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Scottish Water's approach to capital maintenance

Report by the Independent Assuror

November 2013

Executive summary

Scottish Water is planning to increase capital maintenance expenditure to an annual average of £280m over the SR15 period, representing a 12% increase over the average level in the SR10 period. This is in the context of Ministerial objectives which require SW to ensure that assets are maintained so that there is no deterioration in performance from that required to be achieved by 31 March 2015. SW's aim is to become the most valued and trusted business in Scotland.

SW has used three approaches in making its capital maintenance proposals for this review:

- Asset risk modelling (ARM) which uses up to date information on asset failures and their service impact to assess intervention options. This covers 22% of assets.
- Asset stewardship modelling (ASM) which uses information on asset condition to assess deterioration rates and evaluate the benefits of intervention. This covers 47% of assets.
- Bottom up, demand assessment approaches where available data is unsuitable for modelling. These approaches are used for some major assets such as impounding reservoirs based upon engineering opinion and trends in repairs. This covers 21% of assets. For the remaining 10% of assets, notably M&G assets such as telemetry or vehicle fleets, economic replacement cycles are typically used.

The first of these, ARM, is innovative. It uses operational data to determine the optimal timing of intervention to maintain service reliability. The modelling aims to give a 50-75% probability of achieving target levels of performance.

The ASM approach relies on asset condition data. SW conducted its last full survey of asset condition in 2007 and acknowledges that its current asset knowledge is variable, notably for non-infrastructure assets. SW is conducting a series of sample surveys of asset condition, the results from the first of these should become available in January. It appears to us that SW is embarking on these surveys at a late stage in the business planning process. SW disagrees and says that the survey results will be used to target its expenditure on capital maintenance during SR15 and not to determine the level of maintenance expenditure.

SW has conducted sensitivity tests on the relationship between changes in condition grade and the outputs of the model. As a result, it is confident that the model is sufficiently robust to deal with data deficiencies and appears to be satisfied with the current quality of their asset information for investment planning purposes.

Nevertheless, should the new data show significant changes, there would be the opportunity to re-run the ASM models.

SW has carried out validation work on their modelling approaches for which they have had academic input and an independent review. The work, particularly on ARM, has been commended by Black & Veatch and the industry research body, UKWIR as at or near leading edge. Further development work is planned and SW is looking to extend the reach of ARM

modelling to include some assets currently covered by ASM. Black & Veatch has welcomed this and have also commented on the potential benefits of future work to decrease the percentage of assets currently covered by demand assessment. SW does not agree with this assessment and currently has no plans to significantly reduce this percentage.

There are clear linkages between the capital maintenance programme and other parts of the capital programme. These include measures to improve the resilience of water supplies to the Edinburgh area, through connectivity, and other proposals to improve system resilience in order to reduce the vulnerability to service failures. However, we shall undertake a fuller assessment of synergies with other parts of the capital investment plan as part of the review of the Business Plan.

A number of companies in E&W have developed top down investment frameworks that balance investment and risk across the full range of their assets. Strategic concerns regarding business finance and the affordability of customer bills have seen them set a top down challenge to limit the level of investment in each area, including capital maintenance. This constraint is used to encourage teams to examine available options differently and to develop innovative and value for money solutions across the full range of their investment programme. SW believes its approach is better, balances investment and risk with customer demands and maintains incentives for innovation. An example of this is its work with suppliers to explore the use of new technologies.

Given the scale of enhancement investment in non-infrastructure assets over the past 20 years, there is a need for increased capital maintenance spend. The increase SW proposes does not appear unreasonable. It is, however, difficult to assess the scale of increase precisely as part of the growth in capital maintenance spend during the latter part of SR10 was to raise service levels to meet targets set by Ministers.

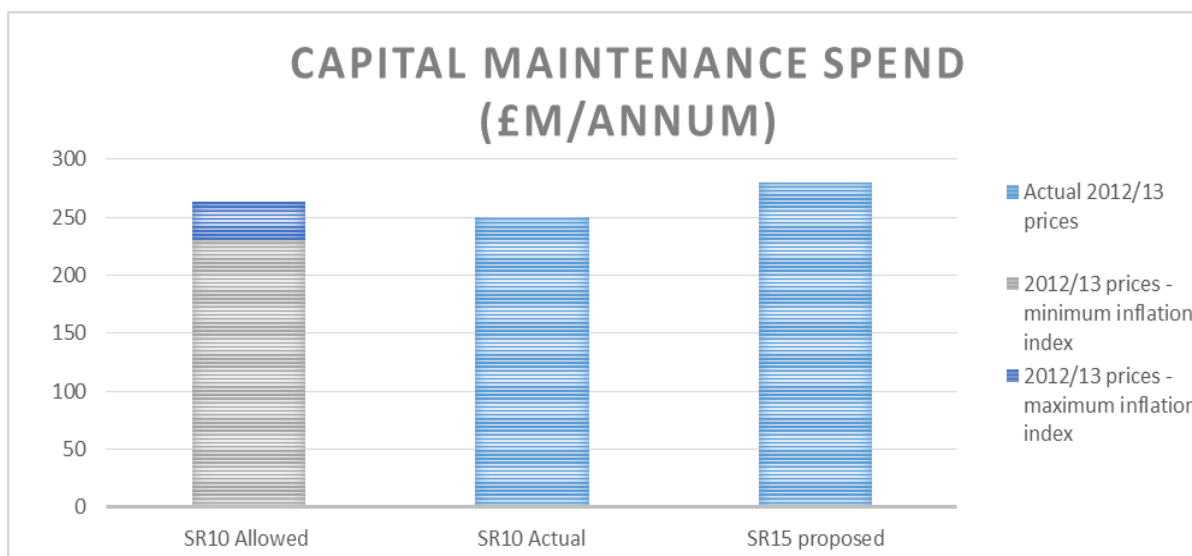
In meeting its performance standards SW are committed to further development of their modelling and improved asset knowledge. These developments, in time, can be expected to influence the level and pattern of future spending.

