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Support to allocate the bioresources RCV

Report for Ofwat on Thursday 16 February 2017

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Introduction

1. Ofwat commissioned Reckon LLP and Jacobs UK Ltd to carry out a project to support its work to allocate part of each wastewater company's regulatory capital value (RCV) to its bioresources (sludge) activities, ahead of the PR19 periodic review of water and wastewater price controls.

2. The sludge RCV allocation forms part of a package of regulatory initiatives that are intended to help unlock the potential for markets to play a greater role in activities relating to sludge transportation, treatment and disposal. These include the introduction of a separate price control for sludge activities from 1 April 2020. Ofwat has decided that the RCV allocation to sludge should be made on a "focused" basis. Our interpretation is that this requires a forward-looking assessment of the economic value of each wastewater company's sludge assets.

3. The main elements of our project have been as follows:

   (a) An assessment of what the valuation of wastewater companies' sludge assets should represent, in the context of the planned RCV allocation between sludge activities and the remaining wastewater activities.

   (b) The identification and review of a number of high-level approaches to the sludge asset valuation process, as well as advice to Ofwat on its preferred approach.

   (c) The development of a potential methodology and guidance material for the sludge asset valuation exercise, drawing on a review of the questions and issues that are likely to arise in practice.

4. The first section of this report discusses the economic value concept that we propose as the basis for the sludge asset valuation exercise. We provide further information and analysis on this topic in Appendix 1. It also summarises some key points from our review of the high-level approach to take for the valuation processes.

5. The remaining sections of this report present and discuss our proposed methodology and guidance material for the sludge asset valuation. This is organised as follows:

   (a) The valuation process and transparency.

   (b) Costing assets on a hypothetical efficient new-build basis.

   (c) Adjustments to new-build costs to take account of the remaining economic life of the existing sludge assets.

   (d) Adjustments to new-build costs to take account of the revenue-generation and operating and maintenance costs of the existing sludge assets.

   (e) Further issues and guidance.

6. We have sought to specify an approach and instructions for the valuation that Ofwat could consult on. In some cases, which are more challenging or require a greater degree of judgment, we are less definitive and present a discussion of the issues and highlight

potential options. This report is not intended to be comprehensive as some aspects of the process and reporting arrangements for the sludge RCV allocation will be covered separately by Ofwat.

7. Appendix 2 provides some examples which show how aspects of the methodology we have proposed could be applied in several illustrative scenarios.

8. In addition we prepared two illustrative spreadsheets to support and help explain aspects of our proposed methodology. These are:

   (a) A draft spreadsheet containing key input data items and showing the calculation steps that could be used as the basis for developing a proposed industry-wide valuation template.

   (b) A draft spreadsheet that provides a prototype tool to calculate adjustments for the remaining economic life of existing sludge assets that is an alternative to an approach based on straight line depreciation techniques.

9. Our work relating to the identification and review of a number of high-level approaches to the sludge asset valuation process is summarised in Appendices 3 and 4. Appendix 3 provides our review of alternative approaches that could be used for the valuation exercise and Appendix 4 highlights points from our review of some relevant regulatory precedent.

Economic value concept to underpin the asset valuation

10. This section provides an overview of the economic value concept that we propose to underpin the valuation of sludge assets and discusses the high-level approach to the valuation exercise. We provide a more detailed explanation and analysis of the economic value concept in Appendix 1 and in our review of high-level approaches set out in Appendix 3.

Economic value

11. We consider that it is feasible and helpful to use an economic value concept for the purposes of the RCV allocation exercise between sludge and wastewater network plus. The economic value of a set of assets depends on the value that can be generated by using (or selling) those assets; this is a forward-looking concept.

12. The economic regulation of wastewater companies' sludge treatment and disposal activities may create a degree of circularity in the application of an economic value concept. If the sludge RCV is set at the value X, then the building blocks approach means that the price control will be calculated with a view to enabling the wastewater company to earn a reasonable return on an RCV of X (if it invests and operates efficiently), and so the expected economic value of sludge assets would be X. Even if Ofwat's approach moves away from a building blocks approach for sludge price controls in the future, the economic value of sludge assets would still depend on how future controls for sludge are set, a policy matter that is yet to be determined. And there is the potential that the economic value is fully determined by competitive market prices

rather than by a mix of price controls (e.g. on wastewater sludge treatment) and market prices (e.g. for energy generation).

13. For the purpose of the RCV allocation, we suggest that the economic value concept should be applied by making an assumption about the nature of the prices for sludge treatment and disposal services. This can help resolve the circularity referred to in the previous paragraph and align the valuation with the policy context for the RCV allocation. Our approach is to assume that these prices will be constrained by price controls which are intended to proxy for the constraints on prices that would emerge through market processes under the hypothetical assumption that there is effective competition for the treatment and disposal of wastewater sludge from new market entrants (using newly-built assets). Such new entrants could, for example, be existing wastewater companies providing services outside their area of appointment or new entrants to wastewater markets.

14. This approach seems consistent with Ofwat's objectives for the focused RCV allocation to sludge, including sending appropriate price signals to potential entrants and mitigating the risks that wastewater companies' presence in other waste markets could distort competition. We used this economic value concept as a foundation for our work to develop proposals for a sludge asset valuation methodology.

Calculation of economic value

15. An estimate of economic value could draw on estimates of the hypothetical new-build costs for the assets needed to provide sludge treatment and disposal services. This suggests links to the modern equivalent asset value (MEAV) concept from Ofwat's previous regulatory accounting framework. But it is important not to conflate the concept of MEAV with the concept of economic value. A measure of MEAV might be an input to the calculation of economic value but is unlikely to capture the whole of it.

16. The economic value of a company's sludge assets might be calculated in two quite different ways:

    (a) **Full discounted cash flow assessment**. First estimate the hypothetical competitive prices for sludge treatment and disposal services that would be required by new entrants using hypothetical new-build assets, as well as the market prices for other related services such as energy generation. Then, estimate the discounted values of the future revenue streams and operating and maintenance costs that would arise if the company provided services at these prices using its actual sludge assets. The discounted cash flow (DCF) can then be treated as an estimate of the economic value of the current sludge assets.

    (b) **Adjustments to hypothetical new-build costs**. Start with an estimate of the costs of the hypothetical new-build assets that would be needed by a new entrant. Then make adjustments for differences between the company's actual assets and the assumed hypothetical assets to capture the extent to which these differences would affect the economic value of the company's actual assets (in the hypothetical competitive scenario). The adjusted estimate of the hypothetical new-build costs can then be treated as an estimate of the economic value of the current sludge assets.

17. In either case, our ultimate interest is in the economic value of the wastewater company's sludge assets, in aggregate, rather than in a valuation for specific assets. Nonetheless, as part of the estimation methodology, we envisage that companies will build up from estimates made at the level of individual sites or processes.

18. We illustrate these two approaches in Figure 1 and Figure 2 below. We explain them in more detail in Appendix 1.

Figure 1 Illustration of approach based on full DCF assessment

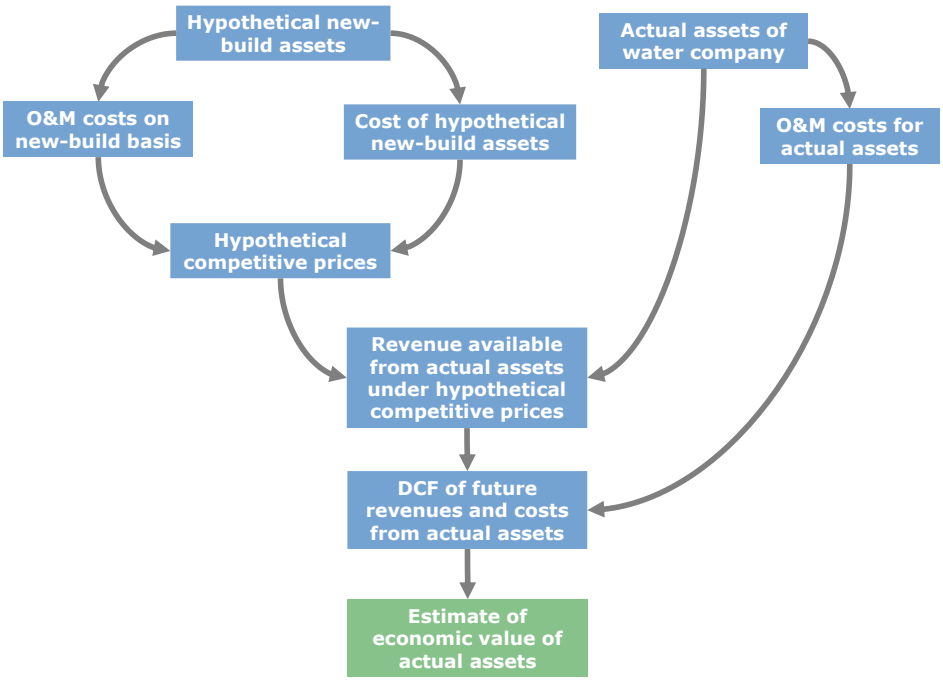
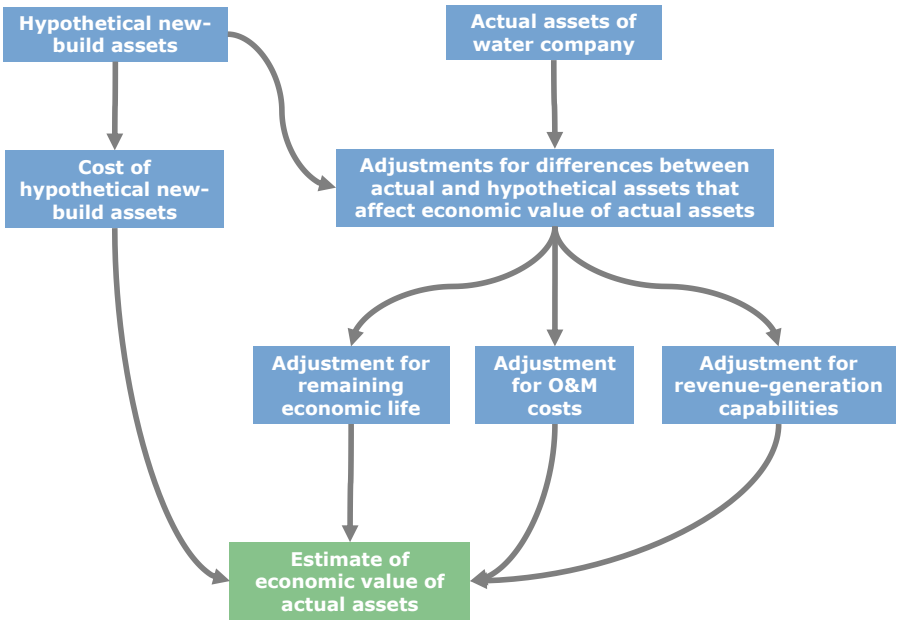


Figure 2 Illustration of approach based on adjustment to hypothetical new-build costs



19. The approach under (b) is a potential short cut. It avoids the need to estimate individual market prices, which could vary by location and depend on the degree of long-term commitment in the services being procured. Furthermore, approach (b) is closer to what water companies will be familiar with from net MEAV estimation as part of Ofwat's previous regulatory reporting arrangements. We propose that approach (b) forms the basis of the asset valuation exercise for sludge.

20. There may be significant differences between the hypothetical assets assumed for the hypothetical new-build costs and the actual assets owned by a wastewater company. These differences could affect the economic value of the company's assets and should, as far as practical, be taken into account under the approach by making adjustments to the hypothetical new-build costs (as illustrated in Figure 2). For example:

    (a) The actual assets owned by a wastewater company will have different age profiles and remaining economic lives than those of the hypothetical new-build assets.

    (b) The actual assets owned by a wastewater company may have higher or lower operating expenses and maintenance costs than the hypothetical new-build assets.

    (c) The actual assets owned by a wastewater company may differ from the hypothetical new-build assets in their potential to generate revenues from services provided to parties other than wastewater customers/retailers (e.g. due to differences in capabilities for energy generation or in the quality/nature of by-product that can be sold).

21. The differences under each of these could be taken into account by making estimates that capture their impact on the economic value of the asset (e.g. an adjustment for the estimated present value of the future differences in operating expenses between the actual and hypothetical assets).

22. A key implication is that it seems necessary to take account of both the assets/processes on a hypothetical new-build basis and the actual assets of each company. Nonetheless, if the differences between the actual and hypothetical assets are sufficiently small, it may be possible to approximate economic value by reference to only new-build assets or only to actual assets.

High-level approaches to the valuation

23. Towards the start of the project, Ofwat shared with us its preliminary views on the most appropriate high-level approach for the sludge RCV allocation, taking account of the context for the work and its regulatory objectives. This approach would involve companies carrying out an updated MEA valuation exercise for their sludge assets, with Ofwat taking a review role. Ofwat's preliminary view reflected its initial work and discussions with wastewater companies as part of its sludge working group.

24. We sought to review and challenge Ofwat's preliminary view. We identified a range of high-level approaches that might be taken as a starting point for the valuation exercise, using the economic value concept outlined above. In doing so, we drew on approaches suggested in Ofwat's Water 2020 publications, on ideas put forward at

Ofwat's sludge working group and on our review of relevant UK regulatory precedent. We describe our review in more detail in Appendix 3.

25. The high-level approaches that we identified differ in a number of dimensions, such as: the roles of water companies and Ofwat in the process; the extent to which the valuation is based on existing information versus new asset valuations; the way that estimates of hypothetical new-build costs are made and the way that each company's actual assets are taken in to account. We compared these approaches against a range of criteria, which included several factors which are likely to affect the accuracy of the valuation as well as other considerations such as consistency and the regulatory burden.

26. Our views were as follows:

    (a) It was not possible for us to take the high-level approaches and conclude as to which is likely to be the most accurate in capturing the economic value concept. Each has its own drawbacks and limitations which may compromise its accuracy, and its accuracy will depend on the details of its implementation.

    (b) An approach along the lines of a company-led valuation suggested by Ofwat seemed a reasonable approach to take. It would make use of the idea that information on companies' actual assets and the local factors that would affect new-build asset requirements is dispersed across companies and difficult to centralise.

    (c) Under that type of approach, there are risks that the accuracy of the RCV allocation process is compromised by strategic behaviour by wastewater companies, who may seek to achieve a low RCV valuation for sludge. This could frustrate Ofwat's objectives for market development and pose risks of inadvertently transferring value from captive wastewater customers to investors. These risks are exacerbated by the extent of subjective judgment involved in the practical application of MEAV and economic value concepts. There may also be concerns about inconsistency across companies in the methods and assumptions used, which could reduce the credibility of the outcome.

    (d) Alternative approaches that reduce the role of the wastewater companies in the valuation process could reduce those risks and concerns. For example, Ofwat could appoint a single set of consultants to carry out detailed valuations separately for each company, or the valuation could be done through common industry costing models or valuation tools. But each of these approaches has its own downsides, such as the implications for the regulatory burden and the ability to take account of each company's assets and circumstances.

27. We recognised that, rather than adopting a radically different approach, Ofwat could tailor and implement its proposed company-led valuation approach in a way that is designed to mitigate, albeit partially, the risks arising under that approach. In particular, Ofwat could reduce inconsistency through the preparation of guidance and tackle the risks of strategic behaviour by ensuring that its review of company valuations has sufficient data and resources to provide an effective counterweight. The proposals and guidance that we set out in this report are intended to support Ofwat in this way.

The valuation process and transparency

28. This section considers a number of questions and issues relating to the valuation process and transparency:

    (a) Roles and responsibilities in the asset valuation process.

    (b) Departure from MEAV terminology.

    (c) Common industry-wide template and other supporting information.

    (d) Reconciliation with statutory and regulatory accounts.

    (e) Publication and transparency.

    (f) Moving from companies' sludge asset valuations to the formal RCV allocation.

Roles and responsibilities in the asset valuation process

29. We outline below the roles and responsibilities of Ofwat and water companies that we envisage in the process to allocate the wastewater RCV.

    (a) Ofwat would consult on and finalise guidance for the valuation of sludge assets.

    (b) It would be each wastewater company's responsibility to prepare an initial valuation of its sludge assets in line with the guidance provided by Ofwat.

    (c) Ofwat would carry out a risk-based review of initial valuations produced by companies.

    (d) Companies would prepare a final valuation, drawing on feedback from Ofwat and any further guidance issued.

    (e) Ofwat would be responsible for making an allocation of the wastewater RCV between network plus and sludge in the light of the final valuations from companies and its assessment of these.

Departure from MEAV terminology

30. The valuation approach that we have developed for the purposes of the sludge RCV allocation builds on, and has similarities with, the "net MEAV" concept from Ofwat's previous regulatory reporting arrangements (e.g. RAG 1.05, now withdrawn) and used as part of the approach for the PR09 periodic review.

31. However, the net MEAV concept used for PR09 and previous regulatory accounts is not the same as our valuation concept. For instance, our concept requires explicit consideration of the potential need for adjustment for differences in the revenue generation capability of actual assets compared to the assumed modern technologies; we did not find explicit precedent for a revenue adjustment in the old regulatory accounting guidance. The methodology we propose differs in some potentially

significant ways to that used for MEAV at PR09. Furthermore, companies may have developed their own interpretation of the net MEAV concept.

