005 the team had developed 6 key themes that they believed would deliver significant out-performance and required capital efficiencies from the AMP4 programme.

138. The 6 themes (described below) were clearly linked to the AMP4 e2e business process i.e. the companies asset management cycle later renamed the AMPIC e2e process. Not only were these themes developed to ensure AMP4 out-performance but they were also seen as delivering improvements in several key of areas of asset management and delivery process that would provide a solid foundation for AMP5 and beyond.

- **AMP4** e2e process improvements

  The AMP4 e2e process was seen as the central theme off which the other themes were linked. The first change was significant in that the process was renamed the Asset Management Planning and Investment Cycle, deliberately dropping reference to time i.e. AMP4. This was to communicate the fact that the process itself is continuous and it would therefore undergo continuous improvement. The main improvements resulting from work on this theme included – full electronically stored

documentation of the process itself with linked policies and procedures guidance and improvements in process effectiveness (how well process works) and efficiency (resources consumed). Key areas of the process that were improved included: problem root cause identification, cost-benefit challenge, target costing, scheme bundling/amalgamation and scheme delivery cost control.

- Lean **theme**

  The Lean theme involved the application of techniques developed and applied in the construction and building industry that eliminated waste and duplication (non value adding work). Lean was originally applied to the scheme delivery part of the asset management cycle. The techniques were then trialled and subsequently applied to eliminate and reduce waste from the AMPIC business process itself.

- Risk management theme

  A number of risk management projects within this theme were scoped and prioritised. The project seen as being able to contribute most to AMP4 out-performance was around raising level of risk management competence across the asset management community. National risk experts were engaged to work in partnership with YW risk managers to develop a bespoke and accredited risk training programme. The programme is currently being rolled out to asset management staff and contract partners and has already won 2 prestigious utility industry awards. Feedback has shown that colleagues are now far more confident in their understanding and application of risk management techniques in their day to job and decision making.

- Accountabilities

  The aim of the accountabilities theme was to ensure that everyone (including Directors) involved in the asset management process clearly understood their roles and responsibilities and how they fit within the process in how they operate in relation to each other. The benefits resulted in reduced duplication of activity and more effective and efficient investment decision making.

- Data theme

  This theme centred on ‘cleaning up’ the source data in the company’s Business Risk Model (BRM). The aim was to provide an up to date ‘risk picture’ across all asset groups and to raise confidence that the most cost beneficial schemes were in fact being promoted to and prioritised across the AMP4 programme.

- Training and Development theme

  This theme recognised that the business needed to raise the technical skills and knowledge of its asset management community. A suite of technical training modules were designed by internal experts who also delivered the modules themselves. This was the first time a technical training programme had been delivered on this scale in terms of both content and delivery. The training programme is ongoing and the modules are designed such that they can be mixed and matched to suit

specific roles (mandatory) with other modules being taken up optionally for personal development. Contract partners were also invited to partake in the programme. This is now in its second year and embedded as part of the corporate training programme.

139. As part of Capital Transformation the e2e process and associated guidance was fully documented along the lines of a quality management system and stored on a central database accessible both to YW staff and contract partners. Further improvements continue, including the implementation of a BPM (Business Process Management) system which will enable asset management staff to inter-relate with and operate the AMPIC process more effectively and efficiently. BPM also enables simulation of proposed improvements to the e2e process prior to their implementation. This enables any negative effects of such changes to be avoided whilst simultaneously enabling improvement opportunities to be maximised.

140. Continuous improvement initiatives – including the latest evolution of LEADA systems so essential to BAU investment, remain fully integrated with the AMPIC e2e process.

141. It is through focusing on what our customers want established by our "Willingness To Pay" study (WTP), driving this through our asset management and capital maintenance planning processes to plan the most efficient way of delivering service (LEADA+), and then focus on the most efficient and effective delivery (Capital Transformation) that ensures we 'strike the right balance' of service and price.

3.4. IMPORTANCE OF TECHNICAL TRAINING IN AMP4

142. Alongside process and systems improvements, the technical competence of asset managers within YW is being raised. Numerous technical modules associated with the asset management business process are being delivered, these are designed to;

- Embed LEADA principles & the AMP4 asset management processes
- Clarify roles and responsibilities for all
- Drive best value in the programme
- Encourage continuous improvement in asset management
- Be owned, developed and delivered by key business teams
- Be part of the YW corporate training suite

143. The modules are available through our corporate SAP application, enabling colleagues to book places as part of their annual training requirement. This is shown in the SAP screen in figure 14.

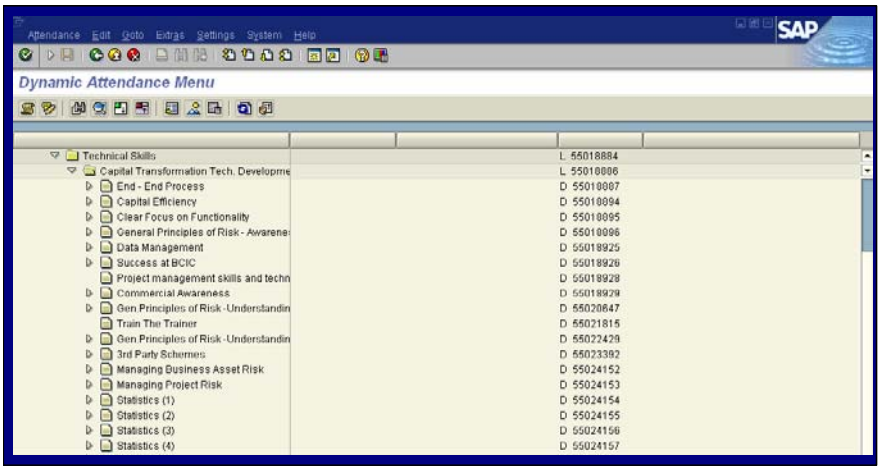


Figure 14 – Technical training modules available on SAP

144. To date more than 50 modules have been delivered with approx 600 colleagues in attendance from both YW and Partner organisations.

145. Particular emphasis is being given to raising competency in risk management. The Company has made an industry first in partnering with the University of Edinburgh to undertake a accredited risk training programme that is tailored to their needs and requirements leading to:

- For individuals, an opportunity to earn Continuous Professional Development (CPD) Points for degrees and higher qualifications
- Improvements in service performance and driving efficiencies by reducing the risk of service interruptions to customers and improving the prioritisation of investment needs.