Introduction and Context

The Independent Assuror was asked to undertake an independent, high level assessment of the capital maintenance proposals set out in Scottish Water’s business plan for 2015-21. The aim was to say whether the capital maintenance proposals for 2015-21 are soundly based, strategically focused and consistent with best practice. A key information source was the report by Black & Veatch (B&V) on SW’s business plan. In addition we have received papers from and held meetings with SW’s asset management team to understand more about the approaches which have been used. In reporting our assessment, we have framed our findings in terms of the specific factors set out in the terms of reference.

At the time of the Phase 1 review by Black & Veatch (B&V), SW was planning a significant increase in capital maintenance expenditure for SR15 with a continuing rise until 2025-2030. Annual capital expenditure was expected to rise from an annual rate of £230-263m, depending on the inflation index used, to £318m in SR15. The major reason for the increase was the growth in the size of the asset base arising from the extensive quality enhancement programme that SW has undertaken over the last 11 years and higher service levels to be maintained in 2015.

The latest estimates show a smaller projected rise. Expressed in 2012/13 prices, they show an increase from an average of £250m in the SR10 period to £280m over the SR15 period, representing an increase of 12% from the level used to deliver 2014/15 service levels. The comparison between SR10 and SR15 is shown in the histogram below.



The profile of capital maintenance spend during SR10 also showed a rising trend. In the first two years of SR10 it was running at a much lower level – in response to a fall in the construction price index (COPI). Once this index stabilized, additional funds were released for investment some of which was used to augment the capital maintenance programme to ensure that the target service levels for 2014/15 set out in Minister’s objectives could be

met. To the extent that the additional expenditure was used to raise performance standards rather than maintain an existing service standard, then we do not think the level of spend in SR10 is necessarily comparable with the proposed capital maintenance spend for SR15. SW contend that the two levels are comparable as both aim at the same service level. However we have not been convinced by this argument.

We have sought to discover what the planned annual spend of £280m represents in terms of an increase on a like for like basis. Given the above concerns it is difficult to assess the actual scale of increase. Nevertheless, we accept that some increase is necessary because of the growth in the size of the non-infrastructure asset base mainly as a consequence of enhancement investment over the past 20 years. This rising trend is seen to be consistent with the plans of the companies in England & Wales.

We have also looked at the factors that have reduced the forecast spend in SR15 from an annual rate of £318m in earlier estimates to £280m currently – a 12% reduction. One reason is the switch of some expenditure to enhancement. An example of this is the re-lining of water mains to achieve compliance with iron standards.

Findings

We have considered and reported on the factors set out in the terms of reference proposed by the Water Industry Commission (WICS) and agreed by Scottish Water.

Are Scottish Water's capital maintenance proposals for 2015-21 based on a comprehensive dataset, reflecting a sound knowledge of the assets, their performance and the investment requirements to maintain the required levels of service?

SW has acknowledged that it does not have a complete and up-to-date asset condition data set for all of its assets; knowledge is variable and is more limited for non-infrastructure assets. The last full survey of asset condition was conducted in 2007. Black & Veatch have not conducted an audit of asset data for use in the business plan but do conduct a full assessment of asset knowledge on an annual basis. In the B&V review of the business plan B&V state that the capital investment requirements have been prepared in a "thorough and logical manner" and appear content with SW's plans to "gradually improve the quality and coverage of the asset data". However Black & Veatch identified three areas where asset knowledge is relatively weak including raw water pumping assets and treated water pumping assets. SW specified that this only accounts for £10m/year of the capital maintenance plan and that these assets will be covered by their sample surveys. We have not seen a full assessment of asset knowledge across SW's business; nor have we directly compared its comparative level of asset knowledge with other water companies.

To produce its capital maintenance proposals for 2015-21, SW has used three approaches. These are

- asset risk modelling (ARM) – 22% of assets
- asset stewardship modelling (ASM) - 47% of assets
- bottom up demand assessment – 31% of assets.