32. We propose to avoid using the terminology of MEAV when it comes to the presentation of the valuation concept and guidance on the methodology for the sludge asset valuation exercise.

33. We would not expect this to have any significant downside and should help ensure that the valuation work that companies carry out is directed at what is needed for the sludge RCV allocation, rather than regarded as an update to previous figures used in a different context and for different purposes.

Common industry-wide template and other supporting information

34. We consider that the use of an industry-wide data and calculation template would enhance both the quality of companies' valuations and the effectiveness of Ofwat's review. It would help ensure that companies have completed the key calculation steps identified under the valuation approach and enable cross-company comparisons of the estimates and assumptions used.

35. There is a risk that any industry-wide template could turn out to be inappropriate to the circumstances or approach of specific companies. This is more likely to be a concern if the template is very detailed and a one-size-fits-all approach compromises the valuation.

36. Our proposal is that the template would be relatively high-level and would show how the overall valuation of sludge assets is calculated from:

    (a) Figures built up from different sites and, within each site, for different processes.

    (b) Different steps in the valuation calculation (e.g. estimates of hypothetical efficient new-build costs and various adjustments for differences between the hypothetical and actual assets).

37. The template would not provide all of the information that would be relevant to supporting and explaining the estimation of the economic value of sludge assets. We suggest inviting companies to provide further supporting information on their methodology, assumptions and information sources.

Reconciliation with statutory and regulatory accounts

38. There is a question of whether companies should be required to present a reconciliation between the valuation they produce and their regulatory and/or statutory accounts.

39. Reconciliation can help improve information quality, but represents an additional burden and may be unhelpful if we expect a series of substantial adjustments from published/previous figures.

40. Our view is that a detailed reconciliation with the 2014/15 regulatory accounts, which detail current costs fixed asset values at 31 March 2015, would not be worthwhile. Furthermore, because of differences in the nature and purpose of the valuation, we

would be concerned that an emphasis on reconciliation with those figures would risk entrenching the previous MEAV methodology rather than enabling a new valuation that is better directed at the needs of the sludge RCV allocation.

41. While a detailed reconciliation may not be proportionate, it may nonetheless be useful for companies to provide high-level explanations of the reasons for differences between their asset valuation and the figures from their 2014/15 regulatory accounts. Companies and Ofwat should recognise that these may differ for good reasons (e.g. differences in the valuation methodology, changes in technology, and revision to the boundary between sludge and sewage treatment).

42. It may also be possible for companies to reconcile their valuation with the gross and net book values for sludge assets used as input to figures reported in their statutory accounts. Again, there would be no expectation that the two would be the same as they represent different things, but the net book values could provide a cross-check to the net economic values, especially if a large proportion of the sludge assets were commissioned since privatisation.

Publication and transparency

43. The reliability of the valuation exercise might be enhanced if there is sufficient transparency of the estimates and calculations to enable other interested parties (e.g. other waste companies or other WASCs) who have relevant technical and commercial knowledge to comment on and challenge the estimates and assumptions used by any one party. The prospect of such review would tend to provide an extra degree of discipline to the valuation exercise.

44. Our view is that the industry-wide template should be published to realise opportunities for review and refinement in the light of the knowledge across different stakeholders. This seems particularly useful if Ofwat has limited knowledge and expertise on the costs and commercial opportunities of sludge assets at the local/site level rather than company-wide level (this is not something that Ofwat has typically needed to consider in detail in the past).

45. We recognise that companies may have concerns about adverse consequences of publication of some of the figures used for the valuation. For instance, companies might be concerned about revealing details of their commercial sludge strategies and impacts on future procurement, for example if they are considering investing in alternative technologies and are submitting costs estimates at a site level. Or they may be concerned about sharing detailed information on their costs with potential competitors and hampering their ability to negotiate commercially with other parties with potential customers or suppliers. These concerns would be more acute if the information disclosed were at a detailed level.

46. We suggest that Ofwat consults on:

    (a) Publication of the responses to the high-level template, subject to an opportunity for companies to propose that some information is redacted and to explain the need for those redactions.

(b) Not publishing any further supporting information that companies provide (though companies could choose to publish this).

47. Ofwat may also consider the links with other areas of its work for which it may be requesting data on sludge costs (e.g. for the sludge market information data or for cost assessment) so that it can adopt a consistent approach to these data requests, where possible.

Moving from companies' sludge asset valuations to the formal RCV allocation

48. After companies have completed the valuation of their assets, including taking account of any feedback or further guidance from Ofwat, there is a question of how the information generated is used to make an RCV allocation between sludge and wastewater network plus.

49. There are several possibilities for the way that Ofwat makes the RCV allocation to sludge for a specific company:

(a) Take the company's sludge valuation directly and use this to calculate the amount of its wastewater RCV to be allocated to its sludge activities.

(b) Revise aspects of a company's sludge asset valuation that are insufficiently well-justified and reliable, drawing on other evidence including estimates made by other companies, and then use the revised figure to make the allocation.

(c) Take account of both the company's valuation of its sludge assets and the valuations from comparable companies, and use a form of benchmarked asset valuation to make the allocation for each company.

50. In each case, the RCV allocation for a company's network plus activities would be calculated as the value of its wholesale wastewater RCV at 31 March 2020, minus the amount of this RCV that is allocated to sludge. Under Ofwat's approach to the focused RCV allocation for wastewater, the RCV allocated to network plus activities is not intended to reflect any similar economic value concept to that used for sludge; it is simply calculated as a residual.

51. The third approach above would make use of estimates from different companies. For example, it might involve a cross-company econometric model of sludge asset valuations that takes account where possible of regional factors affecting sludge costs through explanatory variables in the model. Such an approach could reduce the risks of inaccuracy and inconsistency from reliance on a single source for a highly subjective assessment, and might be argued to better reflect competitive or market-based valuations than focusing on each company in isolation. However, such an approach would increase complexity and might not take full account of the local or company-specific factors that are relevant to the economic value of each company's actual assets.

Costing assets on a hypothetical efficient new-build basis

52. The starting point for the sludge asset valuation is an estimation of the efficient costs of rebuilding or purchasing the assets needed to provide an equivalent set of services

as can be provided using the company's actual sludge assets. To this various adjustments then need to be made to produce an estimate of the economic value of the company's actual sludge assets.

53. This section considers the estimation of the costs of sludge assets on a hypothetical efficient new-build basis and takes the following issues in turn:

(a) Boundary for sludge assets.

(b) Sewage treatment site configuration and output.

(c) Sludge treatment site configuration.

(d) Site-level valuation.

(e) Sludge processes to be costed.

(f) Types of costs to be included.

(g) Choice of technology and processes.

(h) Assets owned outside the appointee.

(i) Capacity of sludge assets to be costed.

(j) Capacity and volume measures.

(k) Land valuation.

(l) Information sources on new-build costs.

Boundary for sludge assets

54. For the purposes of the valuation exercise, companies should make a valuation of the assets of the appointed company that are reasonably allocated to sludge transport, sludge treatment or sludge disposal within the latest version of Ofwat's regulatory accounting guidance. [1]

55. It was not within the scope of our project to review the regulatory accounting guidance on the definition of sludge assets and activities. Nonetheless, we note that there may be benefit in further clarity in the regulatory accounting guidelines in relation to blending/mixing/storage/consolidation tanks where sludge is received and then moved to another site with no further treatment. This operation may be intermittent and dependant on operational needs. We have assumed that these tanks are excluded from the definition of sludge assets. If they were to be included in the definition of sludge assets, rather than wastewater network plus assets, then this would mean a larger number of sites included within the sludge boundary.

[1] As of 27 January 2017, this was "*RAG 4.06 – Guideline for the table definitions in the annual performance report*", dated 17 August 2016.

Sewage treatment site configuration and output

56. For the purposes of the valuation exercise, companies should assume that the business which owns the sludge assets provides services to the appointed wastewater company on an arms-length basis.

57. The volumes and composition of sludge produced by the appointed wastewater company's sewage treatment works should be taken as given, other than for any changes over time that are reasonably forecast.

58. The location of the appointed wastewater company's sewage treatment works should be taken as given, other than for changes that are reasonably forecast as a consequence of the implementation of the company's confirmed strategy for its sewage treatment sites (e.g. major site re-organisation that is underway or confirmed).

59. The consideration of the efficient way to provide sludge services should not include any hypothetical or speculative re-configuration or re-organisation of sewage treatment works.

Sludge treatment site configuration

60. There is a separate question as to whether the valuation should be done by making an assumption that all existing sludge treatment sites are fixed in terms of location and capacity, or whether the valuation should be done on a more hypothetical and forward-looking basis, which takes account of the potential for greater efficiency through re-configuration and re-organisation.

61. The economic value concept that we are using points towards an unconstrained forward-looking valuation. If we knew that the existing configuration was very inefficient, we would be concerned as to what the outcome of the valuation would represent if it were made under an assumption that existing sludge treatment sites are fixed. Such an assumption would lead to over-estimation of the economic value of existing assets, because it would overlook the inefficiency in the site configuration relative to what would be expected from a hypothetical new entrant.

62. However, knowledge and information on the optimal configuration is not readily available. And what is optimal will change over time, not least as the regulatory approach to sludge evolves and opportunities for greater inter-company trading grow. Information is discovered and revealed as companies try different things and this cannot be reproduced through desk-based studies.

63. There seems a serious risk that a valuation process that requires companies to start with a blank sheet of paper and work out the optimal configuration for their sludge treatment sites could be compromised by the informational limitations and subjectivity inherent in such an exercise. There is potential for large estimation errors from such a theoretical exercise, which could dwarf the inaccuracy from overlooking any inefficiency that has arisen in the existing site configuration.

64. In this context, our proposed approach is as follows:

(a) Companies should provide a valuation that takes as given the site configuration that they have or expect to have at the date used for valuation purposes.

(b) Companies should then consider whether there are grounds to make an adjustment to account for identified inefficiency in the configuration assumed under (a) above. Any adjustment should be supported by evidence of what would differ and its implications for the valuation of existing assets.

65. Starting with the existing sludge treatment sites provides a practical benefit and avoids the exercise becoming too imaginary. It will then be for companies to consider whether any form of adjustment under (b) is appropriate.

66. Where a company has confirmed plans to re-organise its sites and/or the volumes that go through them, this should be taken in to account under (b) above. In addition, companies should also consider the implications of their long-term strategy for sludge management for potential adjustments under (b) above.

67. We should recognise that under a competitive market, it is unlikely that any supplier would have the theoretically optimal configuration at any given point in time to serve current customer demand. On that basis, if a company makes a case for an adjustment, it is not sufficient to show some sub-optimality relative to theoretical perfection. The company should explain why there is a significant difference in efficiency compared to a realistic scenario for a hypothetical new entrant providing a full set of sludge services in a dynamic and uncertain world.

Site-level valuation

68. Following on from the point above, we propose that companies make and present a separate valuation for each of their sites. This would support Ofwat's review of companies' valuations by enabling it to make comparisons across sites of the same company and comparisons between companies.

69. For smaller sites (e.g. sites that carry out a limited set of processes and have relatively low asset values) it may be better to group these into a single category which is taken together for reporting and estimation purposes.

70. A site-level valuation will not be appropriate for all of the assets that fall with the scope of sludge activities. Some assets, such as transport assets, would not naturally be associated with specific sites. It would be better to take these separately rather than attempting to capture them within site-level breakdowns.

Sludge processes to be costed

71. When referring to the valuation of a company's "sludge assets", we do not mean that the valuation exercise should be carried out by valuing each individual asset and then aggregating the values across all sludge assets. The valuation should capture the value of the sludge assets, but this does not mean that the best way to make the valuation is by starting at the asset level (e.g. specific pieces of plant and machinery).

72. We have already suggested above that companies produce a site-by-site valuation. Within each site, there are a range of ways in which the assets on the site could be further categorised for the purposes of estimation and comparison:

(a) Categorisation of each site based on the dominant asset at the site (e.g. a digester site).

(b) Categorisation by processes at the site (e.g. thickening, primary digestion).

(c) Categorisation by specific types of plant and machinery.

(d) Categorisations used for fixed assets for accounting purposes which reflect differences in asset lives (e.g. civil works vs mechanical and electrical equipment).

73. There are trade-offs in terms of the level of granularity. Using the dominant-site asset could reduce the work-load for the valuation exercise, as less detail is required and higher-level cost curves could be used. However, this could prove problematic when it comes to thinking of the modern efficient technology and capacity requirements and may overlook or over-simplify the activities and work needed at a site. And the categorisation may be too high-level to enable reasonable comparisons across sites and companies. At the other extreme, a valuation at the level of specific pieces of plant and machinery may be time-consuming and not fit well with a valuation approach that should capture modern efficient assets that may differ significantly from actual assets.

74. Our view is that an intermediate approach would make sense, providing greater transparency and opportunities for comparisons between sites and companies. Furthermore, if the regulatory objective is to put the regulated sludge activities on a more commercial footing, it would make sense for the categorisation to be made on the basis of sub-services or processes that transform inputs into outputs (and where the output to one process is an input to another), rather than on the basis of asset categories.

75. Companies' existing asset data and cost information is, as a minimum, likely to be at the subsite/sub process level. Although all companies will have gaps in specific asset records, this seems a realistic level that companies can initially value at and then aggregate.

76. Our experience is that companies have capital cost curves at a process (e.g. thickening) and asset level (e.g. a pump), and can build up capital costs using a combination of these. They may also have cost curves at a dominant asset level. However given the differences between site configurations, they are likely to have to go to a process level to build up costs by process for any large site, rather than rely on cost curves at the dominant asset level.

77. Our proposal is that the processes would be along the lines set out in Table 1 overleaf. Our approach to defining each process is through the definition of a series of steps taken to achieve a particular output / product. In addition to the specified processes, we propose that there is a category for "other" which could include more bespoke assets (e.g. major sludge pipelines or offsite storage assets that are difficult to fit in to the specified process categories).

Table 1 Categorisation of processes for consultation

	Process category	Process undertaken	Product(s) from the process	Use	By-products
1	Thickening	Transforming raw sludge into a product <10% dry solids	Liquid product typically taken for further processing	Typically goes for further processing (options are process stages 2, 3, 4, 5, 6)	Liquors Screenings
2	Raw / thickened sludge de-watering	Transforming raw or thickened sludge into a product >10% dry solids	Cake product typically taken for further processing	Typically goes for further processing (options are process stages 4, 5, 6)	Liquors Screenings
3	Raw / thickened sludge de-watering with liming	Transforming raw or thickened sludge into a product >10% dry solids	Cake product which is conditioned through lime addition to enable application to land	Spread to land (nutrient value)	Liquors Screenings
4	Raw sludge incineration	Combustion of sludge to produce energy	• Electricity • Heat	• Electricity used to power site and/or sold • Heat used in process	Ash Emissions to air Screenings
5	Sludge pre-treatment	Advanced anaerobic digestion processes (e.g. thermal hydrolysis)	• Pre-treated sludge	• Hydrolysed or other sludge for digestion (process stage 6)	n/a
6	Primary anaerobic digestion	Transforming sludge (all dry solids) into biogas and digestate	• Biogas which has high energy content • Produces liquid digestate	• Biogas used for energy (see process stage 7) • Typically goes for further processing (options are one or more of process stages 8, 9, 10, 11)	n/a
7	Energy generation	Combustion of biogas with gas engines to produce electricity and heat, combustion of biogas in boilers to produce heat, biogas upgrading to produce biomethane. Includes any gas treatment such as siloxane removal	• Electricity • Heat • Biomethane	• Electricity used to power sites with excess sold • Heat used in process (pre-treatment / primary digestion) • Biomethane exported to natural gas network	Emissions to air
8	Secondary digestion	Transforming digestate into conventially treated liquid digestate	Conditions liquid digestate for pathogen removal	Conditioned liquid digestate which typically goes for further processing (process stage 9) or can go to land spreading (nutrient value)	Emissions to air

	Process category	Process undertaken	Product(s) from the process	Use	By-products
9	Digestate de-watering / drying	Produces cake (solids content dependent on technology)	Digestate cake product	Might require conditioning (process stage 10) or can go for land spreading (nutrient value), other land application or incineration (process stage 11)	Liquors from dewatering
10	Digestate Conditioning	Transforming dewatered digestate into sludge cake suitable for land spreading, including mixing with green waste or other	Conditioned digestate cake	Cake product for land spreading (nutrient value), other land application or incineration (energy recovery)	
11	Digestate incineration	Combustion of digestate to produce energy	• Electricity • Heat	• Electricity used to power site and/or sold • Heat used in process	Ash Emissions to air
12	Transport (tankering)	Movement of liquid sludge between sites or to recycling or disposal site	Transport service (tankers)	Typically goes for further processing	
13	Transport (raw cake)	Movement of raw sludge cake between sites or to recycling or disposal sites	Transport service (trucks)	Typically goes for further processing	
14	Transport (digestate cake)	Movement of digestate or treated sludge cake to recycling or disposal sites	Transport service (trucks)	Typically goes to land or disposal	
15	Liquor Treatment	Transformation of untreated liquor to treated liquor for discharge to network plus business or to watercourse	Treated liquor	For discharge to network plus business or to watercourse	

Note (1): the table should only cover thickening activities/assets to the extent that these form part of Ofwat's regulatory definition of sludge activities.
Note (2): there are some further potential processes, assets and activities not covered in this table such as reception, storage, screening and grit removal. We propose that these are allocated to the primary processes from the table that they serve rather than through definition of further processes.