146. Yorkshire Water recognise that risk is in everything that they do, the sustainable programme is aimed at everyone who delivers and maintains assets including our service partners ensure consistency in application and enhancing our partnering arrangements for the long term. Opening the risk management practices up to all rather than keeping it confined to a small specialist group embeds a risk management culture into Yorkshire Water. Over 180 colleagues and partners have taken part in the risk training programme.

The **risk training programme has won two significant awards**; the "People Initiative of the Year" award at the **Water Industry Achievement Awards** in May 2008, and winning the Training Award Category at the **Utility Industry Achievement Awards**, December 2007.

147. The following has also been stated by a leading academic in the field of risk management;

"No other water company in the UK is running a programme of this magnitude and intensity" Jake Ansell, Dean of the Management School, University of Edinburgh

148. In addition, over 100 colleagues and partners have also taken part in training on the asset management planning and investment cycle training. These sessions have been both developed and delivered by those responsible for each element of the AMPIC process, again with significant success and strong feedback from attendees. This modules involves not only the how and when of the AMPIC cycle, but also the regulatory framework and key objectives of AMP4 asset management.

149. As we move towards AMP5, our highly skilled asset managers and new systems such as Business Process Mapping (BPM) will ensure that the AMPIC e2e process remains visible to and operated effectively by all those involved.

4. SYSTEMS

4.1. FORECASTING CAPITAL EXPENDITURE

4.1.1. YW Costing system

150. Yorkshire Water has a single, unified, estimating system that is used for all its capital cost estimates for:

- The Business Plan
- Programme Planning
- Capital Delivery Target Costs
- The Cost Base Report, after the removal of as many as possible of OFWAT's specified exclusions.

151. YW itself does not use outline design / bill of quantities estimating. This is due to the continuous drive for efficiency and embracing the Partnering approach to capital programme delivery. To deliver a capital programme the size of that undertaken by our company through individual tendered schemes, would drive inefficiency and increase cost.

4.1.2. How it works:

4.1.2.1. Capital Costs:

152. The process is based on recording the out-turn costs of 100% of the schemes in the capital programme. The costs are split into three categories:

- Indirect costs (including ancillaries)
- Above ground asset costs
- Below ground asset costs

153. The indirect costs includes all the prelims, method related charges etc., plus all the ancillaries. Ancillaries are defined as those things that are not modelled separately such as: Site roads, fencing, drainage, scada, telemetry, power supplies, cabling, ducting, MCC's, transformers, panels, valves, actuators etc.

154. The above ground direct costs are split into; civil and M&E groupings and the indirect costs distributed by value between them.

155. Those indirect costs that are only civil in nature (for example testing of water retaining structures) accrue only to the civil models (both above and below ground).

156. Likewise those indirect costs, that are M&E (MCCs and transformers for example) accrue only to the M&E.

157. Those indirect costs, that are both civil and M&E, site accommodation for example, accrue it all assets (including the below ground assets) pro-rata by value.

158. Models are generally two-dimensional log regressions of the cost versus size. These take account of economies of scale and the fact that the data has a lognormal distribution. Occasionally linear regressions or average costs give a better fit to the data and these are used as and when required. Advanced mathematical methods have been developed to deal with linear regression modelling of log normally distributed data, to ensure that upper and lower confidence limits are correct and that the mean is accurate. At programme level the central limit theorem will deal with the log normal issue, but at individual scheme level it can be significant.

159. Below ground assets are exclusively classed as civil and consist of sewerage and water infrastructure.

160. Sewers are modelled as multidimensional log regressions with cost on the z axis and length and diameter on the x and y axis yielding a "cost surface", with binary determinants for material, surface type, depth band etc, transforming this into a family of surfaces (figure 15). The process is used because it takes the correlation coefficient from around 20% for a simple "average cost per m run", model to around 70%. This is a significant improvement in model fit and allows the high cost of short lengths of work to be properly accounted for.

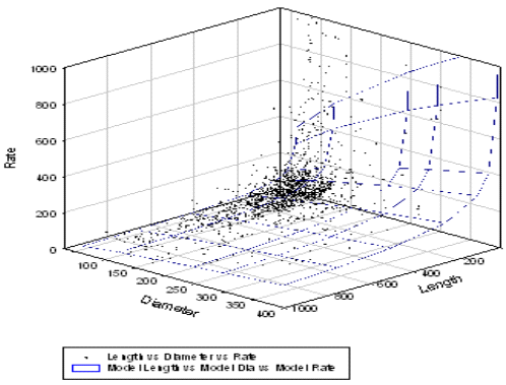


Figure 15 - Cost Surface Model

161. For water mains there is not sufficient data, particularly in the larger sizes to make this approach viable. Therefore "bottom up" models have been created using Yorkshire Water contract rates for distribution mains and national rates for trunk mains and a suite of standard design templates. These include fixed costs as well as size / length variable costs, to give 3 dimensionality to the models. The models are then calibrated to Yorkshire Water observed costs to ensure that they are both accurate and unbiased.

162. Occasionally capital maintenance work involves only the replacement of small component items, for example an MCC, or actuators, and in these circumstances these items are classed as direct costs and are modelled

separately with the proviso that it would be wrong to include an MCC along with a pump, since the pump model already contains the MCC costs.

163. This methodology produces a "building block" model set from which the cost modeller can select say:

- An inlet works with screens and handling kit,
- Sedimentation tanks with scrapers,
- Filters with distributors and media,
- Humus tanks with scrapers,
- Sludge tanks with desludging and mixers,
- Outlet or inlet pumps and well etc…

164. In the full knowledge that all the costs for an entire small sewage works have been provided for, including all the roads and drainage, power supplies etc., and the fence to go round the site.

165. Direct costs are modelled on a "total installed capacity" basis. This means that the user does not have to know for example, how many sedimentation tanks need to be provided. The user only needs to know the total surface area required, which can be derived from the process design (rise rate and the flow). The cost model reflects "custom and practice" in the number of tanks and includes all the economies of scale.

166. If standby capacity is required then this must is included in the "total installed capacity". So if 40 kw of pumping is required to meet a particular flow at a particular head, with 50% standby then, 60 kw of pumps need to be acquired and it is this entered into the costing model.

167. If the user requires only part of the process (say one new filter) then the model will include sufficient ancillary costs to provide for the pipe work to join it up to the rest of the works, and the roads and whatever telemetry might be required etc. The model will also deal with the economy of scale reflecting a higher unit cost for a smaller number / size of units.