ASM uses some data from the 2007 survey, updated to reflect new and replaced assets. ARM uses up to date data about asset failures and their service impact. The primary data sets used for each of the modelling approaches is summarized in box 1.

Box 1: Primary data sets for ASM and ARM

ASM	ARM
<ul style="list-style-type: none"> - Ellipse asset inventory - Condition grade assessments - Structured and verified subject matter expert knowledge - MEAV - The Modern Equivalent Asset replacement Value 	<ul style="list-style-type: none"> - GIS asset inventory - Historic burst repairs - Historic sewer collapse repairs - Historic sewer blockages and cleaning activities - Promise customer service requests / complaints - Historic unplanned interruptions to supply incidents - Historic sewer flooding incidents - Engineering Estimation System asset intervention costs - linkage between customers served and assets

SW has conducted sensitivity tests on the relationship between changes in condition grade and outputs of its ASM modelling. As a result, it believes that it has demonstrated that its modelling approaches are sufficiently robust to deal with any potential data deficiencies. However, while this may be the case for large data sets, we would expect model outputs for smaller data sets, and classes of asset, to be less robust. For this reason the outputs of the sample survey will be vital to delivery of the plan.

For the capital maintenance needs based upon demand assessment, SW has used a mixture of sources, principally expert opinion from the asset owners, asset inspections and the run-rate of investment in the current and recent investment periods adjusted for known influences. While use of expert opinion can lead to bias, SW has sought to control for this by comparing the results with MEAV/Book life estimates and also Yorkshire Water’s Weibull model. These comparisons were also used to test modelling outputs.

Planned asset knowledge updates

SW does not plan to carry out another full-scale survey of asset condition. The last one cost £3-4m and took 18 months to complete. Instead, it is embarking on a series of smaller, more frequent sample surveys. The first of these will report in January 2014 and the findings will be considered in the final business plan. This first phase will cover around 1000 units although, over the next 18 months, the surveys are expected to cover some 17,000 asset units out of a total of 50,000. This is considered to be a large enough sample on which to draw statistically reliable conclusions. The surveys will focus on assets which inform the greatest investment or where the information is least.

Potential effect of knowledge updates

SW is confident that the results of the survey will not lead to revised forecasts of the level of investment required. SW expects that the survey's main effects will be better targeting of capital maintenance activity to achieve the necessary outputs and input to future information collection strategies. Should the results lead to revised forecasts these will be incorporated in the final business plan in early 2014.

From an external perspective, we are surprised that the programme of sample surveys was not started earlier so that its results could inform the draft business plan. This would have given increased confidence that the dataset used is sound or otherwise highlighted issues to be addressed. However, SW have told us that they saw no great urgency for conducting new surveys because they have demonstrated to their own satisfaction that the existing model outputs are robust enough for business planning purposes at the aggregate level.

Conclusion

While SW does not have a complete and up-to-date data set showing asset condition, notably in relation to some non-infrastructure assets, it has tested the results of its models extensively and it is confident that the level of knowledge it has is sufficient to project capital maintenance needs in aggregate for the next six years.

The first of a series of sample surveys of asset condition is now underway and will report in January; the results should provide a further test of the robustness of the projections derived from the modelling work, particularly ASM. Ideally, the full programme of surveys would have been conducted in advance of the draft determination in April to provide a better confidence level regarding the datasets used. However, we understand that their prime role is to confirm specific sites on which to direct investment in the SR15 price control period.

Do the proposals appear to reflect best practice? Are there identifiable areas where the approach is consistent with, or falls short of, best practice? Overall, in broad terms, where does Scottish Water's approach sit relative to the rest of industry: for example, is it a conservative 'tried and tested' approach or is it an innovative, industry leading approach.

SW has made it clear that its strategy is to be the leader in best practice, customer focused asset management consistent with PAS55 performance standards. This is in the context of meeting customer expectations of a safe, reliable supply of high quality drinking water and that waste water will be taken away and returned safely to the natural environment. In addition, the Minister's objectives for SR15 period require that there should be no overall deterioration in performance from that achieved by 31 March 2015.

Modelling approaches

SW has put effort into developing and validating new approaches to asset management since SR10. This has included setting up a new modelling team of statisticians and

mathematicians. One of its aims is to develop risk-based asset management processes to secure reliable high standards of performance for customers in line with its strategy.

It uses two modelling approaches.

- Asset risk modelling (ARM) is mainly applied to water mains and sewers. It takes account of historic failure rates, the service impact of asset failure on customers and intervention options.
- For other classes of asset, asset stewardship modelling (ASM) has been applied. This takes account of the rate at which assets deteriorate between 6 different condition states, based upon condition grade information from 2007, and assesses the benefits of different types of intervention over a 25 year time span.

Scottish Water described the main advantage of its ARM and ASM models as the ability to understand the benefits and risks associated with varying levels of maintenance and understand longer term demands. The interactive process used has been able to incorporate feedback from the operational teams and to challenge them on their original assumptions.