78. The mix of processes used at a site will depend on the approach to sludge management taken at the site. Drawing on our categorisation of processes above, we provide examples in Table 2 of what the typical processes at a site might be depending on the type of site, as represented by the dominant process. These are examples only and not intended to be comprehensive; they show how the processes can vary between sites and also how different types of site can have processes in common.

Table 2 Typical site processes for examples of sites categorised by dominant process

Typical sites by dominant process	Typical site processes
Liming site	• Raw / thickened sludge dewatering with liming
Sludge dewatering centre	• Raw / thickened sludge dewatering
Conventional anaerobic digestion site	• Thickening • Primary anaerobic digestion • Energy generation • Digestate dewatering • Secondary digestion or digestate conditioning
Advanced anaerobic digestion site (e.g. thermal hydrolysis)	• Thickening • Raw / thickened sludge dewatering • Sludge pre-treatment • Primary anaerobic digestion • Energy generation • Digestate dewatering • Liquor treatment (note that liquors from advanced anaerobic digestion are stronger)
Raw sludge or incineration site	• Raw / thickened sludge dewatering • Raw sludge incineration • Energy generation

79. There remain concerns that any attempt to structure companies' valuation of their existing assets, taking into account their views on modern and efficient assets, into a set of standardised categories could cause problems for those companies whose circumstances do not work with a one-size-fits-all approach. As a first mitigation, we would hope that a focus on the types of processes above, rather than a focus on asset types, helps to limit this concern. Nonetheless, there may well be issues and concerns with the categories above, and we suggest that Ofwat seeks to test and refine the categorisation in consultation with companies.

Types of costs to be included

80. The estimates of the costs of a hypothetical new-build process should cover all the costs that would be incurred to enable the process to be ready to function and contribute to service delivery. These could include, for example:

(a) Feasibility costs.

(b) Design costs.

(c) Planning costs.

(d) Land purchase.

(e) Purchasing plant, machinery and equipment.

(f) Contractor project management.

(g) Internal project management overheads.

(h) Construction costs.

(i) Commissioning and testing.

(j) Any other capitalised costs incurred during construction.

(k) An allowance for the costs from shared services (e.g. procurement, human resources (HR), finance) that would be reasonably allocated to the development and commissioning of the asset and which it would be reasonable to capitalise as part of the book value of the asset in statutory accounts.

81. In respect of the allowances for shard services, item (k) in the list above, this should be captured somewhere in the valuation, but it will be important for companies to ensure that it is not double-counted (e.g. once through a process- or site-level build up and once through a company-wide allowance for shared services).

82. There will be uncertainty about the costs of any specific project. The aim should be that the estimates used for the sludge asset valuation should represent a central estimate or expectation value.

83. One potential approach for the asset valuation process would be to require each company to provide a breakdown of their estimated costs into various different cost categories, along the lines of those highlighted above. This would add substantially to the information burden on companies and our view is that it would not be worthwhile (the breakdown by process is more useful and a breakdown by both process and cost type would produce a large number of categories). However, companies may choose to provide such information if they consider it useful for supporting their estimates and calculations. Furthermore, there would be opportunities for Ofwat to request cost breakdowns from companies in specific cases where it has concerns over the figures provided.

Choice of technology and processes

84. Technological developments, innovation and changes in external costs and market prices will affect the way that a wastewater company organises its sludge activities. Building on the categorisation of processes above, we can envisage changes at two levels:

(a) Changes to the technology that a company uses for a particular process at a site (e.g. change of technology for thickening tanks)

(b) Changes to the set of processes that the company uses at a site (e.g. expansion of processes to include energy generation).

85. The valuation exercise raises questions about the choice of technologies and the choice of processes to be assumed for the new-build costing, which are similar to the question about sludge site configuration discussed above.

86. For example, if we knew that the existing set of processes at a site were very inefficient compared to alternatives that are now available and in use, we would be concerned as to what the outcome of the valuation would represent if estimates were based on the replacement costs with a modern equivalent version of the existing processes. Such an approach would lead to over-estimation of the economic value of existing assets, by overlooking the inefficiency in existing processes relative to what would be expected from a hypothetical new entrant.

87. However, knowledge and information on the most efficient technology and processes for a company to use is not readily available and it will change over time. Companies might have views about what approaches are best, based on current information, but these are subject to uncertainty and differences of opinion. Different companies may come to accept new technologies at different points in time. Furthermore, there may be local issues that mean that the optimal solutions at one location are not necessarily the same as those elsewhere.

88. It is useful to distinguish between the following scenarios:

(a) The existing technology and/or processes at a site are clearly obsolete or inefficient, based on the information available today.

(b) The existing technology and/or processes at a site are arguably outdated and less efficient than alternatives, but it would still be reasonable to install these today. For example, there may be reasonable differences of opinion amongst technical and commercial professionals, perhaps due to uncertainty about new technologies that are not fully tried and tested or due to concerns about future revenue streams over the asset life (e.g. due to uncertainty about future energy prices and subsidies).

89. Whether or not a technology or process is still marketed by suppliers and commissioned by wastewater companies would be relevant to the assessment of which of these categories it falls in, although there also may be local factors that affect the choices at a site.

90. We propose that companies should avoid making a valuation on the basis of technology or processes that are within the category of (a) above. For category (b), we propose that companies have discretion and take a reasoned judgment based on the weight and quality of information they have about the costs, capabilities and superiority of any alternative technologies and processes.

91. In doing so, companies should take account of the risks that the valuation is compromised by seeking to produce estimates for technologies and processes that the company is unfamiliar with and may have relatively poor information on. These risks may be greater than the accuracy risks from making the assessment on the basis of an existing and familiar technology which is perceived to be somewhat less efficient than more modern approaches.

92. We suggest that companies confirm the processes on their sites and the assumed processes used for the new-build costing, if these are different.

93. Companies should also explain their reasoning for their assumption about the technology of the new-build assets, whether it is the technology they currently employ or a different one. We would expect them to refer to the approach they take at other sites, their current standards, their approved plans for the future and their long-term sludge strategy, as well as the informational constraints they may face.

94. There is a further question as to whether companies should also be required to provide a valuation on the basis of existing technology and/or processes if they choose to make their valuation by assuming an alternative for the new-build costs. This could help provide information on the materiality of this assumption for the overall valuation. However, this would increase the work required of companies and there is a risk that it could skew the valuation excessively in favour of existing technologies and processes as this would lower the requirements on companies for information provision.

95. We are concerned that the valuation could be compromised by speculative assumptions on alternative technologies or processes that a company may be unfamiliar with, which could lead to greater inaccuracy than making a costing on the basis of a similar technology which may be somewhat less efficient. There may be a case for a company making a new-build costing based on its existing technology and processes and then proposing a high-level adjustment for perceived inefficiency.

Assets owned outside the appointee

96. The sludge asset valuation is a means to allocate the RCV of statutory wastewater undertakers between sludge and network plus activities. The valuation should be made for the sludge assets that are owned by the company subject to the instrument of appointment. The valuation should not cover the economic value of assets that are not owned by the statutory wastewater undertaker (e.g. assets owned by other companies within the same corporate group).

97. The exclusion of these assets does not mean that these assets can and should be ignored from the valuation exercise.

98. The valuation that is needed at each site is a valuation that starts with consideration of a modern and efficient approach to sludge management at that site. Such an approach might involve using assets (e.g. energy generation assets) of the nature that are currently used at the site but which form part of its non-appointed business.

99. In this case, we propose that the valuation is made by first including all elements of the new-build costs of an efficient approach to sludge management at the site, and then

making a separately reported deduction for the new-build costs corresponding to any actual assets at the site which are not owned by the statutory wastewater undertaker.

100. This two-step process should help enable more like-for-like comparisons of the assumed new-build costs across companies, as these might otherwise be affected by variation across companies in the extent of assets that are used for sludge activities but not owned by the appointed company. We would not want the opportunities for comparisons across sites and companies to be compromised by such variation.

101. Furthermore, this process should help reduce the risk that existing assets funded by the RCV are undervalued because the assets that are more closely associated with commercial revenue generation (e.g. energy) lie outside the appointed business.

102. Where there are existing assets that are outside the appointed business, and which would not form part of an efficient approach to sludge management at the site, these can be ignored for the purposes of the valuation.

Capacity of sludge assets to be costed

103. In estimating the hypothetical new-build costs at a site, companies will need to consider what capacity to use for this costing. We provide some guidance in this sub-section on what the capacity used for the sludge asset valuation should represent and how it should relate to the existing capacity at a site. We consider potential capacity or volume measures in the next sub-section.

104. We propose that, as a starting point, the capacity for the hypothetical new-build costs at a site is calculated by reference to the expected capacity of the actual processes at the site at the effective date for the valuation (e.g. as at 31 March 2020). We propose that each company should report its forecasts of actual capacity at that date. The company should then consider whether any of that capacity is in excess of that which will be needed and should, in effect, be impaired as part of the sludge asset valuation process.

105. In considering the capacity of the existing processes, a distinction can be drawn between:

(a) Capacity that the company expects to use on a day-to-day basis, either in relation to sludge produced by its own wastewater network plus activities or as part of the provision of sludge services to other parties.

(b) Capacity that is not expected to be used on a day-day-to basis but which plays a role in maintaining services and meeting obligations. Such capacity can be seen to provide redundancy, back-up or headroom. This may include capacity that is from mothballed assets that are maintained so that they can be used to meet potential operational requirements in the future.

(c) Genuine excess capacity which is beyond the level that would be planned for the future based on the latest forecasts about current and future requirements. This could include, amongst other things, the capacity of abandoned or decommissioned processes for which there is no identified need to maintain or renew the capacity.

106. Companies should include the capacity for types (a) and (b) within the scope of the hypothetical new-build costing exercise as this capacity has operational requirements.

107. Companies should exclude the capacity from type (c) from the hypothetical new-build costing. A separate allowance for the resale, re-use or scrap value of such excess capacity (if any) should be included as part of the economic value of the existing sludge assets.

108. As highlighted above, we distinguish mothballed assets from those assets which have been abandoned or de-commissioned. For the purpose of the valuation, mothballed assets would be those which are maintained such that they can be brought back into service future (e.g. to allow for uncertainty in demand or provide additional protection against operational issues at other sites) and can be classified as capacity required for resilience. Abandoned or decommissioned assets would be defined as those for which there is no intention to bring them back into service and do not contribute to resilience, although they may have some residual value.

109. Where assets have been mothballed, but are expected to be retained in order to keep open the option of use in the future, the estimated costs of bringing them back into service could be deducted from the estimates of new-build costs if they are significant.

110. Where there is land attributed to sludge activities that is in excess of what is needed, we propose that the value of this land could be excluded from the asset valuation altogether and effectively left as part of the wastewater RCV (see separate sub-section further below on land).

111. The capacities of some processes at a site might be limited by a bottleneck (e.g. the thickener capacity on a digester site may limit the digester throughput) or by specific environmental permit conditions (e.g. vehicle movement restrictions). The appropriate approach to determining capacity would depend on the circumstances:

(a) If the circumstances are that if the bottleneck were to be removed the company would then have excess capacity at the site with no identified purpose or value, then the relevant new-build capacity should reflect the scenario in which the bottleneck remains. This may mean that there are some processes for which the assumed new-build capacity would be lower than existing capacity. The capacity of any existing process that is treated as unnecessary on a new-build basis should be valued separately according to estimates of its resale, re-use or scrap value (if any). This may mean that zero or little economic value is attributed to the capacity at the site that is beyond that at which the bottleneck acts as limiting factor.

(b) If the bottleneck is more of a temporary issue, which the company expects to resolve at some point in the future (e.g. given forecast changes in throughout or to provide some additional resilience against operational problems), then the relevant new-build capacity should be taken as the capacity that would exist if the bottleneck were to be eliminated. In this case, the costs of resolving the bottleneck affect the economic value of the actual assets; these costs could be deducted from the estimated new-build costs for the site if they are significant.

112. Similar issues may arise in cases where the capacity of an existing process or asset at a point in time is lower than the capacity previously achieved or planned. There may also be cases where actual assets do not perform as well as expected due to operational problems or asset degradation. We propose the following approach:

(a) If, despite actual capacity being lower than previously achieved or planned, there is no identified need to restore or increase the capacity, then the assumed new-build capacity should reflect actual capacity available.

(b) If the reduction in capacity of the actual asset is a temporary issue that the company expects to resolve in the future, then the assumed new-build capacity should reflect the capacity expected to be available at the site over the longer term. In this case, the costs of restoring the capacity affect the economic value of the actual asset; these costs could be deducted from the estimate of the new-build costs if they are significant and if they go beyond normal maintenance and repairs.

113. The capacity assumptions used for the new-build costing could vary between companies due to differences in their asset standards (e.g. digester retention time) and attitudes towards risk. This could affect any comparisons made, across sites or companies, of new-build costs on a unit cost basis. This issue does not seem straightforward to address. For instance, imposing common assumptions or approaches to risk could be at odds with a company-led valuation exercise and could involve significant work to define the assumptions to be used. Instead, we suggest that companies use their normal practices and that Ofwat recognise that such differences are a potential source of discrepancy in the implied unit cost estimates between companies. Ofwat could then ask companies follow-up questions if material concerns or inconsistencies arise, and companies could explain in the supporting information to their valuation any cases where they consider their approach likely to be significantly out of line with that of other companies. Alternatively, Ofwat could require companies to provide, in support of their valuations, the assumptions or standards affecting their assumed capacity (e.g. retention time), though a balance would need to be struck between the information requirements and the added value of requiring this information upfront.

114. Any adjustments from existing levels of capacity should be justified by the company. We would expect the capacity needed by each company to reflect the volumes of sludge produced at their sewage treatment sites and their current and planned approach to the management of these volumes (e.g. including existing arrangements with third party providers). Other than in exceptional circumstances, we would not expect a company to take account of speculative decreases to its capacity needs which may arise if, in the future, it decides to procure more sludge treatment and disposal services from third party providers rather than using their its own assets to carry out activities in-house. Similarly, it would seem reasonable for a company to exclude from the new-build costing any excess capacity that has no identified need at present and for which the possibility of use in the future to supply third parties is, at best, speculative.

Capacity and volume measures

115. To help support Ofwat's review of companies' valuations, including comparisons between companies of estimates feeding in to their valuations, we propose that

companies report on a consistent basis the assumed capacity of the processes that they have costed.

116. This will require guidance on the capacity and volume measures to be used. There is likely to be some overlap with separate work that Ofwat is doing on the volume measures used for sludge cost assessment and the volume measure used in the denominator for the planned average revenue control for sludge, but the purposes are different and the appropriate approach may vary across these work-streams.

117. There are a number of ways in which companies may think about capacity and volumes:

(a) The maximum processing capacity over a period of time (e.g. an hour or a day).

(b) The design processing capacity (e.g. how much sludge is intended to be treated by the process at the point of its design).

(c) The actual site throughout (e.g. how much sludge was treated by the process in a given time period). This could be higher or lower than design.

118. We propose that companies make the valuation on the basis of design processing capacity, from a forward-looking perspective: what would be planned for the site on a hypothetical new-build basis. This would draw on, but not be constrained by, the annual throughput that was originally planned for the site. The capacity assumed should provide operational resilience and enable the company to accommodate uncertainty in future annual volumes and fluctuations or peaks in volumes throughout the year.

119. The common unit for the measurement of sludge capacity is TDS (or tDS) per annum. This is "tonnes dry solids" and refers to the amount of sludge being processed assuming the removal of all of the water. For some processes, TDS may not be appropriate (e.g. for vehicles moving liquid sludge, cubic metres is more appropriate as the volume is of greater relevance). We envisage that, for the purposes of the valuation, appropriate capacity measures are identified for each of the separate processes to be costed (the same measure may be used be for several processes).

120. The capacity measures used for each process should generally relate to the input to that process (e.g. untreated sludge fed into a digester) rather than the output of that process or the final products arising from sludge activities (e.g. digestate cake).

121. There is a specific issue relating to energy generation capacity. Energy generation may take different forms. For instance, there might be a combined heat and power (CHP) energy generation system, for which we could measure capacity in megawatts of electrical output or, in cubic metres or megawatts per year of bio-methane. Our proposal to resolve this issue is to use megawatts thermal input (MWth) as the unit of measurement to allow for the different types of energy assets to be captured. How this is then used (e.g. boiler, CHP, gas to grid) is up to the wastewater company. This should exclude assets which are captured elsewhere which may use thermal energy (e.g. incinerators, digesters etc).

122. We set out initial proposals for capacity measures in Table 3. These may require further refinement following consultation with stakeholders.