4.1.3. On Costs

168. Costs are derived for complete schemes, rather than for the contracts that make up the schemes alone. This means that models are required to account for the expenditure necessarily incurred by YW, but which is not paid to the contractor. This includes such costs as: Land, Legal, Planning, Minor Works, Commissioning, etc.

169. The on cost model is derived from an analysis of the financially completed schemes in the entire capital programme and the contracts that those

schemes contain. The on costs have been found to be statistically significantly different between investment areas. Accordingly a multidimensional linear regression has been used to derive a set of models of the form; multiplier plus a constant, for above and below ground clean and dirty water schemes. A low end cap has been applied to stop low value schemes attracting an overall disproportionably high on cost.

170. Model selection and on-cost application is undertaken by the expert Cost Engineers, who also model the data from previously completed contracts. This ensures the data modelling reflects the learning from practical application.

171. The key point to draw from this section is that our costing systems are comprehensive, completely integrated and fully reflect the outturn costs we experience (including all feasibility design risk and overhead cost). We believe that this is the best costing system in the industry.

4.1.4. Programme Level Synergies

172. As schemes are "bundled" into larger blocks the overall on cost goes down, since the constant is only added once. The prerequisite for doing this is the schemes in the bundle must be spatially and temporally co-located. Models already account for economies of scale, so the effect of rationalising treatment can be correctly accounted for. Aggregation of risks to process level, undertaken through asset deterioration modelling in AGASP, also ensure synergies are accounted for and lower on-cost value automatically assigned through the costing process.

4.1.4.1. Reinvestment

173. We have developed an enhancement to the existing ELSA+ optimisation engine that allows the residual risk position from previous investments to be considered in future years. This is shown diagrammatically in figure 16:

- Step 1 – an asset is chosen for investment in year 1
- Step 2 – residual risk position fed-back to AGASP for risk aggregation
- Step 3 – new residual risk position made available for year 2

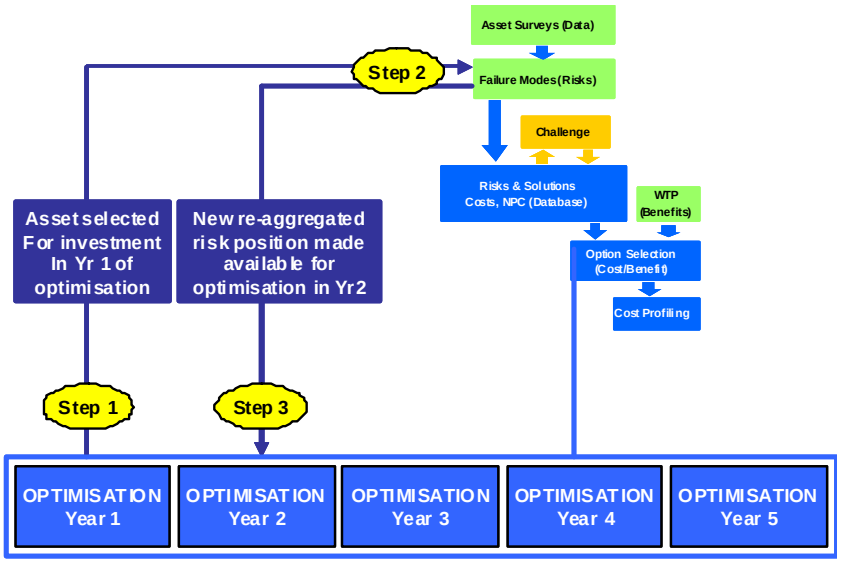


Figure 16 – Diagrammatic representation of reinvestment

174. The reinvestment development is designed to mimic the reality of delivering a capital investment programme, in a planning environment. This functionality has been brought in to operation following submission of the draft business plan, and is a great step forward with regard to business simulation. We believe Yorkshire Water are the only company undertaking this type of activity, and coupled with whole life cost enhancements and WTP research, represents the most optimal programme achievable.

4.1.4.2. Bundling

175. We have developed an enhancement to the existing ELSA+ optimisation engine to enable bundling of schemes within the optimisation routine. The development has been brought in to operation following submission of the draft business plan, and has enabled identification of upfront delivery efficiencies.

176. The bundling functionality will take the output from the first pass of the optimisation engine, review the selected schemes for geographic proximity, group the schemes into one, and then re-run the optimisation routine.

177. This functionality will ensure obvious systematic programme synergies are undertaken via an automated process, as part of the optimisation routine. In current delivery this is a manual business exercise undertaken as part of the AMPIC process referred to earlier in this document.

4.1.5. Opex Costs

178. YW has built on the opex model developed by the Water Research Centre (WRc) in Swindon.

179. The WRc model was built initially from public domain June Return data. The June Return records the running costs of individual large works and groups of smaller works within particular size bands.

180. WRc assumed the processes and use either the actual size or the mid point of the band, and used their own in house process knowledge to derive operating costs. This was done for the entire UK water industry, producing a model that was unbiased overall and got within 20% of the observed cost in almost every case, with many results a great deal better than this.

181. Based on this promising start, Yorkshire Water commissioned a company specific set of models, calibrated to Yorkshire Water data and processes, at a finer level of granularity. This model would easily predict the running cost of an entire works, but not for example the cost of running the inlet screens.

182. A further development has taken place to develop the model down to the finest level of granularity (screens etc.) using observed costs where possible and expert opinion where observed cost were not available, but all calibrated to the first available level at which observed costs were present. The model gives unbiased predictions of energy costs, chemical cost, manpower costs and maintenance cost, with maintenance cost rising with time.

183. This model has been incorporated into Yorkshire Water corporate systems as part of the whole life cost analysis, details of which are contained in **B3 Section 4.2.**

184. Changes in Opex due to capital investment can easily be calculated from the difference in the Opex before investment and after investment. For schemes where there is no existing asset, the higher level model set provides a route by which a calibrated and unbiased estimate of Opex can be derived. This enables modelling of business as usual operational practices based on the actual observed costs of operating the business as reported in the June Return.

4.2. WHOLE LIFE COST MODELLING

4.2.1. Principles of the PR09 WLC Model

185. Yorkshire Water has developed an investment planning process that is capable of producing a **cost optimal point of capital investment**. This is an enhancement to the investment scheduling process delivered for the PR04 submission.