As part of its validation work, SW have compared the predicted asset lifetimes and associated capital maintenance predicted through ARM and ASM with:

- Demand assessment
- Accounting lifetimes
- Yorkshire Water data
- Each other where for certain types of asset (such as inlet screens) both ARM and ASM approaches have been used.

In addition, we understand that SW have used a range of statistical validation techniques for the models which, particularly for the ARM, enable degrees of uncertainty in the model forecasts to be quantified. In general, this extensive validation work appears to have given SW confidence in the outputs of both ASM and ARM.

We also understand that SW has undertaken some econometric work into TOTEX requirements (operating and maintenance costs) the results of which have been shared with the WICS and used to challenge overall maintenance investment.

To ensure the quality of the model is high, they have involved academics at Strathclyde and Edinburgh universities and commissioned an independent review from Professor John Andrews of Nottingham University who heads a team, sponsored by Network Rail, working on asset management techniques. His report contains a series of recommendations for short, medium and long term improvements.

Feedback from Black & Veatch and Professor Andrews is that the modelling SW has developed puts it at or near a leading position among UK water companies and that the models compare well with those used in other infrastructure intensive industries. While there appears to have been little benchmarking against practice in other water companies, UKWIR has commented favourably on the SW approach which it considers to be at the

industry frontier. SW has not actively compared the current results with the outputs from the approaches used in earlier periodic reviews, however their comparisons with demand assessment and Yorkshire's Weibull model have shown that the modelling approaches SW are using result in lower predicted spend.

Bottom up approach

SW uses bottom up approaches when the data is not available to enable modelling, the lifetime of the assets is short or the assets are critical and/or easy to assess. These unmodelled approaches are based on either the run rate of investment in the current and investment periods, adjusted for known influences or a bottom-up assessment of future investment needs based on the expert opinions of asset owners, inspections by engineers and data trends in repairs. These approaches are applied to assets such as impounding reservoirs and wastewater outfalls in the sea – which comprise some 21% of assets. For M&G assets such as telemetry systems, IT and vehicle fleets – which together comprise 10% of assets - separate approaches are used including economic replacement models and software product refresh cycles.

Demand assessment that relies on the opinions of those working with the assets as opposed to empirical data can sometimes lead to an overly cautious approach. SW believes that it has taken steps to ensure this is not the case through measures such as comparisons with book life.

SW's intends to explore whether it can extend the ARM model to cover additional asset classes. It is drawing up a priority list for this, the key to which would appear to be the availability of service data. However, SW does not believe that the 21% of assets covered by demand assessment will decrease significantly. This is because many of these assets, such as ironwork, reservoirs and aqueducts, are covered through regular inspection and SW does not perceive the cost benefit case of a move to modelling approaches to be positive. It may be worth comparing this with the experience of companies in England and Wales, many of whom use bottom up techniques on a smaller percentage of assets than SW, to understand the rationale for the varying conclusions on the optimal proportion of assets assessed via modelling approaches.

Comparisons with other companies

A number of approaches are used for developing capital maintenance plans in England & Wales. These include approaches which are "top down" i.e. premised on limiting the level of investment in the business plan to meet affordability constraints and business objectives. As this is a balance of risk and investment across the full range of assets this allocation is expected to be smaller than would have been proposed through traditional "bottom up" approaches to capital maintenance; it demands that operations teams develop innovative and value for money solutions to deliver the results needed within the investment available.

Given the objectives set by the Scottish Government for asset maintenance and the strong commitment by the company to meeting customer expectations for service reliability, this approach may be less suitable for SW. SW already acts within budget constraints and is confident that it analyses all opportunities for innovative techniques and balances risk with

strategic objectives. SW has also told us that it have applied Stochastic Frontier Analysis in its econometric models to estimate capital maintenance requirements on a top-down basis, the results of which were similar to the results from bottom-up assessments.

Nevertheless, it would be worth considering where SW's modelling approach places it on the risk spectrum and what this means for its maintenance predictions. The Customer Forum might wish to consider this in the future.

Conclusion

SW has developed its own distinctive approach which differs in important respects from those of other water businesses in the UK. This approach appears soundly based, and SW has sought to validate its models in a range of different ways.

SW's ARM approach is particularly innovative and risk based and has been commended by UKWIR as well as Black & Veatch. However, SW have not demonstrated that their overall approach represents best practice and further development work is planned.

At present the application of ARM is limited and SW has plans to further develop this modelling approach and to extend its use to more asset classes.

Are there specific issues or deficiencies in the overall approach identified by Black and Veatch and have Scottish Water adequately responded to and/or addressed these issues?

We have had regard to three of B&V's reports in looking at any specific issues or deficiencies in SW's overall approach.