Table 3 Potential capacity measures by process (starting point for consultation)

Process	Potential capacity measure
Thickening	Tonnes dry solids (TDS) per year
Raw / thickened sludge de-watering	Tonnes dry solids (TDS) per year
Raw / thickened sludge de-watering with liming	Tonnes dry solids (TDS) per year
Raw sludge incineration	Tonnes dry solids (TDS) per year
Sludge pre-treatment	Tonnes dry solids (TDS) per year
Primary anaerobic digestion	Tonnes dry solids (TDS) per year
Energy generation	MWth input
Secondary digestion	Tonnes dry solids (TDS) per year
Digestate de-watering / drying	Tonnes dry solids (TDS) per year
Digestate Conditioning	Tonnes dry solids (TDS) per year
Digestate incineration	Tonnes dry solids (TDS) per year
Transport (tankering)	Cubic metre capacity across fleet
Transport (raw cake)	Cubic metre capacity across fleet
Transport (digestate cake)	Cubic metre capacity across fleet
Liquor Treatment	Cubic metres of liquor treatment per year

123. We propose that companies report both the capacity of their existing assets and the capacity of these assets assumed on a new-build basis. The second of these would form the basis of the new-build costing, while the first would be a useful reference point. It would also be useful for companies to report forecast volumes (e.g. forecasts of average annual throughput in TDS), as comparisons between this and design capacity can provide information on differences between companies in the extent of headroom and risk assumed.

Land valuation

124. To be consistent with our conceptual approach to economic value, the sludge asset valuation should capture the land values on a hypothetical new-build basis: the costs of acquiring land at open market prices for the purpose of engaging in sludge activities.

125. We take two issues in turn below.

(a) The area of land to assume for the sludge asset valuation exercise.

(b) The valuation of this land.

126. On the first point, the starting point would be the amount of land at the company's existing sludge sites (or reasonably allocated to sludge activities in the case of collocated sites). But this may exceed the amount of land needed on a hypothetical new-build basis.

127. We propose that any land at a company's sludge sites that is in excess of the requirements identified for sludge activities on a new-build basis could, at the company's discretion, be allocated to the wastewater network plus business rather than the sludge business and therefore excluded from the asset valuation for sludge. This proposal is made on the assumption that the RCV allocation between wastewater network plus and sludge will not affect the way that the proceeds from land sales or business sales involving land are treated for regulatory purposes.[2] Ofwat confirmed to us that this assumption is appropriate.

128. The allocation of land between sludge and wastewater network plus (or other parts of the appointed company) for the purposes of the sludge RCV allocation exercise should be made on a consistent basis to the way that land is to be treated for regulatory accounting and transfer pricing purposes. For instance, it would not be appropriate if a company was subsequently to expand its sludge business by suppling other companies or wider waste markets using processes located on land that had been allocated to network plus and which the sludge business uses at no cost. This could amount to a form of cross-subsidy to the sludge business from the network plus business.

129. We propose that the sludge RCV allocation exercise goes hand in hand with an allocation of each company's land to sludge.

130. We propose that companies report an estimate of the size (in hectares) of each of the sites within their sludge business, and set out the land requirements assumed for the purposes of the sludge asset valuation. The land requirements for the sludge asset valuation would include (i) estimates of land required on a new-build basis and (ii) any additional land which the company wishes to retain in its sludge business. Both (i) and (ii) should be valued and included within the calculation of the economic value of the company's sludge assets. This land would be treated as part of the sludge business going forward.

131. If a company excludes from the sludge asset valuation some of the land on its existing sludge sites (including co-located sites), on the basis that it is considered unnecessary for its sludge activities, that land should be formally allocated for regulatory purposes to wastewater network plus from that point onwards. If the company subsequently decides to use that land for sludge activities (e.g. because market opportunities develop which it had not anticipated), then the sludge business should pay a reasonable transfer price to network plus for that land. This could, for example, be based on an annual lease charge, calculated by reference to market prices for similar land. Alternatively, it may be possible to arrange for a one-off transfer of the land value between network plus and sludge: if the value of the land were £X, then the wastewater network plus RCV could subsequently be reduced by £X, with this value of £X treated for regulatory purposes as part of the post-2020 investment of the sludge business. Either way, the costs of the land should be captured as part of the costs reported for the sludge business under the regulatory accounting arrangements.

[2] Licence condition K includes provision relating to the treatment of proceeds from the sale of protected land, which reflect Ofwat's policy that these are to be shared 50:50 between customers and shareholders. We assume that these provisions will continue to apply and that they will not be affected by the sludge asset valuation and RCV allocation exercise.

132. We now turn to the valuation of the land that is allocated to sludge.

133. It is possible that some of the land owned by a wastewater company and used for sludge activities is significantly more valuable than the land that could be used by a new entrant to provide the same sludge services on an efficient basis. For example, the land owned by the wastewater company and used for sludge activities may have potential for a future change of use and/or development, which could increase its value beyond that which a new entrant would need to pay to acquire suitable land. In this context, there is a question as to how any premium in the value of the company's existing land, compared to the efficient new entrant land costs, should be treated.

134. We propose that any premium in land value is allocated to the wastewater network plus price control rather than to sludge price control. It does not seem consistent with the aims of the sludge RCV allocation for sludge price controls and resultant sludge service prices/charges to reflect the costs of buying land at an unnecessary premium.

135. As for the treatment of surplus land, discussed above, this proposal is made on the assumption that the RCV allocation between wastewater network plus and sludge will not affect the way that the proceeds from land sales or business sales involving land are treated for regulatory purposes.

136. On this basis, the valuation of land should not focus exclusively on the valuation of the specific plots of land that a wastewater company's existing sites are on: there may be sites with relatively high land values which do not have any offsetting advantage from an operational perspective. The valuation should consider whether lower-cost land could be used if starting on a hypothetical new-build basis. Nonetheless, there are constraints to this exercise. We specified above that the location of sewerage treatment sites should be taken as given and this may constrain the opportunities for land acquisition (especially if co-location is considered the efficient approach on a new-build basis). Furthermore, insofar as the valuation is made taking the configuration of the existing sludge treatment sites as given, the opportunities for land acquisition would be constrained by land that is compatible with that configuration.

137. There are a number of potential information sources that companies may consider for the land costs faced on a hypothetical new-build basis. The following are examples, and are not intended to be comprehensive:

(a) Companies might use information from recent market transactions involving land that they have been engaged in as either buyer or seller.

(b) Companies might seek input and/or data from agents involved in land and property transactions.

(c) Companies might take land value estimates for sludge sites that they have made in the past and use estimates of changes over time in the market value for the relevant type of land to produce a roll-forward estimate for the sludge site land value at the time of the valuation date. But this would need to take account of whether lower-cost land might be available on a new-build basis.

(d) Companies might look at figures produced by the Department for Communities and Local Government,[3] which provide high-level estimates for industrial and agricultural land value across different regions in England. It may then be necessary to consider adjustments for more specific factors that affect the value of land available for sludge activities (e.g. contamination).

138. It would be useful for companies to report the estimated land values that they have used for each site as a separate item in their calculations. This would allow Ofwat to make more like-for-like comparisons between companies as land values may be a source of uncontrollable cost difference between companies (though land values and their determinants will also affect the sludge management strategy so cannot be fully separated from the choice of asserts and technologies).

139. We propose that companies provide a breakdown of their land valuation, which reports the assumed unit cost of land acquisition on a new-build basis (on a £ per hectare basis) alongside their assumption on the amount of land required for their sludge activities at each site (hectares).

140. It would be useful for companies to report an estimate of the area (hectares) and value of the land of their specific sludge sites under existing use/planning permissions, in addition to their estimates of the value of the land faced on a new-build basis. Previous Ofwat guidance was that existing use valuation should be the basis for the majority of land.[4] This might require an allocation of land values between sludge and other activities and, within sludge, between sites.

Information sources on new-build costs

141. The starting point for the valuation exercise is an efficient new-build basis, which means that the information needed is not primarily the information on gross or depreciated asset values in each company's accounts. Instead companies will need to draw on a range of evidence and knowledge to estimate costs. Whilst we did not seek to develop any detailed guidance for companies on information sources, we make some comments on this below.

142. Companies may choose to produce estimates of capital costs using a series of "cost curves". These may be based upon historical experience of project delivery and be company-specific, and will take account of overhead costs which are specific to the company. In addition, companies could seek to draw on input from technical advisors who can bring a wider breadth of cost knowledge to bear on the valuation or on available data sources on costs.

143. We identified a number of potential issues with using cost curves:

(a) **Small number of data points**. The accuracy of the cost curve for a given technology will be dependent on the number of times that type of technology has

[3] Department for Communities and Local Government (2015).
[4] Ofwat (2008) *PR09 business plan information requirements part C3: Company guidance information requirements v1.0*, page 7.

been deployed at the company (or by its advisors or by information available from technology suppliers), as this will determine the number of points on the curve.

(b) **Outliers**. Small or large installations may be particularly difficult to cost, especially where they rely on extrapolation from existing data points rather than interpolation between them.

(c) **New technology.** Where costing of new technology is needed there may be a limited numbers of points on the cost curve, which may lead to a requirement to undertake an engineering build-up of new curves. Where new curves are reliant on the availability of supplier quotations/estimates, they may be difficult to complete.

(d) **Boundaries of costs to be included**. There may be inconsistences between the categories of costs that need to be included for the sludge asset valuation exercise and those which are included in cost curves. Companies may need to make adjustments to ensure that estimates from cost curves are directed at the costs that are relevant for the sludge asset valuation exercise.

(e) **Accuracy of estimating tools**. Cost curves may still have a high degree of inaccuracy as exact circumstances maybe different.

(f) **Site-specific factors**. There may be specific issues at a site which mean that the costs are significantly higher or lower than indicated by cost curves (e.g. due to planning constraints or topography).

(g) **Cost inflation.** Cost curves based on historical data may not provide good estimates of new-build costs if there has been significant cost inflation (or deflation). Companies may need to make adjustments, or apply assumptions, when making use of historical cost data.

144. Companies should give due consideration of these issues, and their materiality, as part of their valuation.

Adjustment for remaining economic life of existing assets

145. One of the adjustments that is needed as part of the calculation of the economic value concept that we are using is an adjustment for the age and condition of the wastewater company's actual assets, relative to the hypothetical new-build assets. This section takes the following issues in turn:

(a) The nature of the adjustment for age and condition.

(b) The use of straight line depreciation techniques.

(c) Assumptions on asset lives.

(d) Further guidance on calculation of remaining life.

(e) Use of cumulative depreciation figures from statutory accounts.

(f) Assets that are fully depreciated in the statutory accounts.

(g) Alternatives to straight line depreciation to improve accuracy.

146. In the sections below we use the term "asset" as something of a shorthand. We do not necessarily mean a single asset (e.g. a single piece of equipment that is recorded separately in the asset register). Instead, we may mean a group of assets (e.g. the assets comprising a process).

The nature of the adjustment for remaining economic life

147. Our approach to the estimation of the economic value of a company's sludge assets involves starting with an estimate of the costs of hypothetical assets on an efficient new-build basis and then making a series of adjustments to reflect differences between those hypothetical assets and the company's actual assets which matter to the economic value of the actual assets.

148. One important difference is that the actual assets may have a shorter remaining economic life than the hypothetical assets, which by definition are taken to be new. If so, a negative adjustment should be made to estimate the reduction to the economic value of the actual asset, compared to the hypothetical asset, due its age and/or condition.

149. It is also plausible that some of a company's actual assets have a longer remaining economic life than the hypothetical assets, for example if changes in construction techniques or technologies means that economic asset lives have reduced substantially over time. In this case, a positive adjustment would be made to estimate the increment to the economic value of the actual asset, compared to the hypothetical asset, due its greater remaining lifespan.

150. In either case, the adjustment is a calculation made from a comparison between an actual asset and a hypothetical, and potentially quite different, new asset. This means that the nature of the adjustment is conceptually different to that which is used for depreciation in a company's statutory accounts. Nonetheless, some of the information that is used for statutory depreciation (e.g. asset ages and assumed asset lives recorded in asset register) may be relevant as part of the calculation of the adjustment for the remaining economic life of actual assets.

The use of straight line depreciation techniques

151. The use of an economic value concept does not preclude a role for approximation methods for practical valuation purposes. Any attempt to take account of the remaining economic life of actual assets, relative to new assets, will require an approximation. A balance needs to be struck between the accuracy of the adjustments and other considerations such as the time and resource to make these adjustments, consistency across companies and transparency.

152. One way to make adjustments for differences in the remaining life between actual assets and hypothetical new assets is to use straight line depreciation techniques.

153. Under a straight line approach to depreciation of the hypothetical asset, the adjustment for the remaining life of the actual asset could be calculated as follows:[5]

> *Gross new-build asset * [(estimated remaining life of actual asset / assumed asset life of the hypothetical asset) – 1]*

154. This will produce a negative adjustment in the case where the actual asset has a shorter remaining asset life than the assumed new asset. We take a simple example to illustrate this calculation. Suppose that the new-build asset has a cost of £100 and an estimated asset life of ten years. Suppose that the company's corresponding actual asset has an estimated remaining life of six years, and is the same in all other respects. The adjustment for the remaining economic life of the actual asset would be calculated on this basis as –£40 on a straight line depreciation basis, which would produce an economic value for that asset of £60. [6]

155. The calculation will produce a positive adjustment in the case where the actual asset, despite not being new, has a longer remaining economic life than the assumed hypothetical new-build assets.

156. The remainder of this section proceeds on the basis that straight line depreciation techniques will be used for the calculation of adjustments for the remaining economic life of actual assets versus hypothetical assets.

157. Nonetheless, we are concerned about the potential scale of inaccuracy, and risks of a systematic downward bias to economic value, arising from the approximation of using straight line depreciation for the calculating of an adjustment for the remaining economic life of actual assets. We discuss this further in the separate sub-section below "Alternatives to straight line depreciation to improve accuracy".

Assumptions on asset lives

158. If straight line depreciation techniques are to be used, then we require estimates or assumptions on:

    (a) The expected remaining economic life of the actual assets or processes.

    (b) The expected economic life of the hypothetical new-build assets or processes.

159. As a first approximation, for both (a) and (b) above, companies could draw on information used for their statutory accounts. More specifically, for (a) they could use the information held on the age and assumed remaining life of actual assets from the asset register used for statutory accounts, and for (b) companies could use the asset life assumptions that are routinely used for comparable assets or asset categories.

160. However, the purpose of the sludge asset valuation / RCV allocation exercise is different from the purposes of a company's internal accounting and statutory reporting

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[5] This approach was used, though expressed differently, in Ofwat's MEA revaluation guidance used for the PR09 periodic review: Ofwat (2008) *PR09 business plan information requirements part C3: Company guidance information requirements v1.0*, Appendix 2.

[6] Economic value = new-build cost + adjustment for remaining asset life = 100 + 100*((6/10) –1) = 100 – 40 = 60.

activities. This means that the approach taken for the company's normal accounting purposes is not necessarily appropriate for the sludge asset valuation. Issues which may not be material for statutory accounting purposes may nonetheless be worth tackling for the sludge asset valuation exercise.

161. Our main concern is that using only accounting information would tend to overstate the adjustment for the remaining life of the actual asset (i.e. overstate depreciation) and under-state the economic value of that asset. This is for several reasons:

(a) There may be a degree of prudence in the preparation of statutory accounts in terms of the application of standard asset life assumptions, which may lead to an understatement of assumed asset lives compared to a more central forecast or expectation value. This may lead to a systematic under-estimation of the remaining economic lives of existing assets.

(b) There is a degree of survival bias which means that the expectation value of the total asset life for actual assets that (still) exist will tend to be greater than the expectation value of the total asset life for a new asset. If there is uncertainty about the economic life of a specific asset when new (which seems likely in most practical cases) then the older the asset is, the longer we would expect its total asset life to be: an asset that has survived five years is likely to have a longer total asset life than a new asset which could fail/need replacement in the first five years.

(c) Asset management may have involved substantial work to maintain assets which has extended their life beyond that envisaged for accounting purposes.

162. Within the content of a straight line approach to depreciation, there are several ways that remaining asset life assumptions from statutory accounting purposes could be adjusted or updated to improve the accuracy of the overall assessment:

(a) Review the assumptions on asset lives that are used for the various asset categories for the statutory accounts, and make revisions to these for the purposes of the sludge asset valuation if there are grounds for an alternative assumption. This might reflect, for example, improved knowledge of sludge asset lives gained through experience over time. It is possible that asset management experience has revealed that asset lives for particular categories/types of assets are likely to be significantly longer or shorter than originally expected. Or it may be revealed that asset life assumptions for accounting purposes are too prudent for the sludge RCV allocation exercise. Revision to the assumed total asset lives for existing assets could then be made on this basis.

(b) Assess the remaining economic lives for assets using a modelling approach which takes account of the age and or condition of current assets and draws on data relating to past experience of similar assets (e.g. failure rates by age or condition).

(c) Make a fresh assessment of the remaining economic life of the actual assets, based on a judgement following physical examination of the condition of those assets.