186. A key component of this model is an enhancement of the existing Net Present Cost & Whole Life Cost (WLC) calculation routine. In this context **WLC is defined as 'the economic assessment considering all agreed projected significant and relevant cost flows over a period of analysis expressed as a monetary value'.**

187. The requirement was to build a corporate process and supporting IT application that embodies WLC 'best-practise' and provides auditability, visibility and integrity. Table 2 compares the components of WLC being used for PR09 against those used in AMP4 :

PR04	PR09
Discounted Construction Cost	Discounted Construction Cost
Capital Replacement/Refurbishment Costs (discounted)	Capital Replacement/Refurbishment Costs (discounted)
Opex effect of Capex	Opex effect of Capex
Residual Value of assets at end of 40 year period	Residual Value of assets at end of 40 year period
	Change in Cost Of Ownership (COO) (including early write off penalty)
	Change in Cost of Failure (COF)
	Change in Carbon/Sustainability Costs

Table 2: Summary of Changes in Whole Life Costing

188. The **change in Cost of Ownership** (with early write-off penalty applied) and the **change in Cost of Failure** and the **change in Cost of Carbon** as a result of the capital investment are calculated for each PR09 solution.

189. **Cost of Ownership (COO)** models have been built covering all aspects of the asset hierarchy at the sub-assembly level for Chemical, Energy, Labour and Maintenance costs. In addition deterioration algorithms have

been defined for each model. The WLC calculation can therefore determine the optimal point for investment i.e. the point when a capital replacement becomes more beneficial than continuing to incur an increasing operating cost.

190. **Cost of Failure (COF)** models have been built at Service Measure level. These define the service failure costs that the capital investment has mitigated, for example a Property Flooding event having a Very High impact. Figure 17 shows diagrammatically how the COF has been calculated:

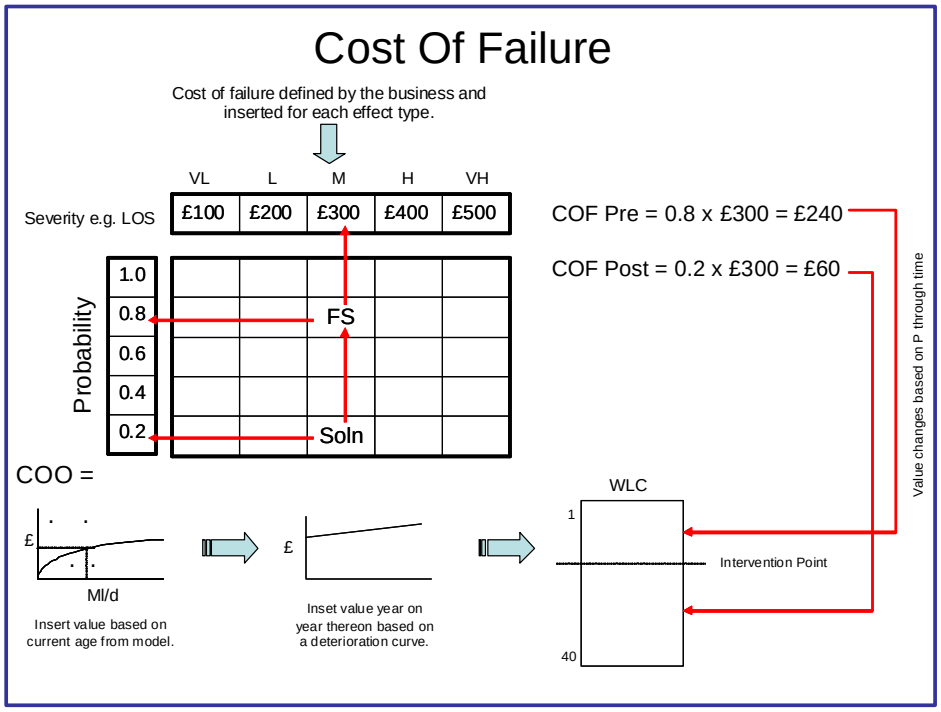


Figure 17 – Cost of Failure Application

191. The diagram demonstrates how the cost of failure is linked to the risk exposure based on probability and cash values assigned to the severity scale, and changes over time. When the solution is chosen the residual risk position is used to establish the reduction in the cost of failure. In the above example a reduction of £180 is shown post investment.

192. **Historic write-off costs** have been examined to determine the cost of writing off assets early in their life. This is applied as a factor to the COO models to ensure that, all other factors being equal, a solution that is proposing to write-off assets early is less beneficial than one that lets them run to the end of their life.

193. **Carbon/Sustainability** models have been developed to cost the net change (of the carbon footprint relating to procurement and operation of the asset) due to implementing the solution.

194. For solutions where it is not possible to calculate a COO then it is necessary to capture the OPEX effect of the capital injection and when this will take place. This is likely to occur where the solution is proposing to deliver different assets from those currently in operation e.g. rationalisation type projects, new build etc