- SW SR15 BV Assurance Services Report 2 - Capital Maintenance.
- SW SR15 BV Assurance Services Report Phase 1 Business Plan Review
- SW SR15 BV Assurance Services Report Phase 2 Business Plan Review

Each of these reports provides a positive overall assessment of SW's approach. We have reported this in Appendix A. Below we note the key outstanding B&V recommendation. B&V has indicated that it is happy with SW's responses to the remainder of the recommendations made. Our work gave us no reason to disagree with B&V.

For most asset classes, B&V supports the approach and conclude that capital investment requirements for maintaining service and compliance have been prepared in a '*thorough and logical manner*'. B&V notes that because ARM requires good knowledge of assets and their failure modes, with a clear link to service failure, it is currently not suitable for many asset classes. Bottom up demand assessment approaches are used for some 21% of operational/engineering assets, plus 10% of M&G.

B&V has recommended that SW should work to improve its asset knowledge with a view to applying modelling approaches to more assets in the future, including the proportion of assets assessed via bottom up approaches. SW has questioned the scale of the work

recommended by B&V, due to the costs involved, given that some of these assets are based on annual inspection regimes.

Does the overall approach to capital maintenance appear consistent with the approach set out in other areas of the business plan: for example, do the synergies with other areas of the capital investment programme (such as growth and capital enhancement) appear to have been taken into account?

Linkages in the plan

There are clear linkages between the capital maintenance programme and other parts of the capital programme. One example that was quoted was to improve the resilience of the water supplies to the Edinburgh area by increasing the connectivity between two water supplies – at Marchbank and Glencorse – and in this way avoiding a large capital maintenance spend to prevent the Megget raw water main from bursting, which would cause many customers to lose their supply. A number of other measures are being put in place to improve resilience and reduce the vulnerability to service failure.

More generally, investment to improve system resilience and build connectivity in order to continue to be able to maintain supply customers in the event of a plant failure is categorized as enhancement rather than capital maintenance spend. Currently, some 10-15% of customers have dual supply.

Synergies

SW have explained that it held regular challenge sessions between teams to identify synergies while developing the plan. Synergies identified include rationalization of treatment plants, leakage control and pressure management.

When assessing capital maintenance needs for existing plant and infrastructure, and capacity enhancement, SW has regard to growth projections out to 2027. It may bring forward investment in new capacity where asset replacement is due where it deems this appropriate, given the level of investment and certainty involved. SW have also taken steps to ensure there is no overlap between capital maintenance and enhancement, at least in part following feedback from Black & Veatch.

Conclusions

The approach to capital maintenance appears to be consistent with the remainder of the plan. SW has used a process to identify synergies which has borne results. In our review and discussions with SW we have not identified areas where synergies have not been considered.

In assessing the overall approach, are there areas where the Independent Assuror is of the view that there are opportunities for Scottish Water to further enhance its approach and to what extent are these opportunities recognised by Scottish Water and being acted upon?

Overall approach

SW's approach as described above appears innovative, strategically focused and soundly based. SW is planning further development of its modelling based approach and intends to confirm and improve its asset knowledge through a programme of sample asset surveys. The results of the latter will be critical in effectively targeting their capital maintenance programme.

Alternative approaches

In England and Wales some companies have adopted a "top down" approach that are premised on limiting the level of investment in the business plan to meet strategic objectives. This is then used to challenge asset managers to deliver within this budget. The benefit of this, on the assumption that the budget is not generous, is the incentive to focus on innovative and efficient solutions and the discouragement of overly risk averse approaches. SW act within investment constraints for the overall plan and state that they have applied similar approaches to the capital maintenance budget through econometric techniques. The results from these techniques are broadly consistent with those from the bottom up demand modelling approaches they have used.

While SW may have good reasons for not adopting this approach, it should nonetheless look for ways of achieving the benefits of having to secure best value for money within a budget constraint while, at the same time, exploiting the undoubted strengths of the statistically based approach. SW believe they have achieved this through choosing the proposed spending levels based on the confidence of service reliability. For SR15 this is 50-75% according to the model.

Developments

SW has a focus on innovation for sustaining high quality services to customers and sees this as part of finding new and better TOTEX solutions and procuring reliable and cost effective assets. SW explained that it is planning to provide new guidance to its asset managers and their teams in the interests of securing better informed decisions on capex/opex tradeoffs, procurement and delivery plans. This will build upon current practice based upon minimum whole life cost planning. They are also proactively working with the supply chain to develop new innovations. There may be scope for some international comparisons in this area.

SW is drawing up a priority list of assets for future ARM modelling since this risk-based model accords with their strong focus on maintaining uninterrupted supplies to customers. The key to this is likely to be the availability of service data. Over time, we would expect more assets moved from ASM to ARM modelling, together with some assets to be moved

from demand assessment to a modelled approach, recognising the constraints for certain classes of asset.

Conclusion

SW will be able to enhance its approach through increased use of ARM and increased innovation. It is targeting both of these as part of its drive to become Scotland's most valued and trusted business.

It is not clear to what extent ARM can, and will be expanded. B&V have recommended that it will be beneficial for SW to improve the knowledge of assets and their failure modes, with a clear link to service failure to enable the increased use of ARM. Whilst we agree with SW that modelling techniques should only be used where there is a clear benefit we would encourage SW to understand further where and why other firms have come to alternative conclusions.