163. These approaches could involve significant time and effort and would need to be done separately for each process or category of assets.

164. For example, it may not be proportionate for a company to look through every sludge asset it has and determine its remaining economic life based on its condition. Furthermore, there are risks that, given constraints on companies' time and resource, the review of remaining asset lives could turn out to be less accurate if the assessment of condition were to become a somewhat superficial exercise.

165. In these circumstances, we propose that each company starts with figures on the remaining asset lives that are used for its statutory accounts, and then considers whether these provide a reasonable approximation or whether further refinement and adjustment is appropriate.

166. Separating out the adjustment for condition does not necessarily place a requirement for companies to submit a condition grade assessment (e.g. condition grade rating 1-5). It does however recognise that the adjustment for age may not in itself give a true reflection of the remaining asset life, and therefore that where companies have intelligence, for example through physical surveys or information from corporate systems on failure rates, then they have scope to improve upon asset life information based only on statutory account systems.

167. There is a related question of whether it would be acceptable for a company to sample assets and processes to establish asset condition for the purposes of making adjustments. Sampling could play a role as a means to improve on the figures for remaining economic lives of assets within a modelling approach. Sample sizes would need to be of a sufficient size and cover assets that are sufficiently similar to those that sampling results are applied to.

168. If companies take steps to produce more accurate estimates of the remaining economic life of actual assets (e.g. based on condition), there may be merit in asking them to first report the adjustment they would obtain if they just relied on remaining asset lives used for statutory accounts, and then to report a separate adjustment for condition if this is considered appropriate.

Further guidance on calculation of remaining life

169. In making adjustments for the remaining economic life of its existing assets, a wastewater company will need to consider how to make best use of the available information in a context where the estimated costs of hypothetical new-build processes are to be used as a means of valuing existing processes.

170. There are several practical considerations, including the following:

(a) In some cases, the information that a company holds and/or can estimate on the remaining economic life of its existing assets may be at quite a granular level (e.g. a specific piece of mechanical and electrical (M&E) equipment installed at the site, or the civil engineering assets constructed at the site in a particular year).

(b) In other cases, the information that a company holds and/or can estimate on the remaining economic life of its existing assets may be at a more aggregated level (e.g. at the level of a process or set of processes at the site).

(c) The information a company has for the economic lives of hypothetical new-build assets may be in the form of standard assumptions on asset lives for different asset categories (e.g. civil assets might have an assumed life of around 60 years and M&E assets an assumed life of 15 years) rather than an asset life for the overall new-build design.

(d) If the hypothetical new-build design is quite different to the existing assets in terms of the type and mix of processes, then it could be difficult (or misleading) to calculate adjustments for the remaining economic life of the existing assets by carrying out an asset-level or process-level comparison between existing and hypothetical assets.

171. We provide some further guidance and suggestions below on two related issues. The first concerns how existing assets might be mapped to hypothetical new-build assets for the purpose of making adjustments for the remaining economic life of existing assets (e.g. at what level of granularity should the mapping be done?). The second issue concerns the way that information and estimates on remaining lives of existing assets or on the assumed lives of hypothetical new-build assets could be used in cases where this information is at a more granular level than the mapping between existing and new assets.

172. We suggest that the mapping between existing and hypothetical assets is done at as granular a level as possible, subject to availability of information and the need to keep the sludge asset valuation exercise proportionate. Table 4 suggests approaches for mapping existing assets to hypothetical new-build assets, under several possible scenarios for the relationship between the two.

Table 4 Mapping existing assets to new-build assets for remaining life adjustments

	Scenario	Potential approach
1	Each existing asset at the site corresponds to a similar asset within the hypothetical new-build design Where: • By "asset" we mean an asset for which estimates of the economic life / remaining economic life is available or can be obtained • By "similar", we mean similar in terms of the functionality and capacity provided	Calculation of adjustment for remaining life done at the asset level, by comparing estimated remaining economic life of existing asset with estimated economic life of corresponding asset within hypothetical new-build design Adjustment for remaining economic life at the process level can be calculated as aggregate of the adjustments for assets within each process Adjustment for remaining economic life at the site level can be calculated as aggregate of adjustments across assets at the site
2	Scenario 1 does not apply or method indicated for scenario 1 not considered proportionate For those existing assets that do not correspond to similar new-build assets (i.e. where scenario 1 does not apply), these can be put into groups, such that each group of assets at the site corresponds to a similar group of assets within the hypothetical new-build design By "similar", we mean similar in terms of the functionality and capacity provided A "group of assets" could, for example, comprise: • a group of assets for which the existing and new-build designs differ • the assets that fall under a specific asset category (e.g. M&E assets) for which the existing and new-build designs differ • the assets forming part of a single process for which the existing and new-build designs differ • the assets forming part of several processes for which the existing and new-build designs differ	Use method from scenario 1 as far as applicable (e.g. for the set of existing assets that correspond to similar hypothetical assets) For the remaining assets, the groups should be chosen to help the mapping between existing and hypothetical assets and support the estimation of reasonable adjustments to economic value for remaining life of existing assets For these assets, calculation of adjustment for remaining life done at the asset group level, by comparing estimated remaining economic life of the existing group of assets with estimated economic life of corresponding group of assets within hypothetical new-build design Adjustment for remaining economic life at the process level can be calculated as the aggregate of the adjustments for assets within each process (provided groups of assets do not span multiple processes) Adjustment for remaining economic life at the site level can be calculated as the aggregate of adjustments across assets at the site *See separate comments below on estimates of asset lives for composites from sub-elements*
3	Neither scenario 1 nor scenario 2 apply OR the methods indicated for these scenarios are not considered proportionate	Calculation of adjustment for remaining life done at the site level, by comparing an estimate of the remaining economic life for the existing assets on the site (taken together) with estimate of the economic life of hypothetical new-build design for the site *See separate comments below on estimates of asset lives for composites from sub-elements*

173. In table 4, we highlight that companies may need to use estimates of asset lives that apply at the level of groups of assets, at the level of processes or at the level of the overall site, rather than individual assets. This reflects the second issue mentioned above, concerning the use of more granular information on asset lives.

174. We identified two possible methods for deriving estimates of asset lives in cases where the relevant data or information is primarily available at a lower level of granularity than required (e.g. asset-level information in a context where a comparison is needed between existing and new-build processes or at the overall site level). We give an overview of these methods in table 5 and explain them further below. In this table a "sub-element" might be an individual asset, an asset category or process and the "composite" might be a group of assets, a process or the overall site.

Table 5 Assumptions on economic lives for composite assets from sub-elements

	Assumption on remaining economic life of existing composite asset	Assumption on economic life of hypothetical composite asset
Method 1	Weighted average of remaining life of each sub-element of composite	Weighted average of assumed asset lives for each constituent element of composite
Method 2	Assumption made on remaining economic life of the composite If significant, capture differences between remaining economic life for sub-elements and remaining life of composite as part of the consideration of future O&M and revenues for the existing assets More specifically: • For any sub-elements with shorter remaining economic life than assumed for overall process, treat their projected asset replacement costs as part of the O&M costs to be incurred during the remaining economic life of the process • For any sub-elements with longer economic life than assumed for composite, treat estimated future re-use/resale/scrap value at end of life of composite as additional source of revenue at that point These O&M costs and revenues can then be taken into account as part of the assessment of potential adjustments for differences in future O&M between hypothetical and actual assets (see separate sub-section further below)	Assumption made on economic life of the composite If significant, capture differences between economic life for sub-elements and economic life for the composite as part of the consideration of future O&M and revenues for the hypothetical assets More specifically: • For any sub-elements with shorter economic life than assumed for composite, treat their projected asset replacement costs as part of the future O&M costs to be incurred during assumed economic life • For any sub-elements with longer economic life than assumed for composite, treat estimated future re-use/resale/scrap value at end of assumed composite life as additional source of revenue at that point These O&M costs and revenues can then be taken into account as part of the assessment of potential adjustments for differences in future O&M between hypothetical and actual assets (see separate sub-section further below)

175. Method 1 involves a mathematical combination of estimates of asset lives for individual sub-elements. Method 2 involves more of a judgment about the economic life at the overall level of the composite asset, combined with potential adjustments for sub-elements considered to have longer or shorter lives than the composite.

176. Method 2 provides for a more forward-looking assessment. It requires the company to make an assumption on the remaining economic life of the composite (e.g. process or site). This is not something that would necessarily be available from the company's accounting information (e.g. because asset lives used for accounts are applied to more granular categories than the overall process). Where not available from existing information, an assumption could be made, for example, using judgment in the light of

estimates of when the most important assets within the composite will become uneconomic and/or need replacement.

177. If Method 2 is used, we propose that the separate adjustments to take account of material differences between the assumed remaining economic life for the process and the remaining economic life of individual elements of the process are included as part of the adjustments for O&M costs between actual and hypothetical assets discussed in a separate section below.

178. Method 2 seems to provide a reasonable way to take account of variation in assets lives across different sub-elements (within the framework of straight line depreciation).

179. Method 2 may be more demanding than Method 1 in terms of the time, information, and assumptions required. A view is needed on the remaining life of the overall asset and then consideration of asset lives for sub-element is needed if these are different. Against this, Method 2 can be applied without the need for detailed accounting information on current assets, using instead a forecast of the economic life of the process and the future replacement costs for elements of it that will need replacing before the end of the economic life.

180. Finally on Method 2, there seems merit in seeking consistency between (a) the assumed remaining life for the existing processes at a site and (b) the time horizon used for the assessment of the adjustments (discussed in subsequent section below) for differences in revenue generation capability and O&M costs between existing and hypothetical assets.

181. Method 1 above might be a more proportionate approach in some cases, but is more difficult to reconcile conceptually with the economic value concept.

182. Under Method 1, if a weighted-average asset life is to be used, there are different methods for determining the weights. One approach would be to use a measure of the value of each sub-element within the composite. This could be based on, for example, the historical purchase price or a company judgement on relative values. Suppose we have two assets, A and B, each with a purchase price of £100, and asset lives of 20 years and 5 years respectively. This approach would give equal weight to each asset and produce a weighted-average asset life as 12.5 years.[7]

183. An alternative approach to the weighted average would be to use weights based on the relative shares of historical cost depreciation charges for each sub-element in the composite. Taking the same illustrative figures as above, the straight line annual depreciation charges taken for weights would be £5 per year for asset A and £20 per year for asset B and the weighted-average asset life would be 8 years.[8]

184. Both approaches to the weighted average provide for approximations which may lead to different results than if the sub-elements had been considered separately.

[7] This is calculated as (£100/£200)*20 years + (£100/£200)*5 years.
[8] This is calculation as (5/25)*20 years + (20/25)*5 years.

185. The second approach has the beneficial feature that, for the period of time before the end of the economic life of any sub-element, it gives the same allocation of value over time (i.e. the same annual and cumulative depreciation) as if the components had been taken separately. This helps limit the loss of accuracy from using a weighted-average asset life, but this feature does not apply in all circumstances. It seems most useful where the remaining life of existing assets is shorter than the shortest economic life for the elements within the composite hypothetical asset or process.

186. Note that, as reflected in Table 4, where existing assets can be mapped to hypothetical assets at a granular level, it does not seem necessary to use weighted averages of asset lives, and this would avoid some of the problems arising from the use of such averages.

187. Finally, given the range of potential approaches and levels of detail in the analysis, we suggest that Ofwat asks companies to describe the approach they have used and their reasoning for the choice of approach.

Use of cumulative depreciation figures from statutory accounts

188. The adjustment required for the remaining economic lives of actual assets differs conceptually to the concept of cumulative depreciation from statutory accounts. We should not be surprised to find differences between the two. Nonetheless, in some cases, the information from statutory accounts may provide a useful figure.

189. The closer the actual asset is to the assumed hypothetical modern asset in terms of both purchase price and depreciation profile, then the more useful (i.e. less inaccurate) is the information on cumulative depreciation from statutory accounts as an estimate of the adjustments for the remaining economic life.

190. Where the depreciation profile is similar (e.g. such that it would be reasonable to depreciate both over ten years on a straight line basis) but the purchase price is different (e.g. due to cost inflation) then it may be possible to make a reasonable estimate of the adjustment by taking the cumulative depreciation from statutory accounts and multiplying it by the estimated cost inflation since the asset purchase date (e.g. 10 per cent if the new-build asset is estimated to cost 10 per cent more than the purchase price of the actual asset).

191. An alternative way to apply this kind of approach is to say that the value of an existing asset can be calculated by taking the ratio between its net book value and its gross book value (i.e. NBV/GBV) and then multiplying this ratio by the estimated new-build cost for an equivalent asset. An approach along these lines has been used by BT as part of its current cost accounting (CCA) regulatory accounts.[9] However, this approach is less informative where the depreciation profile of existing assets is different to that for new-build assets or where the remaining economic life of existing asset is likely to differ significantly from the remaining life implied by the accounting records.

192. There may be merit in asking companies to report the cumulative depreciation of actual assets as a cross-check on the proposed adjustment, though we would have concerns about the proportionality of this if the information were not readily available. If the

[9] BT (2016) *Accounting Methodology Document*, section 6 and Annex 6.

information that companies have available from their systems does not readily provide figures for cumulative depreciation at the site and/or process level then it may be better for companies to report on a more aggregated basis than to seek to make more detailed allocations, which could prove a distraction and provide limited additional insight.

Assets that are fully depreciated in the statutory accounts

193. Where information on asset lives has been taken from the statutory accounts as an approximation, it is possible that an asset is fully depreciated for the purpose of the sludge RCV allocation despite having a remaining economic life and positive economic value. This raises the question of how to treat assets that are fully depreciated in the statutory accounts for the purposes of the RCV valuation.

194. This is an extreme case of the more general concern we raised above: that the remaining economic life of actual assets may be understated if based on asset life data used from statutory accounts.

195. Our view is that, where material, the remaining economic life (and hence economic value) of an asset that is fully depreciated in statutory accounts should be estimated as a positive figure.

Alternatives to straight line depreciation to improve accuracy

196. We highlighted above that one potential approach to the calculation of the adjustment to economic value for the remaining economic life of actual assets, compared to hypothetical new-build assets, would be to use straight line depreciation techniques.

197. For the purposes of the sludge asset valuation, a feature of the straight line depreciation technique is that it treats the economic value generated by a hypothetical new-build asset as a constant stream of value over a finite asset life. For example, if the new-build asset value is £100 and the economic life is five years, then the economic value is attributed as £20 per year over the next five years.

198. There a number of reasons why, in the context of an economic value estimation process, a straight line depreciation technique on a historical cost basis may be inaccurate. In particular:

(a) **Time value of money**. A straight line approach would not take account of the time value of money; this stems from view that £1 today is worth more than £1 in a year's time. If an asset produces a constant stream of services over a ten-year period, then a full discounted cash flow (DCF) approach to economic value would attach greater value to the first five years of the asset's life than to the second five years' due to the application of a discount rate (e.g. reflecting the company's cost of a capital for the relevant business activity). In contrast, a straight line approach would attach equal value to the services generated in the first five years compared to the last five years.

(b) **Changes over time in prices and costs**. A straight line approach would not, on its own, take account of the potential for the value of services produced by an asset to rise or fall in nominal terms over the economic life of the asset. For example,

if prices for these services are expected to increase in nominal terms over time then this would be a factor that causes the value generated from the asset to grow over its economic life. The profile over time for the prices of services produced by the asset will reflect a range of factors, including changes over time in the costs of assets that can be used provide the services, changes over time in running costs and productivity improvements in the processes used to provide the services (to the extent not already captured in asset and input prices).

(c) **Degradation**. A straight line approach would not take account of the potential for assets to degrade over time in a way that significantly affects the value generated from them. For example, if the requirements for inspection and maintenance tend to increase with the age of the asset, or with its usage, but the value of services produced by the asset is constant over time, then the value generated each year (e.g. reflecting revenues less running costs) would gradually decline over time.

(d) **Uncertainty on asset life**. A straight line approach would not take account of the uncertainty as to the economic life of an asset. Other than in special cases (e.g. where a company's asset management approach involves planned replacement of the asset after a specified length of time, regardless of condition or usage) the economic life will be uncertain: it could be longer and it could be shorter. A detailed DCF analysis could seek to take account of an assumed probability distribution for the economic life, and hence value generated from the asset. While uncertainty about the economic life of an asset might be tackled by making a central estimate (i.e. expectation value) of the economic life, this may not be sufficient for the economic value calculation in cases where, for the reasons above, the value generated from the asset may vary from one year to the next.

199. The effect of these issues is that a straight line approach may lead to a form of misallocation of the value of the asset over time. This may, in turn, reduce the accuracy of an approach to the valuation of existing sludge assets in which we first seek to estimate the new-build costs of hypothetical efficient processes delivering equivalent capacity and then make adjustments for differences, including the remaining economic life, between the actual processes and the hypothetical processes.