195. The steps in the calculation process are summarised in the process flow diagram figure 18 below;

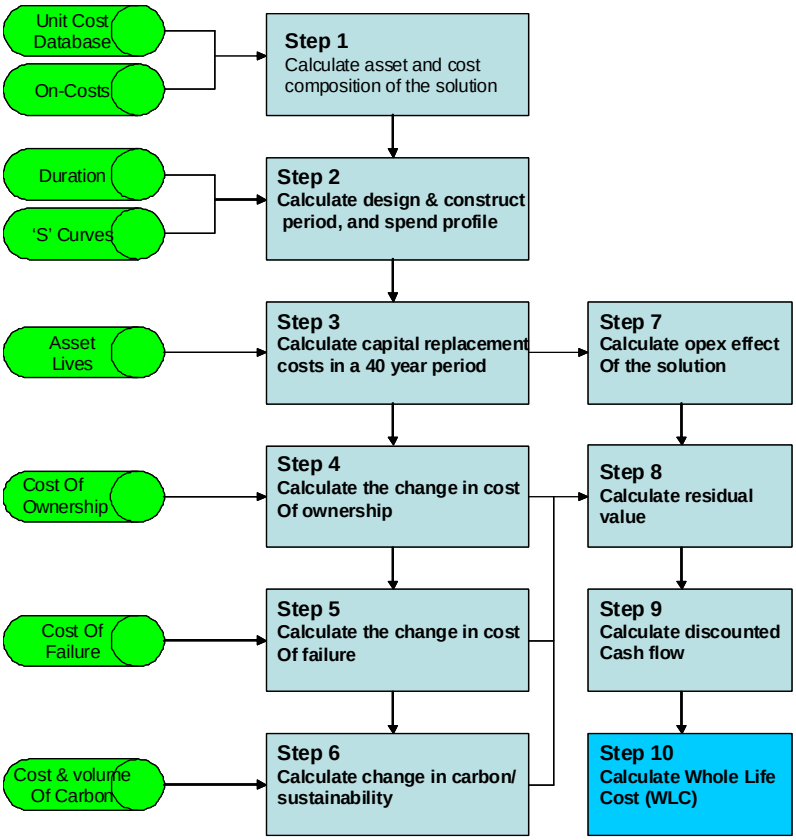


Figure 18 – Whole Life Cost Process Flow

196. The costs at step 10 are made available for the cost/benefit optimisation process contained in ELSA+.

197. The user is presented with a 'menu' of WLC components to select before passing solutions to the optimiser. It is therefore possible, for example, to select solutions with or without Carbon/Sustainability costs included.

198. The key steps in the calculation are displayed in tabular form by the IT application. Figure 19 shows the discount factor by year and the four cost parameters that change on an annual basis. A row is displayed for each year of the calculation. For clarity of presentation Carbon/Sustainability Costs have been excluded.

Figure 19 – Example Whole Life Cost Calculation

- Column A – the change in Cost of Ownership as a result of the capital investment.
- Column B – the change in Cost of Failure as a result of the capital investment.
- Column C – Opex effect of capex
- Column D – capex cost of initial construction plus replacement/refurbishment costs

199. The costs are discounted and amalgamated to produce a summarised WLC value as shown in figure 20.

Figure 20 – Whole Life Cost Summary

200. The WLC then passes forward to the cost benefit optimisation in ELSA+ where it is used to develop the annualised WLC available for comparison with the annualised benefit from WTP.

4.3. BUSINESS AS USUAL ASSET MANAGEMENT SYSTEMS

4.3.1. Clearly the best

201. The vision for Yorkshire Water is to be known as clearly the best Water Company in the UK and Asset Management is an integral element within the delivery of this vision. Asset management processes and information systems are constantly evolving and improving within the Company in order to meet this challenge. This is supported by our Strategic Direction Statement, where one of the five strategic objectives is 'World Class Asset Management and Great People'. The Company's approach to the PR09 submission with the continued development and integration of the LEADA+ process is proof of the commitment that this Company places on efficient and economical management and operation of it's networks of assets.

202. The following section describes the principles of asset management within YW. Various systems, procedures and quality assurance systems the company uses for the efficient management and operation of it's assets. In particular are details of the management information systems that support company asset plans, and therefore serviceability to customers.

203. Yorkshire Water demonstrates a world class asset management culture utilising the asset management cycle (AMPIC) as the framework. This allows all aspects of investment and asset management to be linked to the Strategic Direction Statement and delivered through the business plan.

204. The following overview will give an understanding to how asset management is embedded into the culture of the business and drives aspirational targets whilst delivering maintained service to our customers.

4.3.2. Asset Management Process and Systems

205. The following section is designed to help the reader understand and appreciate our view of Asset Management and where specific systems interface;

206. We have simplified the AMPIC process (Appendix 1) to show the basic Asset Management Cycle, as shown in figure 21 and incorporates:

- Operate assets
- Monitor
- Identify performance gaps
- Assess risk
- Prioritise
- Plan solution

- Deliver and Implement

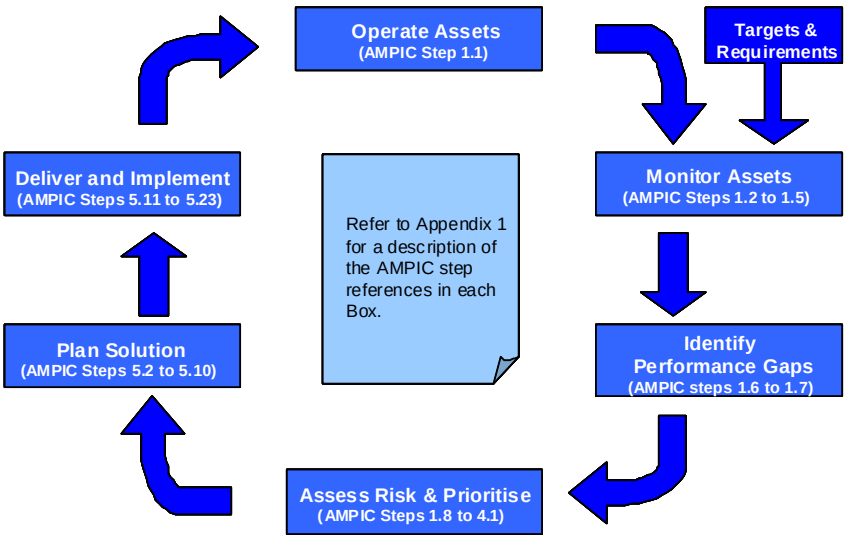


Figure 21: Company asset management cycle

4.3.2.1. Operating Assets:

207. Asset Records and Asset Plans are essential to underpin good Asset Management and Operation. Good quality assured asset records are at the heart of any efficiently operated and maintained water company.

208. The key Asset Record systems in Yorkshire Water are Asset Inventory (AI2), Geographical Information Systems (GIS) and schematics. AI is the foundation and warehouse for all plant data and the basis for all other systems e.g. WMS (Work Management System).

209. The provision of a central asset registry allows Yorkshire Water's assets to be accessed through what is essentially a single data warehouse, using common names and common references. This common referencing mechanism allows the seamless integration of existing information systems into the Asset Information Base (AIB) environment.

210. Asset information is contained within various sources of corporate data including:

- The Asset Inventory (AI2) for assets and asset groups;
- The Boundary and Zones (BoZo) system for Zone and Zone hierarchy data;
- Regional Operations Database (ROD2) - Asset Performance (the archive for Flow, Water Quality and Telemetered data)
- Work Management System (WMS) - for day to day operation and maintenance instructions for assets

- Water Resources Allocation Plan (WRAP) - simulation modelling systems used to support production planning;
- Engineering Drawings Management System (EDMS)

211. We have developed and maintained a corporate GIS system since AMP1 Transitionary Asset Management System, (TRAMS) records all underground assets within the Water Network Enquiry Records System (WNERS). The GIS has been developed, implemented and populated over the last twenty years based upon digitising of the existing paper records onto the system. Data input to the system was controlled by a strict quality assurance system. This system has undergone an update to a 32 bit application in 2002 and is now known as ODYSSEY. This system has been operationally available throughout the region for fifteen years and is available across the network and on over 1000 Toughbooks provided to Field Operation's staff.