Is there evidence of innovative solutions or approaches to capital maintenance being employed to test new ways of delivering the required levels of service?

Current use of innovation

SW is developing new ways of working to improve the performance and reliability of its assets. It considers innovative and non-capex solutions in the delivery of all of its projects as part of business as usual.

SW sees modelling techniques as the key innovation for delivery of high quality, reliable services to customers in an efficient manner.

An example of innovative solutions being used to deliver the required level of service involves the application of condition monitoring techniques, of the kind used in manufacturing and petro-chemical industries, to reduce the risk of plant shutdowns and to improve understanding of the way their assets deteriorate.

Future use of innovation

SW sees innovation as one of the ways in which it can become Scotland's most valued and trusted company. It is working proactively with their suppliers to examine alternative technologies and ways of reducing their dependence on complex technology. They have two existing alliances and are considering how to develop Scottish Water Solutions 3 possibly as a third for delivery of the capital programme. It believes that the supply chain will deliver the majority of innovations that reduce the cost of delivery.

We agree that the supply chain can be a strong source of innovation provided the client acts appropriately and gives its suppliers the scope to innovate with proportionate rewards. An excessive focus on cost or a reversal of procurement strategy will dampen the supply chain's willingness and ability to take the risks that innovation might entail. This is an area where SW could be asked to provide information on its approach and progress.

Conclusion

There is evidence that SW consider the use of innovative solutions and approaches to capital maintenance as part of business as usual.

SW will lead innovation in their approach to service, with support from the supply chain, and will rely on the supply chain to deliver innovations that reduce the cost of delivery. SW agree that the success of the supply chain in developing innovations will need to be carefully managed and do not see themselves relying purely on the supply chain.

Conclusions

In the current price control period, SW has significantly improved its customer service and reliability and has been set an objective by Ministers to ensure no overall deterioration in performance from those achieved by March 2015. SW's strategy is to become the "Scotland's most valued and trusted business" whilst delivering those objectives.

Approach

SW have developed modelling approaches to determine future capital maintenance spend. Its asset risk modelling (ARM) approach is recognized by UKWIR and Black and Veatch as leading edge and is directed at optimizing intervention options and their timing and thereby minimizing the impact of service failures on customers. Both of SW's modelling approaches – ARM and ASM – have been subject to extensive external validation and key areas for future development have been identified. This has included identifying priority assets for the extension of asset risk modelling.

Data

SW has variable asset knowledge. Its last full asset survey was in 2007 and it is now planning to embark on the first of a series of sample surveys – these will be stratified samples in areas perceived to be of greatest value. The results will be available in January.

We were surprised at the timing of the survey in relation to the business plan timetable as there would have been advantage in having the results in time to inform the draft business plan. However SW has explained that the output from its models has comparatively low sensitivity in relation to errors in the asset data and they are confident that the aggregate capital maintenance predictions will not be impacted by any data deficiencies. While we accept this be the case in the aggregate, we would expect model outputs for smaller data sets and classes of asset to be more sensitive to data quality. The sample surveys will therefore be vital to allow SW to develop its delivery plan.

From SW's perspective, the prime objective of the sample survey is to identify assets for repair in SR15, rather than to validate the model or refine capital maintenance forecasts. Their results from the survey will be used to help maintain service levels. However, we

would expect them to re-run their models using the sample survey data if this shows up significant changes.

Improved data remains the key requirement to extending the scope of current modelling work – and particularly asset risk modelling – and reducing the currently high proportion (21%) of assets for which 'bottom up' demand management approaches are currently used.

Planned levels of spend

Taken as a whole, planned annual investment levels during SR15 represent approximately a 12% increase in real terms over the average level for SR10. However, it is acknowledged that part of the higher levels of spending in the last 3 years of SR10 were aimed at increasing levels of service to achieve target performance levels set for 2015. In our opinion this suggests that the two levels of spending are not directly comparable and that the true rise in capital maintenance for SR15 may be higher than 12%.

We accept that the scale of enhancement investment to meet EU standards over the past 20 years, by increasing the asset base, has contributed to an increased requirement for capital maintenance spend in future years. This is both due to a growth in the number of assets and the nature of them; technical or electronic assets often provide more certain outcomes but require replacement more frequently than traditional assets. SW has provided information to WICS and the customer Forum regarding this split but is unable to quantify the separate effect of these drivers on the level of capital maintenance. There are offsetting factors including extended asset lives in some classes, often through repair and refurbishment; technical innovation across a range of activities and work with the supply chain to reduce the costs and improve the performance of plant and equipment. Other developments such as catchment management will improve the productivity of assets in the future.

In informing views in this area, it would be useful to compare trends in asset values and capital maintenance over time, perhaps expressed as a ratio. If the ratio has increased significantly, we would need to understand why and the particular features of certain new types of asset that appear to be driving heavier maintenance demands. We understand that data exists which would allow such comparisons but we have not seen this.