200. Suppose that we had a hypothetical new-build asset with an economic value of £100 and an estimated asset life of ten years, and an actual asset which is otherwise identical but has an estimated remaining life of four years. A straight line depreciation approach would suggest an adjustment for economic life of –£60 giving an economic value of the actual asset of £40. However, the value generated from the hypothetical new-build asset in the first four years of its economic life could be significantly higher than £40 if the discount rate (net of output price inflation) means that we attach greater value to the annual revenue generated in these first four years than the last six years of the hypothetical new-build asset's life.

201. We carried out some illustrative modelling to explore issues (a) and (b) above. This suggested that, for some plausible assumptions, using straight line depreciation could produce estimates of economic value that are 20 per cent lower than a DCF approach that takes account of the time value of money and forecast inflation/deflation in the value of services. We did not identify grounds to expect this difference to be cancelled

out across the various assets and processes that form part of a company's sludge activities.

202. While it may not be practical to fully address each of the issues above, it seems feasible to attempt to mitigate the first and second issue, concerning the time value of money and inflation/deflation in services produced by the hypothetical asset.

203. For the purposes of the sludge asset valuation exercise, we see merit in an approach in which each company produces two different estimates of the economic value of its sludge assets which reflect two different ways to make adjustments for the remaining economic life of actual assets and processes:

(a) An adjustment for the remaining economic life that is made using a straight line depreciation technique.

(b) An alternative adjustment for the remaining economic life that is intended to better capture the way that the discounted economic value generated from the hypothetical process varies over time. Companies could be given some discretion in the approach that they take to this adjustment, but as a minimum their approach should take account of the points concerning the time value of money and changes over time in prices and costs.

204. The approach under (a) is more straightforward and likely to be more familiar to water companies. The approach under (b) is potentially more accurate, although it is more complicated and relies, to an even greater extent, on subjective judgment. We suggest that Ofwat consults further on this aspect of the methodology.

205. In both cases, the adjustment should, as far as practical and proportionate, make use of the best available information on the remaining life of actual assets, rather than rely only on the remaining asset lives implied by statutory accounting information

206. To help with the approach under (b) above, we developed a prototype model or tool which can be used to calculate an adjustment for the remaining economic life of actual assets which takes account of the time value of money and inflation/deflation in the prices of services produced by the assets. The input data items for the tool are: (i) assumptions on the nominal discount rate or nominal cost of capital; (ii) assumptions on the annual inflation or deflation in the price of the service(s) produced by the new-build process; (iii); the new-build cost of the hypothetical process; (iv) the assumed economic life of the hypothetical new-build process; and (v) the assumed remaining economic life of the actual process.

207. It is not our contention that this tool resolves all of the issues that would arise in seeking to use information on the new-build cost of a hypothetical efficient process as a means to estimate the economic value of an existing process with a shorter (or longer) remaining economic processes. But it seems practical and capable of offering a significant improvement on a methodology that considers only a straight line depreciation approach.

208. A further perspective might be available by considering economic depreciation concepts which treat depreciation as the (expected) change in the value of a capital asset

from one period to the next. This perspective might provide the basis for a more sophisticated assessment of how the economic value of a hypothetical new-build asset can be allocated over time and, in turn, how this can be used to estimate the value of an existing asset which may have a shorter, or longer, remaining economic life. However, there may be limitations in terms of what is feasible and proportionate in the context of the asset valuation for the purposes of the sludge RCV allocation.

209. For the purposes of the calculations of economic value using hypothetical new-build costs, there is a need for internal consistency on the treatment of prices and discount rates. We see two approaches:

(a) **Nominal discount rate and nominal price trends**. Under this approach, the relevant discount rate or cost of capital would be in nominal terms and the assumptions on the changes, over time, in the (hypothetical) price of sludge services would be in nominal terms.

(b) **Real WACC and relative price trends.** Under this approach, the relevant discount rate or cost of capital would be in real terms (e.g. a WACC that is appropriate to apply to an RPI- or CPI-indexed asset). The treatment of price trends in the calculation should consider the rate of growth in the (hypothetical) price of sludge services relative to the relevant price index. For instance, if the real WACC was a WACC applicable to a CPI-indexed RCV, then if that real WACC is used for the economic value calculations, the method should take account of the estimate trend, over time, in hypothetical sludge service prices relative to the trend in the CPI.

210. It would not be sufficient to simply assume, without further assessment, that the price trend for hypothetical sludge services is the same as the inflation index used for the specific purposes of price control indexation. There is no reason to assume that RPI or CPI are appropriate assumptions for price changes over time for sludge services, especially given the extent of technological change and opportunities for commercial revenues from energy generation.

Adjustments for revenue-generation and for operating and maintenance costs of existing assets

211. The previous section discussed the role of adjustments to take account of differences in age and condition of the company's actual sludge assets compared to the assumed hypothetical efficient new-build assets, insofar as these differences affect the economic value

212. This section considers some further adjustments for the economic value of actual assets. These adjustments are relevant to the extent that there are differences between the actual and hypothetical assets in terms of their ability to generate revenues and in terms of their ongoing operating and maintenance (O&M) costs.

213. The section takes the following issues in turn:

(a) Adjustment for differences in operating and maintenance costs.

(b) Adjustment for differences in revenue generation capability.

(c) Separate reporting of adjustment for energy generation.

(d) Time horizon for the adjustments.

(e) The discount rate for the adjustments.

(f) Reconciliation with regulatory accounts.

Adjustment for differences in operating and maintenance costs

214. The actual assets owned by the wastewater company may have different ongoing operating and maintenance costs than the hypothetical assets used for the new-build costing. If so, estimation of the economic value of existing assets may require an adjustment to recognise these differences.

215. The adjustment could be calculated as an estimate of the present value of the difference in operating and maintenance costs in future years (calculated using a suitable discount rate or financing cost assumption).

216. The relevant differences relates to differences in the costs that would be incurred in the future and should exclude the initial purchase price of assets and any depreciation charges.

217. This adjustment should only comprise expenses and costs. They should not reflect deductions for any revenue or income that helps to offset running costs: we propose that income adjustments are made separately.

218. The adjustment could either be made by estimating the total running costs of the actual asset and the hypothetical modern asset and taking the difference, or by estimating the incremental running costs of the actual asset compared to the hypothetical modern asset.

219. An adjustment of this nature has some precedent in Ofwat's previous regulatory reporting guidance for gross replacement cost and MEAV figures. For instance, RAG 1.05 (now withdrawn) stated that:

> *"In principle net MEAs of existing assets should be adjusted [for] the different operating costs of the actual assets compared with their modern equivalent. It is assumed that this has been done, for example, by deducting the present value of the difference in operating costs from the unadjusted MEA values." (Paragraph 1.9.6)*

220. The adjustment should be made for differences between the hypothetical new-build assets/design and the existing assets/design, and should only be applied in relation to existing assets at the site that are appointee assets. For the purposes of the sludge RCV allocation, it would not be relevant to consider the differences in O&M costs between any existing non-appointee assets at the site and the corresponding hypothetical new-build versions of those assets.

Adjustment for differences in revenue generation capability

221. Apart from differences in operating and maintenance costs, there may be differences between hypothetical and actual assets in terms of their revenue-generation capability.

222. The hypothetical new-build assets assumed for the purposes of the new-build costing may generate revenues from sources other than the treatment and disposal of wastewater sludge produced by wastewater customers in the company's area of appointment. If so, there may be the need for an adjustment to recognise differences in the economic value due to differences in capabilities for revenue generation between the hypothetical assets and the actual assets used by the company.

223. To take a simple example, suppose that the hypothetical assets would produce energy generation revenues of £100,000 per year and that the company's actual assets cannot generate any energy revenue but are otherwise identical in terms of capabilities to treat sludge, remaining economic life and future operating and maintenance costs. In this example, if we use the new-build cost of the hypothetical assets as the starting point for the calculation of the economic value of the existing assets, we would need to make a deduction or impairment to reflect the fact that the actual assets have a lower economic value than the hypothetical assets due to the absence of the £100,000 per year income stream with no offsetting benefits. We can make an adjustment to approximate for the difference in economic value using an estimate of the present value (calculated using a suitable discount rate or financing cost assumption) of the future income stream.

224. The adjustment could either be made by estimating the total revenues from the actual asset and from the hypothetical modern asset and taking the difference, or by making a direct estimate of the difference in revenues.

225. The adjustment should be made for differences between the hypothetical new-build assets/design and the existing assets/design, insofar as these relate to the appointee's assets at the site (it should not be an adjustment for the allocation of existing assets between the appointee and non-appointee businesses). For the purposes of the sludge RCV allocation, it would not be relevant to consider the differences in revenue generation capability between any existing non-appointee assets at the site and the corresponding hypothetical new-build versions of those assets.

226. Furthermore, if the calculation of the economic value of assets at the site has excluded the new-build costs of some assets or processes because these are non-appointee assets rather than appointee assets, then there should be no further adjustment to try to account for the revenue generation capability of those non-appointee assets; this could lead to double counting.[10]

Separate reporting of adjustment for energy generation

227. Where a company generates energy as part of its sludge activities, there are different ways in which the energy could be used:

[10] See approach under sub-section above "Assets owned outside the appointee".

(a) It may be sold to other parties as part of the GB electricity or gas systems.

(b) It may be used for internal purposes, thereby reducing the expenditure the company needs to incur purchasing energy from energy suppliers.

228. Where companies calculate adjustments for differences between the energy generation potential of actual assets compared to assumed hypothetical assets, we propose that the revenues under (a) and the cost savings under (b) are taken together. We propose that companies report this as an adjustment for energy generation capability, which covers both elements.

229. This would help avoid the situation where separate adjustments need to be calculated for revenue and costs, and comparisons between companies and sites are made more difficult due to variations in balance between external sales and internal use.

230. Under this approach, and with regard to energy generation, the company would report three separate adjustments: (i) differences in revenue and costs from energy generation; (ii) differences in revenues from sources other than energy; and (iii) differences in operating and maintenance costs excluding the effects of energy generation.

Treatment of renewable energy incentives

231. The current system of subsidy for renewable energy generation creates some practical questions for the valuation exercise. Subsidy rates vary by technology and have changed over time, with significant reductions in respect of electricity generated through advanced anaerobic digestion.

232. We propose the following approach:

(a) The hypothetical new-build asset should be determined as one that would be chosen given the subsidies that will apply from the effective date of the valuation exercise (i.e. April 2020) and should not reflect subsidy schemes or rates that would no longer be available. In some circumstances, the hypothetical new-build assets at a site could differ from the actual assets at a site due to changes over time in the subsidy arrangements.

(b) Where a company has an existing asset that benefits from significantly greater degree of subsidy than would be available on a new-build basis, a positive adjustment should be made to reflect the economic value of this stream of income for the actual asset to the extent that it exceeds the subsidy income stream on a new-build basis.

233. Given uncertainties about future subsidies, companies may wish to consider a number of alternative scenarios and produce estimates for each of these, and then use judgement to arrive a central estimate for the purposes of the sludge asset valuation.

234. The adjustment under (b) would form part of the adjustments for revenue differentials between actual and hypothetical assets, described more generally above. Nonetheless, we suggest that companies report separately the adjustments they have made in respect of differences in subsidies available to existing and new-build assets.

Time horizon for the adjustments

235. The time horizon considered for the adjustments described above should cover the remaining economic life of the process or group of processes giving rise to differences in revenues or O&M costs compared to the hypothetical new-build design.

236. The logic for this is that this is the time period over which a difference between the existing process and the hypothetical new-build process is identified. After the end of the economic life of the actual process, it would be replaced with a new asset which would then have the same running costs and revenue generation capability as the prevailing hypothetical efficient new-build asset at the time.

237. In cases where several different assumptions are used for the remaining economic life of existing assets or processes at a site, it may be necessary to use several different time horizons for the calculations for that site. If so, a reasonable allocation of the revenue or O&M cost adjustments between the different time profiles could be used.

The discount rate for the adjustments

238. It will be necessary to make assumptions about the relevant discount rate or cost of capital for the purposes of the present value calculations above.

239. One approach would be for the estimates of economic value that companies develop to reflect their own perspective on the appropriate discount rate, taking account of their own circumstances. This seems consistent with a company-led approach to the valuation exercise. There is no single correct answer on what the discount rate is and seeking to develop a single rate could prove contentious and a distraction. Furthermore, the sludge price control WACC would not be known until Ofwat's final determinations for PR19 and, in any event, might not be the right measure to use for a valuation exercise that considers hypothetical competitive scenarios for sludge activities.

240. However, it would be useful for Ofwat's review processes to understand the materiality of companies' assumptions on the discount rate in the overall calculation of the valuation. That way, Ofwat can identify cases where the company's discount rate is having a significant effect and assess whether the rate is justified.

241. There may therefore be merit in requiring each company to make adjustments for revenues and O&M costs, and hence the calculation of the economic value of its sludge assets, in two separate ways:

    (a) Assuming a discount rate or cost of capital specified by Ofwat, for consistency across companies.

    (b) Assuming the discount rate or cost of capital that it considers most appropriate, together with supporting information for that assumption,

242. Provided that companies build up their calculations using spreadsheets or other tools that take the discount rate(s) as input data that can be varied, it would seem straightforward to re-calculate the valuation using alternative rates.

243. It is possible for the discount rate for the adjustments to be made on a nominal basis or on a "real" basis. If it is on a nominal basis, then forecasts of costs and revenues should also be made in nominal terms. If it is on a real basis, then forecasts of costs and revenues relative to the inflation index used for the real rate (e.g. RPI or CPI) are needed.

Reconciliation with regulatory accounts

244. The adjustments discussed for revenues and operating and maintenance costs are adjustment for differences between hypothetical assets and actual assets. As such, they do not have a direct read across to the regulatory accounts.

245. It may be possible to arrange for elements of the calculation of the adjustments to be reconciled with regulatory accounts. For instance, companies could provide data on the revenues and costs of existing assets at the site level, which is reconciled with revenue and cost data from regulatory accounts which is at an aggregated level covering all sites. The company could then reconcile its proposed adjustments with its site level data on costs and revenues of existing assets.

246. However, the opportunities for reconciliation are limited because the regulatory accounts can be linked to actual assets whereas we are more interested in differences between actual and hypothetical assets. Furthermore, the adjustments for O&M costs and revenues are present value calculations of future revenue and cost streams over a span of future years, which may not be directly comparable with cost and revenue data from regulatory accounts for specific past years.

247. Requiring the data to enable reconciliation of assumptions and figures with regulatory accounts could be a data intensive exercise and we would be concerned that it may not be proportionate. One possible simplification would be to avoid attempting to reconcile the present value calculation with regulatory accounts, but instead to ask companies to report the assumed revenues and costs for a single year (e.g. 2020/2021), which, when aggregated across sites, could be more readily compared with figures from past regulatory accounts, but even this may not be worthwhile.

Further issues and guidance

248. This final section discuss a number of further issues on which guidance and clarification may be helpful. The section takes the following in turn:

(a) Effective date for the asset valuation.

(b) Price base for the valuation.

(c) Treatment of work in progress.

(d) Update for changes from valuation date to 31 March 2020.

(e) Shared services and management and general assets.

(f) Tankers and transportation assets.

(g) Liquor treatment.

(h) Goodwill and customer relationships.

(i) Grants and contributions.

(j) Potential further cross-checks.

Effective date for the asset valuation

249. The purpose of the sludge asset valuation exercise is to feed into the allocation of the existing wastewater RCV at 31 March 2020 between sludge and wastewater network plus. The effective date for the valuation should be 31 March 2020. In practice, this means that companies will need to make forecasts for what assets they will have at that date.

250. Our view is that each company's valuation should be based on forecasts of what its existing assets will be at 31 March 2020. These forecasts should reflect the company's well-developed business plans (e.g. with relevant sign-off) rather than more speculative forecasts of changes between the time at which it carries out the valuation exercise and 31 March 2020.

251. We do not consider that it would be proportionate to ask companies to produce an asset valuation for assets as of the initial valuation date (e.g. later in 2017) and then to require an update to this. This may involve unnecessary work to produce a view of assets at 2017 which is only used as an intermediate step.

Price base for the valuation

252. There is a question about the price base for the sludge asset valuation. Ultimately the valuation should feed in to the determination of a sludge RCV that applies from 1 April 2020 in money of the day. But there are different ways to arrive at this, and some relevant interactions with other elements of Ofwat's PR19 price control methodology, such as the price base for other items that will be used to calculate the sludge and wastewater network plus RCV from 1 April 2020.

253. Ofwat told us that it planned to ask companies to first make the valuation on the basis of prevailing prices/costs at the date they submit their valuation. This valuation would then be adjusted to take account of changes in prices in the period to 1 April 2020. This approach seems reasonable.

254. For the purposes of the inflation adjustment, we propose making an assessment or reasonable assumption of the inflation in sludge asset values, rather than using the indexation rule applied to the RCV (e.g. RPI indexation in the period to 31 March 2020). For instance, economic conditions between 2017 and 2020 may mean that the inflation, or deflation, that is relevant to sludge asset values is significantly greater or lower than implied by the growth in the RPI or CPI. This may be something for which companies' own experiences of movements in contractors' costs and equipment costs over time provides useful information to augment economy-wide measures of inflation.