212. The ODYSSEY system has been developed over time and is now the sole depository for the distribution mains records within Yorkshire Water. All amendments to records from capital schemes are fed back to the system. The current Service Level Agreement ensures records are now updated within 24hours

213. To enable YW to be the company of choice and earn the respect of its customers we continue to utilise our award winning Integrated Customer and Operations Management (ICOM) system (figure 22) The integrated IT infrastructure developed has enabled us to provide a single view of all customer contacts and accessing all customer information, together with real time visibility of progress of all work on the company's assets.

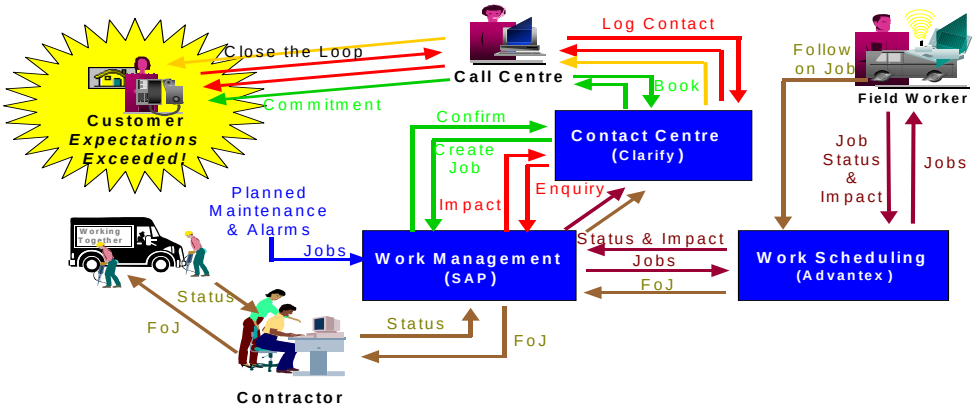


Figure 22 - ICOM (Integrated Customer and Operations Management

214. Developments made over the last 2 years to ensure asset operability and outstanding levels of service to our customers have included the centralised control and automation of our largest treatment facilities. This enabled full remote monitoring and control of these assets to ensure the highest performance levels are achieved.

215. The development of real time WRAP is another major step change in the development of our asset management IT systems ensuring the optimum programme is managed and maintain for the secure supply of water to our customers at all times.

216. As the Company strives to improve the quality of the service we deliver to our customers we have sought external ISO accreditation for different aspects of our delivery process. The following describe the current position of ISO accreditation within the business

217. The Company has developed a Water Assets Quality Management System which achieved ISO certification in 2004 (figure 23), which combines existing quality systems in Headworks, Water Treatment and Distribution, which all individually held ISO accreditation from as far back as 1995.

218. A new user friendly IT interface has been rolled out across the business to ensure the system are easily accessible for all personnel involved in the asset management cycle.

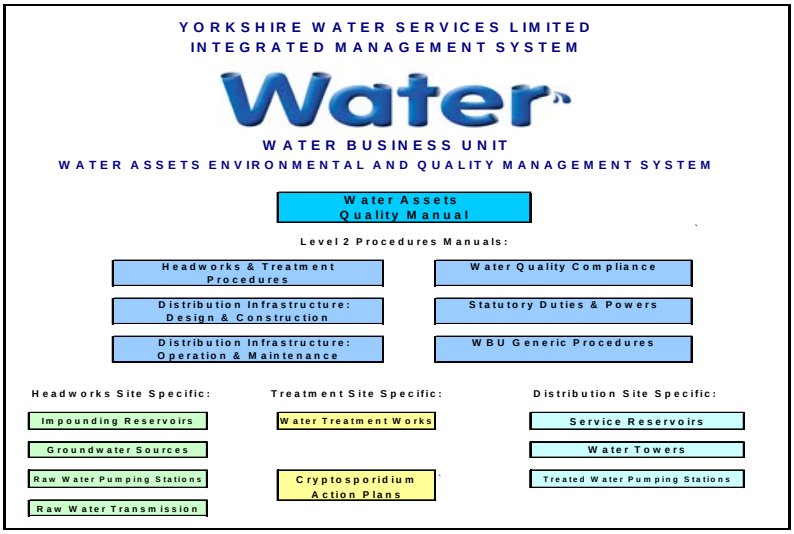


Figure 23 - Water Assets Environmental and Quality Management System

219. YW continues to maintain and develop an Environmental Management System (EMS) which has been certified to ISO 14001 since 2004. The

scope of certification covers all Yorkshire Water's operations - "The provision of sustainable water, sewerage and waste management services". The EMS plays a pivotal role in asset management through the following:

- development of an Environmental Policy Statement which outlines the key environmental issues for YW and states, as a business, how we intend to manage those key issues (risks).
- identifying and evaluating environmental aspects and impacts (risks) and managing those we deem significant. The majority of aspects and impacts identified relate to potential environmental risks on our assets e.g. oil and chemical management, drainage, pollution, aging assets etc.
- ensuring environmental objectives and targets are developed, managed and included in internal management systems e.g. the balanced scorecard.
- ensuring the business is fully aware and understands environmental legal and regulatory compliance issues.
- a full schedule of environmental audits at all YW assets investigating compliance against legal, ISO 14001 requirements and internal policies and procedures..

220. Although the EMS scope covers all Yorkshire Water's operations it is the various QMS systems around the business which have a closer link with asset management through operational control procedures. The EMS is mainly a top level system (figure 24) which feeds into existing systems such as the various QMS around the business.