Synergies

SW have set up a process to identify synergies between different areas of the plan and this has borne results. We have seen examples of synergies and have not identified any areas where synergies are not being appropriately addressed in the plans which we have reviewed and the discussions we have had with SW.

Use of innovation

We have been impressed with the range of innovative approaches being developed by SW and believe that a number of these approaches – including catchment management – should help reduce future capital maintenance requirements. Investment in improved system resilience – under the enhancement programme – will also reduce the vulnerability

of customers to failures with particular treatment plant. It is important that SW continue to pursue identification and implementation of innovations and do not rely too heavily on the supply chain alone for future improvements.

Recommendations from B&V

In their latest reports, B&V have identified few specific issues or deficiencies in the overall approach. They have expressed satisfaction with SW's response to the vast majority of issues raised in their initial assessment.

SW have taken action to address all of B&V's issues except for the concern raised regarding the percentage of assets which SW plan to assess via 'bottom up' demand management in the future.

Summary of conclusions

SW has made good progress in developing innovative modelling techniques for asset management to ensure the risk of service failures remains low. These approaches are reasonable if combined with an internal drive for innovative lowest cost whole life solutions and are therefore in line with the government's objectives and SW's strategy to become the "most valued and trusted business". We have seen evidence that innovative solutions are being pursued.

B&V and UKWIR have commented that the use of ARM is at or near leading edge although ARM only forms one element of the overall approach.

Our view is that SW's investment in improving asset knowledge appears to have lagged behind the modelling work, although this is now being addressed. The results from the first of a series of sample surveys in January should provide a further test of the sensitivity of the models to data changes as well as help inform the delivery programme for capital maintenance investment in the 2015-21 price control period.

Set against the growth in the size of the asset base, mainly as a consequence of investment in non-infrastructure assets over the past 20 years, the planned increases in maintenance spend, in real terms, over SR10 levels do not appear unreasonable. However, we do not believe we can quantify on a like for like basis, what the true increase in the level of spending is, since part of the spending in the later years of SR10 was directed at raising performance levels to meet service targets.

Appendix A: Capital maintenance - Are there specific issues or deficiencies in the overall approach identified by Black and Veatch and have Scottish Water adequately responded to and/or addressed these issues?

Black and Veatch have written a number of reports on SW’s approach. In particular the relevant reports to answer this question have been the “maintaining service and compliance” section (section 4) of SW SR15 BV Assurance Services Report – Phase 1 BP Review and the SW SR15 BV Assurance Services Report – Phase 2 BP Review, and SW SR15 BV Assurance Services Report 2 – Capital Maintenance. These provide a positive overall report of SW’s approaches. Below we have summarised where they made recommendations or suggestions for change and the responses SW have made to these points.

The SW SR15 BV Assurance Services Report – Phase 1 BP Review and Phase 2 BP Review were two reports designed to highlight any areas for improvement (phase one) and report on progress (phase two). We discuss the recommendations made under “maintaining service and compliance” in these documents below.

In Black and Veatch’s phase one business report they made recommendations or on a number of areas, in phase two they make comment on changes which have been made to address these concerns. The table below summarises these.

Area	Recommendation/ suggestion in phase one report	B&V statement in phase two report
Demand assessment	31% of assets are currently assessed using the demand assessment approach. B&V recommend SW target the movement of these assets to a modelling approach for future business plans.	“We accept that Demand Assessment is an appropriate approach for smaller asset groups, or those where there is good knowledge about the asset base and future trends, such as logistics. The approach can give reasonable results for the nearer future, but is likely to be less accurate for later years. We recommend that if possible SW should reduce the proportion of assets using this approach and target the acquisition of improved asset knowledge on appropriate asset types, with the aim of moving them to a modelling approach for future Business Plans.”
	B&V highlighted a need for clarification on the extent of overlap or gaps between demand assessment and modelled outputs for wastewater infrastructure.	The potential duplication of investment needs between the ARM and Demand Assessment methods has been eliminated following analysis by SW.” ¹

¹ Note – SW has also assured us that it has reconciled the two approaches through discussion between the modelling team and operational teams.