Update for changes from valuation date to 31 March 2020

255. Given the timeframe for the PR19 periodic review process, the bulk of the valuation exercise needs to done well before 31 March 2020. There is a question as to what happens if (as seems likely) the set of assets that the company actually has at 31 March 2020 is different to that expected at the time of the valuation.

256. The question then is whether this should be updated/revised in light of any material differences and, if so, when this should be done given that there will not be precise information on the assets at 31 March 2020 until after that date?

257. There is a risk that seeking updates may involve additional work and complexity for what may be a relatively minor source of inaccuracy/risk compared to other aspects of a challenges valuation exercise. There may be a case for allowing a form of true-up / correction at a later date (i.e. after the price control determination and once the outturn at 31 March 2020 is known) if there is a significant difference.

258. In any event, if Ofwat adopts a two-stage valuation process with companies having an opportunity to make revisions following a review by Ofwat of initial valuations, then there will be an opportunity for some updating during the valuation process.

Treatment of work in progress

259. It seems inevitable that there will be work in progress, both at the time of the initial valuation exercise in 2017 and at the effective date of the valuation, 31 March 2020.

260. If a company is currently in the process of installing a modern asset, or replacing an existing asset with a modern asset, then the valuation should capture the expected total cost of that asset, minus the part of it which remains to be done/spent.

261. Where work in progress is for assets that will, when complete, lead to other assets being taken out of service, companies should avoid the risk of double counting arising from valuing both the old asset and the new asset under construction (insofar as it exists). To address this risk, it may be appropriate to exclude the old asset from the valuation. However, in line with the general approach to capacity above, there should be consideration of whether there will still be some economic value in the capacity of that old asset when the new asset is operational.

Shared services and management and general assets

262. We can distinguish between two types of management and general (M&G) assets:

    (a) Those that are on site at a sludge treatment centre/works and fully attributable to the sludge business.

    (b) Those that are corporate overhead assets. These include, amongst other things, corporate IT, finance, HR, head office buildings which the sludge business may be benefiting from.

263. We would expect those assets under (a) to fall within the sludge asset valuation process for each site, featuring in both new-build costs and the assumptions for actual assets.

264. Currently all companies should be allocating/reporting a proportion of overhead costs against sludge within the APR (regulatory accounts). The current APR guidance (RAG 2.06) requires companies to designate the principal use of an asset. Where possible, capital expenditures and associated depreciation should be directly attributed to one of the price control units. Where this is not possible as the asset is used by more than one service, it should be reported in the service of principal use with recharges made to the others services that use the asset reflecting the proportion of the asset used by the other services.

265. For assets such as corporate overheads that are covered through recharges, there is a reasonable argument that net book values are a good enough approximation for replacement cost and that it would be disproportionate to require companies to revalue all of their corporate/overhead assets as part of the sludge valuation exercise. For example overhead assets might have a modern equivalent value of £250 million but with only 5 per cent allocated to sludge. However, companies could carry out an asset valuation for corporate overheads if they considered it appropriate.

266. Under this approach, the economic value of sludge assets (and hence RCV for sludge) would include some allowance for a percentage of the net book value of relevant corporate / overhead assets. This could use the same percentage as used for recharges in regulatory accounts.

267. This is subject to the percentage allocation factor being robust to the outcome of the sludge asset valuation exercise and the introduction of price separate controls for sludge. For example, if it were based on headcount or floor space, it would not be significantly affected by the RCV allocation exercise or the price control reforms. Alternatively, if, for example, it was based on old estimates of the ratio of sludge gross modern equivalent asset value (GMEAV) to appointee GMEAV or sludge revenues relative to appointee revenues, then the allocation factor may need to be updated.

268. Companies should report separately the percentage they have used and the value, expressed in Pounds Sterling, allocated to sludge, and explain the basis for the percentage allocation factor.

269. Other potentially shared asset include shared vehicles (for example site vans), other equipment used on site (such as tools) and services shared with network plus (for example vacuum tanker services). For these assets a proportional approach based on net book values and an allocation percentage may be sufficient.

270. The approach above assumes that it is the policy intention for some part of the sludge asset valuation, and hence sludge RCV, to capture an allocation of corporate/overhead assets that are drawn on by the sludge business. An alternative approach would be to exclude these assets from the sludge asset valuation and sludge RCV altogether. This could be justified as being consistent with an approach in which a hypothetical new entrant that covers the costs of these activities either through outsourcing arrangements with third party suppliers or through recharges from its own corporate business unit. This could simplify the sludge valuation exercise and allow more like-for-like comparisons between companies, not only for elements of the sludge asset valuation but also for cost assessment (e.g. totex) for sludge activities. This would require appropriate recharges to the sludge business unit (including return on capital for assets

employed) to be reported under sludge totex and captured in the totex allowances under the sludge price control, and for these recharges to be deducted from totex for other wholesale activities.

Tankers and transportation assets

271. There may be significant differences between companies in terms of the strategic approach to sludge.

272. For example, some companies may have relatively few sludge treatment sites and then incur relatively high transportation costs to transport sludge to these sites, while others may have more sites and lower transportation costs. Furthermore, there may be differences between companies in the extent to which they meet their transportation requirements through assets that they own rather than through the procurement of transportation services from other parties.

273. These differences will have implications on the value of sludge assets held by each company. This in itself is not problematic. Capital costs are only one part of overall costs and we should not expect all companies to adopt the same mix of operating expenditure and capital costs. It is normal that there are differences of approach.

274. We do not consider that the sludge asset valuation exercise should seek to impose any view on the optimum approach or mix.

275. Nonetheless, it may be useful to provide guidance to companies to help ensure that their valuations are internally consistent across different steps in the calculation. For example:

(a) Suppose that a company currently owns transportation assets (e.g. tankers) but takes the position that it would be efficient, from a new entrant perspective, to procure all its transportation services from other parties and not to own any transportation assets. In that scenario, it would not assume any new-build costs or asset values for transportation assets, despite these forming part of its actual assets. But when it comes to considering potential adjustments to take account of differences in its operating and maintenance costs, it should recognise that its actual assets imply lower operating costs than the assumed hypothetical assets. This is due to the need for the hypothetical new entrant to pay for the transportation services provided by the third party, which would tend to exceed the running costs of the company's existing transportation assets. This could call for an upward adjustment to the asset value derived from the assumed new-build costs, to reflect the comparative advantage of its actual transportation assets in terms of lower operating costs than the hypothetical model.

(b) Suppose that a company currently has a large number of sites but is seeking an asset valuation on the basis that an efficient new entrant would reduce the number of sites and carry out greater sludge transportation. For internal consistency, the company should make an upward adjustment to the asset valuation based on the new-build costs for the reduced number of sites, to reflect the comparative advantage of its actual site configuration in terms of lower operating costs than the hypothetical model.

276. The issues above are not specific to sludge transportation but help to illustrate issues of internal consistency that may be relevant more widely.

277. A separate issue concerns the allocation of tanker and transportation assets between sludge and wastewater network plus assets. Tankers may provide resilience for network plus activities (e.g. employing primary tanks and discharging into inlet works). Companies should ensure that any inclusion of transportation assets in the sludge asset valuation is focused on assets necessary for sludge activities and does not inadvertently cover assets used for other purposes. This may require, for example, a reasonable allocation to be made of transport assets between sludge and other wholesale activities.

Liquor treatment

278. We turn to address a specific issue relating to liquor treatment for which clarification and guidance may be useful.

279. There may be differences between wastewater companies across sites, in the following:

(a) As reflected in our suggested process categorisation, sludge liquors are a by-product from a number of the sludge process categories and the technologies and processes used at a site will affect the volumes and strength of sludge liquors (e.g. AAD can increase the levels of ammonia compared to conventional AD).

(b) The treatment of sludge liquors may be carried out in different ways, ranging from dedicated assets included as part of the sludge assets to the transfer of sludge liquors straight back to sewage treatment assets. Recognising this in RAG 4.06, Ofwat requires companies to report separately the costs of treating liquors, within network plus, although this excludes liquor treatment that is undertaken at a self-contained sludge processing centre. Appendix 5 of RAG 4.06 shows liquor treatment as a separate process within the sludge boundary.

(c) To the extent that companies use sewage treatment assets to treat sludge liquors, companies might adopt different ways to account for the costs and it is not clear how consistent this is across the sector.

280. In may be useful for companies to report, as part of their valuation, whether they includes the valuation of all the assets needed for liquor treatment or whether the valuation is made on the assumption that the sludge business procures liquor treatment as a service from a separate business unit (and pays a reasonable price for this). This question applies to both the assumed hypothetical assets and the actual sludge assets being valued. This would help enable more like-for-like comparisons between companies and to understand what capabilities are provided by the assets covered by the valuation.

281. One way to do this could be to define a separate sludge liquor treatment process and for companies to indicate whether they have included an asset valuation for this process or whether their valuation relies on liquor treatment being carried out separately from the sludge business and be recharged to sludge. For completeness, in our process categorisation suggested earlier, we included a category for liquor treatment.

Goodwill and customer relationships

282. There is an argument that, apart from tangible assets, a sludge business that provides services to a wastewater company will have some intangible assets in the form of goodwill and an existing trading relationship with a major customer.

283. We do not propose that an attempt is made to capture this in the economic value of sludge assets. If the value of intangible assets such as customer relationships are excluded then any RCV allocation based on the valuation could underestimate the economic value of sludge assets were these assets transferred to a separate entity that then supplied sludge services to the appointed wastewater company at competitive market prices. This issue might require further consideration in the future as the regulatory arrangements and competitive conditions develop.

Grants and contributions

284. In determining the economic value of sludge assets to use for the RCV allocation, there is a question of whether we should make a deduction for the value of any assets or past investment that has been funded through third party contributions.

285. We are unsure whether there are material amounts of third party grants and contributions in relation to past sludge asset investment. In case there are, we provide below some comments on their potential treatment.

286. We propose the following approach:

(a) If an asset that is used by the wastewater company for its sludge treatment and disposal activities is actually owned by a third party, its value should be excluded from the valuation of the company's sludge assets.

(b) Provided the company owns a sludge asset, the valuation should include this asset without any deduction for the customer contribution, unless the customer contribution is something that hypothetical new entrants would also expect to receive to set against the costs of the assets on a new-build basis.

287. The reasoning for (b) is as follows. Our conceptual basis for the valuation exercise is an economic value concept that captures the value that can be generated from existing sludge assets under actual market prices where competition is effective (e.g. energy generation) and, where competition is not effective (e.g. sludge treatment and disposal services provided as part of monopoly wholesale wastewater services) prices assumed to proxy for hypothetical competitive prices under a new-build entry model.

288. Past customer contributions may affect some historical cost measures of asset value but would not necessarily affect value on a forward-looking basis. One possible exception, for example, would be if there are grants that are widely available to different companies such that a new entrant would benefit from them in the same way as the statutory wastewater company: these should be deduced from new-build costs.

289. This approach may have the effect that some grants and contributions are ignored from the valuation exercise. Such an outcome does not seem problematic in a context where

the aim is to allocate an existing amount of RCV (a historical cost measure of value) between sludge (to be valued and priced on a more-forward looking basis) and wastewater network plus (the residual, which will reflect historical costs). In effect, the approach would mean that, to the extent that the existing RCV for wastewater is partially offset by past grants and contributions, the effect of these historical contributions are allocated to the wastewater network plus RCV rather than to the sludge RCV.

Appendix 1: review of what the valuation should represent

291. This appendix provides further discussion and analysis supporting our view on what the valuation of sludge assets, for the purposes of RCV allocation, should represent. It is organised as follows:

(a) Context for the valuation.

(b) Limitations of a historical cost basis.

(c) Preliminary discussion of economic value.

(d) Treatment of price control regulation for the purposes of economic value.

(e) Two ways to calculate the economic value of sludge assets.

(f) Net MEAV concept from Ofwat's previous regulatory reporting framework.

(g) Interactions with totex allowances and incentives.

Context for the valuation

292. The bioresources RCV allocation forms part of a package of regulatory initiatives that are intended to help unlock the potential for markets to play a greater role in activities relating to wastewater sludge treatment and disposal (as well as water resources). These initiatives include: the separation of the price control for sludge treatment and disposal; the move to an average-revenue control for sludge at PR19; the withdrawal of regulatory/RCV protection for new investment in sludge treatment and disposal assets from 1 April 2020; and measures to increase the level of market information available.

293. Ofwat has decided that the RCV allocation to sludge should be made on a focused basis. In the context of the Water 2020 programme and the planned price control framework for PR19, we consider that an essential feature of the focused approach to the RCV allocation is that Ofwat are seeking a valuation of each wastewater company's sludge treatment and disposal assets that reflects a measure of value that is *not* driven by the value of the company's historical RCV and *not* distorted by any historical RCV discount or privatisation discount. The choice of a focused approach provides a constraint on the set of approaches that could be used for the valuation exercise, but still leaves much to play for in terms of the principles and approach.

294. In deciding to use a focused approach for sludge, Ofwat wanted to ensure that the sludge RCV would reflect the economic value of the sludge assets and ensure that sludge charges reflect capital cost.[11] Our interpretation is that the primary benefits that Ofwat sought to achieve from such an approach are as follows:

[11] Ofwat (2016) *Water 2020: our regulatory approach for water and wastewater services in England and Wales*, pages 115-117

(a) Ensuring that competition in wider waste markets is not distorted by unduly low pricing by regulated water companies who can provide services using assets financed through the RCV.

(b) Sending the right price signals to third party service providers (including water companies operating out of their areas of appointment) who may be able to participate in markets for the provision of sludge transport, treatment, recycling and disposal services to a wastewater company.

(c) Protection against the risk that future developments in sludge markets (e.g. the sale of sludge assets by water companies) could unfairly transfer value from customers to investors if these assets have been undervalued as part of the determination of the sludge RCV.

Limitations of a historical cost basis

295. One potential approach to the valuation of sludge assets would be to gather information on the historical purchase prices and the accumulated depreciation of these assets that companies have assumed for the purposes of their statutory accounts. The valuation of sludge assets could be calculated by deducting accumulated depreciation from the purchase price, to give a measure of the net book value of assets attributed to the sludge activity.

296. We do not consider that such an approach would capture the economic value of sludge assets in the sense envisaged by Ofwat in developing its regulatory approach under the Water 2020 programme.

297. There are several reasons why a historical cost interpretation of economic value seems ill-suited to achieving the benefits that Ofwat expects from the valuation, such as sending appropriate price signals to potential entrants and mitigating the risks that wastewater companies' presence in other waste markets could distort competition. In particular:

(a) **Technological and commercial change**. There has been substantial change in the technologies and processes used for sludge treatment and disposal and, related to this, in the commercial models, with an increasing role for energy generation as a core part of sludge treatment activities.

(b) **Inflation.** Historical purchase prices will differ from the modern costs for otherwise similar assets due to the effects of economy-wide inflation. For some sludge assets with relatively short lives (e.g. five years) the effects of inflation may be small and perhaps immaterial. But there will be a significant proportion of assets (e.g. tanks and civil engineering assets) with longer lives for which the effects of inflation could be pronounced. The extent of cost inflation may vary across different types of assets and may not be captured well by published measures of inflation.

298. This is not to say that historical cost information is of no use to the valuation exercise. It could play some role as part of carrying out cross-checks and reviews. In particular, there may be merit in making use of information linked to audited financial reports as

far as it can be reconciled with other estimates. The point here is that a historical cost basis does not seem the best concept to use as the theoretical foundation for the valuation exercise.

299. It may be possible to make adjustments (e.g. inflation adjustments, impairments) to data on historical purchase prices to allow for the effects of technological change and inflation. Our view is that the scale and nature of these adjustments would be such that the end result would be an alternative valuation concept to historical costs.

Preliminary discussion of economic value

300. Our interpretation of Ofwat's objectives in seeking a focused valuation for the sludge RCV which reflects the economic value of sludge assets is that this requires a forward-looking concept of value rather than a historical one. Both an economics and an accounting perspective suggest that the valuation of a set of assets depends on the value that can be generated by using those assets (or some measure of resale/scrap value if higher). This is a forward-looking concept.

301. We use a simplified numerical example to introduce the concept. Suppose that the market price for a product is £10 per unit, and that there is no inflation in the economy. Suppose that the product is produced by a machine that has running costs of £70 per year, produces 25 units per year and has an asset life of 10 years. Suppose that the cost of capital for investing in the machine and running the business is 5 per cent and that there is no corporation tax. A simple discounted cash flow or net present value analysis would suggest that the value generated by the machine is around £1,400. This could be taken as the economic value, today, of the machine.

302. We can also look at the same example from a different perspective. Suppose that we know that the cost of buying the machine today is £1,400, and that it has the same output, running costs and asset life as above. If the cost of capital is 5 per cent, then a company investing in the machine could achieve its target return if the market price for the output is around £10 per unit. If we then find that the market price is in fact £10 per unit, then the purchase price of that machine today could be taken as a measure of economic value. Alternatively, if the market price for the output is quite different to £10, there would be a discrepancy and we would not accept the stated cost of £1,400 as the economic value of the machine.