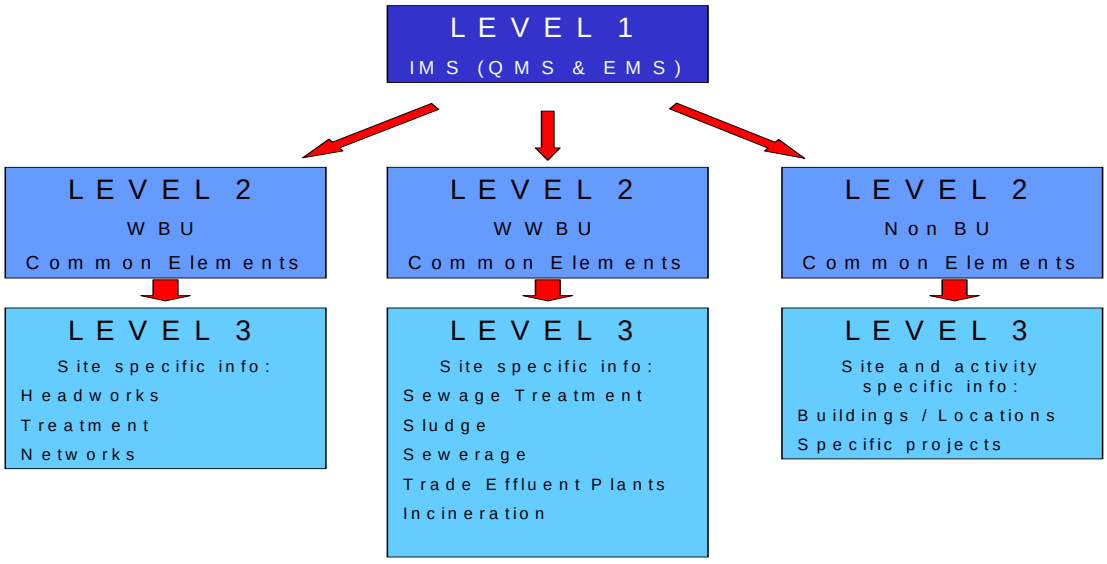


Figure 24 - EMS Tier Structure

221. The Business Risk Model (BRM) also received ISO 9001 certification in 2006, to ensure the data quality and reliability is of a consistently high standard to ensure investment decisions are made with from an informed position.

222. ISO 9000:2001 certification continues to be held for:

- The Asset Records department for the processes and methods by which asset data is maintained and updated within our Asset Record Systems. This important third party endorsement by SGS Yarsley demonstrates that the Company's commitment to quality information upon which to base our Asset Investment decisions. The asset inventory is corporate application that holds data on YW assets with regard location, individual asset referencing through an asset hierarchy. Greater depth of detail can be found in Section C3 of this business plan submission. Asset Inventory (AI) forms the core data structure for all surveys undertaken as part of the Yorkshire Water asset survey process. A screen shot of AI is shown in figure 25 which represents the asset hierarchy referred to above;

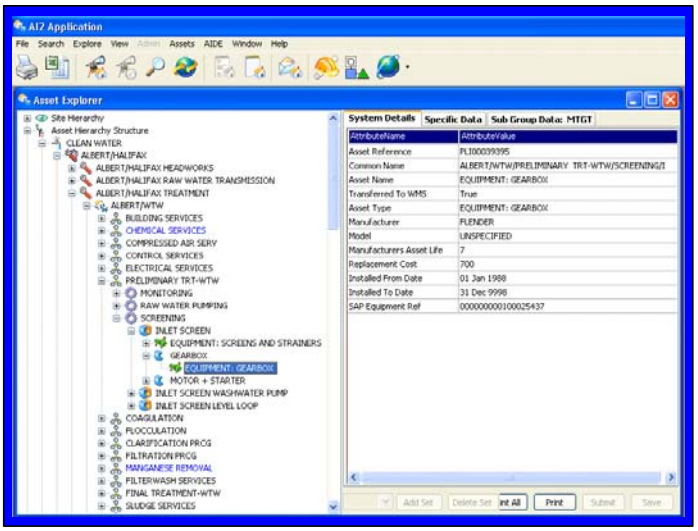


Figure 25 – AI Asset Hierarchy

- The Control Room has been ISO 9001 accredited since March 1999. As part of our ongoing commitment to service and quality we have recently extended the scope of this accreditation to include the Work Management and Security and Emergency Planning functions within the Control Room.

223. Total care plans (TCP's) have been developed for major sites. TCP's define the planned maintenance requirement for each installation. The Work Management System (WMS) is used to programme and record routine maintenance and statutory inspections

224. The Work Management System manages and records data on all repair and maintenance activity undertaken on our assets whether undertaken by Yorkshire Water staff or our contract partners.

4.3.2.2. Monitor assets and Identify Performance Gaps

225. Assessing asset performance is important to determine performance gaps, how efficient the Company's assets are and where improvements need to be made.

226. Central control has been developed over the past 24 months, the use of an alert system for both treatment and distribution assets is allowing an increase in the proactive nature of our response to asset reliability, ensuring YW are the first to know of any potential failure in service to our customers. This is by using the technology of Regional Telemetry Systems which has been utilised by YW for many years but has seen significant development over the past three years.

227. All water treatment works, selected sewage treatment works, key pumping stations and selected Combined Sewer Overflows (CSO's) are linked by the Regional Telemetry System (RTS) to Regional Operations Control Centre (ROCC), where the alarms are received and actioned 24 hours a day. Information generated by the RTS system, both alarm status and on line instrumentation output, is held on the ROD and used to inform decisions on asset maintenance and replacement.

228. Data on the status of the asset, including flow, pump status, wet well levels and chlorine residual levels amongst others, are collected via the RTS and held on the ROD for trend analysis to increase understanding of asset performance and enable more efficient asset management to be effected.

229. At the heart of the company's performance is the Shortfalls monitoring system, which constantly reviews asset performance against defined targets and reports accedence's by exception to Asset Managers.

230. Shortfalls provides monitoring, exception reporting and normalisation (which aids consistent comparison of performance) of compliance, chemicals and energy usage, number of maintenance jobs, telemetry alarms and customer contacts for Treatment Works, Pumping Stations and Drainage and Distribution Zones.

231. Within AMP4 developments have been made into systems to identify risks in both above and below assets. The Distribution, Operation and Maintenance risk matrix, shown below (figure 26), is an excellent example of this. Identifying DMA which are at risk of discolouration events via a traffic light system and allowing the management of these assets through operation mitigation or capital investment.