<p>Categorisation of spend as capital maintenance or enhancement</p>	<p>B&V raised a concern that items which are service enhancement were being classified as capital maintenance. For example revenue maximization installations (meters) may not be capital maintenance.</p>	<p>Various comments including: "investment needs at Phase 1 included an element of service enhancement. This has now been removed." "Service enhancements have been clearly identified and separated from capital maintenance expenditure." In the case of meters the spend has been split 50:50.</p>
<p>Overlap between capital maintenance and enhancement</p>	<p>B&V raised a concern that there could be overlap between capital maintenance and enhancement programmes on various projects and the ASM approach.</p>	<p>"At the time of our Phase 1 review there appeared to be some overlap between the wastewater capital maintenance and enhancement programmes.... This overlap has been identified and eliminated by SW."</p>
<p>Metering</p>	<p>SW anticipate that the proposed increase in capital maintenance replacements will be outweighed by increased revenues. B&V state that "this has not yet been proven" and recommend that this is confirmed.</p>	<p>"SW also anticipates that the proposed increase in capital maintenance replacements will be outweighed by increased revenues. This has been demonstrated through the meter-testing programme meters which have been removed after a number of years of service to prove the degree of under-recording in practice."</p>
<p>IT programme</p>	<p>Business benefit of IT upgrades – and their existence within capital maintenance expenditure as opposed to enhancement</p> <p>IT investment is not currently benchmarked against other WASCs in England and Wales</p> <p>Potential unduly conservative replacement cycles</p>	<p>"Since our Phase 1 review, SW has challenged and reduced its proposed IT spending, using a risk-based methodology." "SW is investigating the possibility of moving to a whole-life cost approach for IT investment, rather than relying on assumed lives for IT assets. We support this, but note that this will require some quantification of the effect and cost of IT failure for the business."</p>
<p>Expected asset lives</p>	<p>SW are not conducting checks against the theoretical book life of wastewater assets or the rate of investment implied by the calculation of asset depreciation from MEAV values. B&V recommend SW consider doing this.</p>	<p>Reference to this not found in phase two report – unclear if matter has been resolved for all assets.</p>
	<p>Sea outfalls - concern that the assumption of an average life of 200 years is too long.</p>	<p>"Sea outfalls exist in a comparatively hostile environment and in our opinion, an average life for planning purposes of 200 years is long. SW accepts this, but points out that outfall surveys</p>

		completed so far do not indicate that condition is poor. SW’s strategy for these assets is to complete the survey programme, concentrating on continuous discharges, and use the results to inform SR21 investment. Actual interventions will be prioritised based on survey results.”
Clarification	On the base service level of EPIs for sewage pumping stations	“At the time of our Phase 1 review, the expected level of serviceability resulting from capital maintenance expenditure was not always clear for some classes of assets. This has been resolved for Phase 2 and corresponds to the expected SR10 exit level.”

Black & Veatch also commented on areas where they still had recommendations in their phase two report. These were areas where they did not feel the issues raised in phase one had not been resolved (such as the planned use of demand assessment) or where they feel that increased focus will be needed in future. Below we summarise what the issues are and how or if SW is planning to address these.

- Demand assessment.
 - As noted in the table of actions following phase one recommendations B&V have stated that “we recommend that if possible SW should reduce the proportion of assets using this approach and target the acquisition of improved asset knowledge on appropriate asset types, with the aim of moving them to a modelling approach for future Business Plans.”
 - B&V have accepted that ARM would not be suitable for all types of asset but still believe it would be beneficial to increase its coverage.
 - SW plan to decrease their use of demand assessment but only by a small proportion as they believe the cost benefit of moving more assets to a modelled approach is not positive.
- ASM
 - B&V highlight in their phase two report that for ASM “moving from the median elicitation response to the 25 percentile or 75percentile response produces a greater range indicated investment needs. This may be due to elicitation responses covering a comparatively wide range of assets within an asset type and we have recommended that this is applied to asset groups at a greater level of granularity to assess the effect.”
 - SW have reported to us that they have taken this on board and are currently starting a piece of work to look at exceptions to more generic groups. The sample survey will also inform this and they will have results prior to the final business plan submission.
- Raw water pumping
 - B&V recommend that SW completes a programme of condition and performance surveys, following which investment levels may need to be reviewed, and also collects data on breakdowns to support the increase.

- SW will be conducting their sample survey, the results of which will be available in January. This is a stratified survey and will cover this area. If needed the investment levels can be refreshed prior to final business plan submission.
- The possible change in capital maintenance projections from this issue is £3m/annum.
- Treated water pumping
 - B&V raised a concern regarding the apparent deficiency in asset data and recommend that SW reviews asset data in its records and, if necessary, carries out further surveys.
 - As with raw water pumping the treated water pumping assets will be covered in the sample survey.
 - The possible change in capital maintenance projections from this issue is £4m/annum.

In the SW SR15 Assurance Services Report 2 – Capital Maintenance B&V also raise a number of recommendations or suggestions for improvements. The only recommendation which has not already been covered in our discussion of the phase 1 and phase 2 reports on the business plan is that, “There may be some benefit in considering the adoption of some elements of ISO 9001 procedures for selected aspects of the process to establish the audit trail, record assumptions and make the process easier to repeat in subsequent Strategic Projections.” It is not clear how SW have addressed this.

On all but demand assessment recommendations or suggestions we are comfortable that SW’s approach has or will address B&V’s concerns. Regarding the use of demand assessment we share B&V’s concerns on the % of assets assessed under this mechanism and we would endorse any measures to bring this down. SW have stated that the cost of this is high. This is principally due to the level of information needed. It is not clear to us why the gathering of service information does not form part of SW’s plans for future best practice in any event.