DMA	DMA Name	Prop Count	WSZ 2004	WSS	MSP	Matrix Colour Apr08		Matrix Colour Jan08		Matrix Colour Jul07		Matrix Colour Apr07		DOMS score		DMA within Priority A of TM prog (TM section named)	Priority of WSS within TM prog (Disc/WQ)	WSZ of Mn >50%	WSZ of Fe >50%
D438	OWSTON FERRY	504	Doncaster Rural	CANTLEY WATER SUPPLY SYSTEM	0	Green	1	Green	1	Green	1	Amber	2	5		A		Y	
D440	HYDE PARK SOUTH	526	Doncaster Urban	CANTLEY WATER SUPPLY SYSTEM	4	Amber	2	Amber	2	Green	1	Amber	2	7		A			Y
D442	FINNINGLEY	1155	Doncaster Rural	CANTLEY WATER SUPPLY SYSTEM	1	Amber	2	Amber	2	Amber	2	Red	3	9		A		Y	Y
D443	HYDE PARK NORTH	755	Doncaster Urban	CANTLEY WATER SUPPLY SYSTEM	4	Amber	2	Amber	2	Amber	2	Amber	2	8		A			Y
D460	ST JAMES STREET	525	Doncaster Urban	CANTLEY WATER SUPPLY SYSTEM	4	Green	1	Green	1	Green	1	Amber	2	5		A			Y

Figure 26 – DOMS Risk Matrix Extract

232. Asset Managers review poorly performing assets using performance data to determine the most appropriate course of action whether through cheaper operational practice or capital investment.

233. JUT (Joined Up Thinking) for E&M plant monitors maintenance at plant item level (e.g. a pump), flags up exceptions (e.g. large numbers of breakdowns) and has the facility for whole life cost comparisons of Opex or Capex solutions.

234. Service reservoirs are inspected as part of a rolling programme. This process is managed by the reservoir maintenance database. Regular or serious quality failures would also result in more frequent inspections. All risks identified from inspections are promoted through the Business Risk Model and are prioritised through the Leada Suite.

235. Asset breakdowns are recorded through WMS, mentioned in the sections above. Decisions on asset replacement are made using these records of performance, at assets or process level. Any risks identified are promoted into BRM+ and prioritised through the Leada suite.

236. Health and safety compliance is monitored by routine safety inspections with deficiencies being addressed through operational or capital solutions.

237. Reservoirs under the 1975 Reservoirs Safety Act are also inspected annually by a Supervising Engineer and any recommendations are also passed to BRM for priority ranking.

238. A ten year inspection programme for reservoirs falling under the 1975 Reservoir Safety Act is also in place. These are carried out by Inspecting Engineers and and subsequent recommendations are processed through the Leada Suite.

239. Quality compliance is monitored using historic quality data held on the corporate Regional Operational Database (ROD2). The data is analysed to determine the level of risk of failure against statutory quality standards and to identify trends which may result in future failures. For above ground assets, works with a high level of risk are investigated to determine the underlying reasons behind the quality failures. An operational, research or capital solution is agreed and the appropriate action taken. All risks are promoted through the Business Risk Model and are prioritised through the Leada Suite.

240. Quality Compliance at Water Treatment Works is based on 100% Maximum Admissible Concentration (MAC) standards. Routine sampling data are held on ROD and compared to these standards. Any deviation is monitored and an appropriate course of action devised.

241. A 'DG5 predictor' tool has been developed which identifies properties at risk of internal flooding due to 'other causes' by monitoring network activity e.g. blockages, customer contacts, and then prioritises proactive operational intervention to prevent flooding incidents.

4.3.2.3. Assess risk & prioritise

242. Refer to Section 2.2.1

4.3.2.4. Deliver and Implement

243. The Investment Authorisation Procedures (IAP) are used to ensure appropriate levels of authorisation and approvals are obtained throughout the life of the scheme. The IAP Lotus Notes database holds the Investment Need (IN), and Solution Authorisation (SA) - the forms required to approve a scheme.

244. If approved by the regional challenge group, Investment planning raise a IN electronically from the BRM+ entry using the IAP Lotus Notes database. The IN specifies the problem description, assets involved, cost etc. The IN provides data at a scheme outline level.

245. The Solution Manager (SM) forms a Core team with the Business Unit Sponsor. The SM issues a brief to the contractor with details of the problem and a target cost based on an obvious solution.

246. A core team is established and a preferred solution agreed and submitted via the Solution Authorisation (SA) process for approval. prior to the scheme solution proceeding to a detailed design.

247. The Capital Management System (CMS) is used to track the progress of the scheme to time, cost and for outputs and activities.

248. On completion of each capital project, agreed procedures are in place which require as-built records and documentation to be completed by the contractors before final payments can be made, so that company asset records can be updated. Completion of the schemes to time and cost, activities and outputs is monitored by CMS.

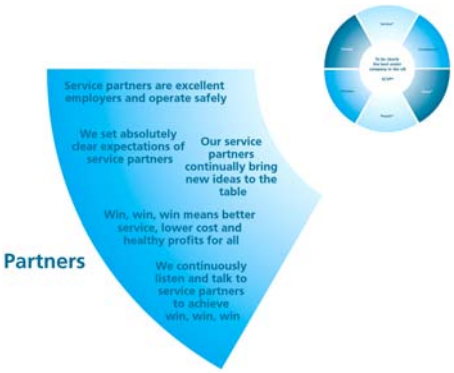
249. Lessons learned from schemes are monitored by Post Project Reviews. Any residual risks are also documented at this stage and captured on BRM+ to ensure an updated risk position is available for this asset.

250. To deliver capital schemes, Yorkshire Water has two main contract structures including 6 Joint Delivery Teams and 4 Large Scheme Contractors, 2 Repair and Maintenance (R&M) contract partners for work on distribution assets and 1 Sewer R&M contract partner. All the contractors work in pre-defined geographical areas

251. Two consultants have been appointed to work with the Company under a framework agreement, being selected on their proven ability to carry out the range of works required, their potential to develop with the company in terms of updating practices and procedures and their relative costs.

252. Framework suppliers are employed where bulk ordering of appropriate quality goods can provide a competitive advantage and reduce maintenance costs and spares holding. Framework suppliers work with the contractors and input to company design standards and standard designs.

253. One of the key underlying principles of our capital delivery management plan has been the concept of 'Partners', and truly embedding this culture into all organisations involved in delivering the capital programme. This importance of this to our company is evidenced through it's inclusion as part of the company vision wheel. Successfully embedding this during the AMP4 period was dependant upon the following;



- Evolution that built upon the success of AMP3
- Aligned commercial objectives
- Mutual understanding of objectives and drivers

- Partners working together to sharing learning & purchasing strengths
- Maintaining competitive tension in a partnering enviro