303. We consider that this concept of economic value is the right one to use for the purpose of the RCV allocation exercise for sludge, given the context and objectives of Ofwat's decisions in the May 2016 Water 2020 approach document. Where we refer to economic value in this report, we mean this concept based on the value that can be generated from the assets. There are different ways in which this economic value can be estimated, and there remain questions about the interpretation of the concept when applied to sludge assets. But it provides a good foundation for the work to develop a valuation methodology for the sludge RCV allocation process.

Treatment of price control regulation for the purposes of economic value

304. Sludge treatment and disposal activities are predominantly carried out on a vertically-integrated basis by the appointed wastewater company in each area. Market-

determined prices for these activities do not currently exist, at least for the type of long-term and comprehensive arrangements that water companies need in order to provide reliable wastewater services to customers and to meet their environmental obligations and responsibilities. Wastewater companies' sludge activities are generally not priced separately from their other wastewater activities and there are no established internal transfer pricing arrangements between companies' sludge/bioresources "business" and their wastewater network plus "business".

305. From 1 April 2020, with the separation between the sludge price control and the wastewater network plus price control, there will be a separate revenue stream in respect of the treatment and disposal of sludge produced as part of each company's statutory wastewater functions in its area of appointment. This revenue stream will be constrained by the average revenue control set by Ofwat as part of the PR19 review. This, in turn, means that the economic value of a company's sludge assets depends on the price control regulation that Ofwat determines for its sludge activities.

306. For PR19, Ofwat has committed to an RCV-based building blocks approach to the sludge price control. The sludge price control will be calculated to allow the WACC on the RCV allocated to sludge, as well as other building block elements such as the PAYG element of totex, RCV run-off and allowances for corporation tax.

307. Under the building blocks approach, there is a degree of circularity in the application of the economic value concept. If the sludge RCV is set at the value X, then the building blocks approach means that the price control will be calculated with a view to enabling the wastewater company to earn a reasonable return on an RCV of X (if it invests and operates efficiently), and so the expected economic value of sludge assets would be X.[12] From a narrow perspective, any value of X might be as good as any other for the determination of the level of the sludge RCV as the building blocks approach to regulation would adjust the price control so that X becomes the economic value.

308. Ofwat's approach to the price control regulation of sludge may evolve over time, as the changes made for PR19 bed in and as more information is revealed. Ofwat may move away from a building blocks approach to sludge at subsequent periodic reviews. If so, the circularity above may not apply. But it would remain the case that the economic value of sludge assets would depend on how future price controls for sludge are set, which is a policy matter that is yet to be determined. Furthermore, if a greater role for markets emerges in the future, there is the potential that price controls on sludge activities do not bite and the economic value is determined instead by competitive prices.

309. In these circumstances, in order for the application of the economic value concept to be meaningful, it seems necessary to make some assumptions about the prices set by wastewater companies for the services of treating and disposing of sludge generated through appointed wastewater activities. We identified two possibilities:

[12] This is a simplification for the purposes of illustrating the point. It is subject to: (i) any relative efficiency differences between the actual company and the notional efficient company assumed for price control purposes; (ii) any inaccuracy in the estimated cost of capital assumed by the regulator; and (iii) any other estimation errors or approximations used in the price control calculation. And it leaves asides the effects on future revenue of incentive schemes applied to past performance.

(a) **Hypothetical new entrant benchmark**. One approach is to assume that these prices will be constrained by price controls which are intended to proxy for the prices that would emerge under the hypothetical assumption that there was effective competition from new market entrants (using newly built assets) for the treatment and disposal of wastewater sludge.

(b) **Hypothetical monopoly WASC re-build benchmark**. An alternative approach is to assume that prices will be constrained by price controls which would allow a regulated monopoly WASC to finance its activities in the hypothetical scenario in which it has to reconstruct or repurchase all of the assets needed to provide an efficient sludge treatment and disposal service.

310. Note that using a hypothetical new entrant benchmark provides a conceptual basis for the valuation exercise but does not mean that we need to estimate specific (hypothetical) prices for the purpose of the valuation. We explain this point further in the sub-section below.

311. Both of the assumptions above seem consistent with Ofwat's objectives for the focused RCV allocation to sludge. We did not identify any alternative assumptions that would make sense for the purposes of the valuation. The two assumptions are similar because they both involve new-build assets. One potential point of difference is that the financing costs of a new entrant may be higher than those of a monopoly WASC and this would affect the implied price. We use the first assumption (new entrant benchmark) to work through the practical questions for the valuation methodology, but recognise that there are different approaches that could be taken to the cost of capital where this matters to the valuation.

Two ways to calculate the economic value of sludge assets

312. Adopting the concept of economic value presented above, there seem to be two ways in which we can approach the calculation of the economic value of sludge assets, which we explain below.

313. If our economic value concept is based on a hypothetical price assumption, as above, then one approach to the valuation of the sludge assets of a specific wastewater company is a discounted cash flow approach follows:

(a) Estimate the hypothetical prices for sludge treatment and disposal services. This should take account of information on the new-build costs of sludge assets today and other determinants of price such as running costs and financing costs. It should also take account of the opportunities for revenues from other services such as energy generation, as part of sludge treatment, which could, in a competitive market, help to reduce the price that needs to be charged for wastewater sludge treatment.[13]

[13] Sludge assets and processes can be used to generate revenues from various different types of services, including: (i) the treatment and disposal of sludge produced as part of statutory wastewater functions; (ii) electricity or gas generation; (iii) sale of by-product to parties such as farmers. There is even the possibility that the revenues from energy generation are so great that no income is required from sludge treatment and disposal services for the sludge business to trade profitably and

(b) Estimate the future revenue streams using actual assets that would be generated by the wastewater company, given the hypothetical prices from (a) above and the estimated market prices (and subsidies) from other services such as electricity and gas generation. These revenues should reflect those attainable using the assets that the wastewater company has, not the hypothetical new assets assumed for the purposes of step (a).

(c) Estimate the future costs that the wastewater company will incur in generating the revenues under (b), leaving aside the historical purchase price or amortisation of its existing assets (e.g. focusing on future operating and maintenance costs). These costs should reflect those arising the using the assets that the wastewater company has, not the hypothetical new assets assumed for the purposes of step (a).

(d) Apply discounted cash flow analysis to produce a present value or capitalised valuation for the revenues and costs from (b) and (c) above. This will involve assumptions on the relevant financing costs or discount rates. The time period for the analysis should cover the remaining economic life of the company's actual assets. This present value can be taken as the economic value of the sludge assets.

314. This process is illustrated in Figure 1 set out at the start of this report.

315. This is one way to make the calculation of economic value. There is also a potential short cut which starts with the following observation. If the actual wastewater company's assets (tangible and intangible), running costs and financing costs used in steps (b) and (c) above are the same as those for the hypothetical price calculation under step (a), then we could just take the estimated hypothetical new-build asset costs from step (a) as the estimate of economic value. The other elements of the calculation would cancel out.

316. To the extent that there are differences between a wastewater company's actual assets and the hypothetical new assets, then we could calculate the economic value of the actual assets as the hypothetical asset costs adjusted for these differences. This gives rise to an alternative calculation and possible short cut:

(a) Estimate the cost of the hypothetical new-build assets that would be required to provide the volume of sludge treatment and disposal services that the wastewater company is expected to provide. This cost should be the purchase price or construction price if procured today.

(b) Identify differences between the actual assets of the wastewater company and the hypothetical assets assumed under step (a), and estimate the implications of these differences for the future flows of revenues and costs that arise from using the actual assets rather than the hypothetical assets. For example, the actual assets might be estimated to have an additional £1 million per year of operating and maintenance costs, compared to the hypothetical assets.

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it may treat the untreated sludge available for processing as a valuable resource for which it would be willing to pay a fee; this could be treated as a negative price for sludge treatment.

(c) Calculate the economic value of the wastewater company's actual assets as the new-build costs from step (a) adjusted for the present value (or capitalisation) of the revenue and cost differentials under step (b).

317. This process is illustrated in Figure 2 set out at the start of this report.

318. We provide in Table 6 an indication of various types of adjustment that could be considered for the purposes of step (b) above. These may not be comprehensive.

Table 6 Potential adjustments to reflect differences between actual and hypothetical assets

Scenario	Nature of adjustment for actual company
The actual asset owned by wastewater company has a shorter remaining economic life than the hypothetical modern asset (which by definition is a new asset)	Calculate a negative asset value adjustment to account for depreciation of the actual asset This adjustment could be made, for example, by combining the estimated remaining economic life of the existing asset and an appropriate annual depreciation charge for the modern asset
The actual asset owned by the wastewater company has higher ongoing operating and maintenance costs than the hypothetical modern asset	Calculate a negative asset value adjustment for the higher running costs of the actual asset The adjustment could either be made by estimating the total running costs of the actual asset and the hypothetical modern asset and taking the difference or by estimating the incremental running costs of the actual asset compared to the hypothetical modern asset
The actual asset owned by wastewater company does not have as much potential for commercial revenue generation as the hypothetical modern asset (e.g. does not provide for revenues from energy generation)	Calculate a negative asset value adjustment for the lower revenue generation capability of the actual asset The adjustment could either be made by estimating the total revenues from the actual asset and from the hypothetical modern asset and taking the difference or by estimating the difference in revenues directly.

319. Both of the calculation methods outlined above seem valid conceptually, and they would provide the same answer in a world of perfect information.

320. The second approach seems an attractive short cut in practice. It avoids the need to estimate individual market prices, which could vary by location and depend on the degree of long-term commitment in the services being procured. It may be easier to estimate the differences between actual and hypothetical assets than it is to produce a complete set of forecast costs and revenues the full discounted cash-flow approach.

321. A key implication is that, under either approach, it seems necessary to consider both the assets of the hypothetical new-build basis and the actual assets of the company. However, if the differences between the actual and hypothetical assets are considered small, and can be treated as immaterial, then it would be possible to calculate economic value by reference only to new-build assets or only to actual assets.

Net MEAV concept from Ofwat's previous regulatory reporting framework

322. The second calculation of economic value above has links to the "net MEAV" concept from Ofwat's previous regulatory reporting arrangements. For instance, RAG 1.05 (now withdrawn) states that:

> *"The gross MEA value is what it would cost to replace an old asset with a technically up to date new asset with the same service capability allowing for any difference both in the quality of output and in operating costs. The net MEA value is the depreciated value taking into account the remaining service potential of an old asset compared with a new asset, and is stated gross of third party contributions." (Paragraph 1.7.4)*
>
> *"In principle net MEAs of existing assets should be adjusted [for] the different operating costs of the actual assets compared with their modern equivalent. It is assumed that this has been done, for example, by deducting the present value of the difference in operating costs from the unadjusted MEA values." (Paragraph 1.9.6)*

323. This would go some way towards the adjusted asset valuation above, but is limited in the sense that no explicit reference is made in respect of adjustment for revenue generation capabilities. Furthermore, it is unclear whether in practice companies would have made the operating expenditure adjustments that should be done "in principle".

324. Because the net MEAV concept from RAG 1.05 is not identical to the economic value concept we introduced above, it is important not to confuse the two. The net MEAV reported in the past is a potential estimator or approximation of our economic value concept, but it is not the same thing. Furthermore, because the necessary adjustments for costs and revenues may be significant for sludge assets, we are concerned that the terminology of net MEAV may be overlooked because the difference between "net" and "gross" might simply be taken as the adjustment for depreciation.

Interactions with totex allowances and incentives

325. The economic value concept set out above is subject to an assumption about the value from assets under a hypothetical competitive counterfactual. This valuation may not align precisely with the economic value of assets in the real-world under the PR19 price control framework. There are potential differences between the economic value under a hypothetical competitive counterfactual and the economic value under the type of RCV-based revenue controls that Ofwat may use for sludge for PR19. In particular:

(a) If a company has made past investments in sludge assets which mean that its future operating and maintenance costs from its actual sludge assets are likely to exceed the regulatory allowances for these costs under the price control framework, then under a 50 per cent totex cost sharing incentive scheme (for example), 50 per cent of the excess is recoverable from customers through regulated charges. This partial pass-through of over-spend means that, under this price control framework, the "impairment" to asset values that is due in cases where a company's actual

assets have relatively high operating and maintenance costs is not as high as it would be under a scenario in which the company really did face competition.

(b) The economic value concept based on a hypothetical competitive counterfactual would imply that both upfront capital costs (asset costs) and ongoing running costs are those that would be faced on a hypothetical efficient new-build basis. However, even if the sludge RCV were set to capture this concept of economic value, the price control allowances for ongoing running costs would not necessarily be on this basis: they might reflect, for example, estimates of efficient costs which are derived from benchmarking analysis across actual companies. The combined effect may be such that the prices charged (and revenues expected) under the sludge price control differ to the prices (and revenues) that would arise under the hypothetical competitive counterfactual.

326. Both of these issues reflect the potential for a degree of inconsistency between the use of hypothetical new entrant/new-build assumptions for price controls for the purposes of economic value, and the price controls that Ofwat may set in practice for PR19. It may be possible to tackle this inconsistency by adjusting the calculation of economic value to take account of how Ofwat carries out wholesale cost assessment and how the totex incentives work for the PR19 sludge price controls. But this seems complex and may then distort the RCV allocation in the period from PR24 onwards when a different price control framework may apply.

327. We propose that these issues are left aside, and the economic value concept is done on the basis of the hypothetical competitive price assumption.

Appendix 2: illustrative scenarios for calculation of economic value

328. This appendix provides several examples which show how aspects of the methodology we have proposed could be applied in some illustrative scenarios. It is not intended to be comprehensive, but simply to help clarify aspects of the proposed approach.

Scenario 1: digestion site for which only difference to efficient new-build is concrete tanks	
Background	The digestion facility has a design capacity to process 10,000 TDS/yr. This is a combination of indigenous sludge from the co-located wastewater treatment works and imported liquid sludge. Sludge processes undertaken on-site are as follows: • Thickening • Digestion • Secondary Digestion • Dewatering • Biogas to Energy Generation (CHP + Boilers) Company business plan between 2017 and 2020 is to retain the current sludge assets. Post 2020 there is no plan to replace the assets other than the maintenance required to enable on-going operation.
Assumption on hypothetical new-build processes vs existing processes	WASC considers that hypothetical new-build design for site would involve the same set of processes, so the valuation approach is based on the existing site processes and design TDS throughput of 10,000 TDS/yr. However, the WASC identifies that a new entrant would install steel digesters, rather than concrete digester as the company currently has.

Scenario 1: digestion site for which only difference to efficient new-build is concrete tanks	
	The WASC identifies that the asset life for steel digesters is 25 years and concrete digesters have asset life of 60 years. As the existing digesters are concrete the WASC will continue to operate these until end of life.
Comments on valuation approach	Valuation needs to take account of the remaining asset life of the concrete digester exceeding the estimated asset-life for the hypothetical new-0build assets (steel digesters). This requires an upward adjustment as part of economic value calculation to reflect an aspect of existing assets that is more valuable than hypothetical new-build assets. Under straight line approach to depreciation, this adjustment can be done as follows: • Steel Digesters £2m estimated new-build cost • Residual life of concrete digesters is 30 years • Therefore adjustment for longer economic life of existing digesters is £2m x (30/25 – 1) = £0.4m. This reflects fact that hypothetical entrant would need to purchase a new tank in 25 years, whilst the concrete digesters will not be replaced for 30 years. For other parts of existing processes, a downward adjustment is made to the new-build costs to reflect remaining economic life being shorter than the assumed life for the new-build processes. The valuation is based on the same site processes therefore it can be assumed that operating costs and revenue streams (e.g. ROCs, electricity value) will be the same; no adjustment is required in respect of these.

Scenario 2: site for which new digestion processes will be commissioned before April 2020	
Background	The existing processes at the site are liming processes Company business plan between 2017 and 2020 is to change an existing site sludge operation from liming to digestion. The replacement is planned to be operational from 2019. The liming assets are coming to their end of life and will be decommissioned in 2019. The WASC currently has a net book value for these assets of £1m. It has included in its business plan to take any write-off costs associated with these existing assets. The new digestion facility, which has a design capacity to process 10,000 TDS/yr, will import sludge. This is a combination of indigenous from the co-located wastewater treatment works and imported liquid sludge. Sludge processes undertaken on site are as follows: • Thickening • Digestion • Secondary Digestion • Dewatering • Biogas to Energy Generation (CHP + Boilers) The replacement of the liming operation with AD reduces future operating costs, (e.g. through generation of electricity, mitigating cost of lime, sludge to land costs). Some of this benefit is off-set by new operating costs. The AD solution also provides improved business resilience and carbon performance.
Assumption on hypothetical new-build processes vs existing processes	The hypothetical new-build design for the site would be based on that which the company plans to have in place in 2019, with design TDS throughput of 10,000 TDS/yr.
Comments on valuation approach	The planned change from liming to AD before 2020 means that the liming assets are not relevant to the valuation exercise.

Scenario 2: site for which new digestion processes will be commissioned before April 2020	
	The estimate of the hypothetical new-build cost will reflect the new-build assumptions for the AD solution that are in the company plan/strategy for the site. There would be a small adjustment for the age / remaining economic life of the assets to reflect the expectation that the existing assets at the site are due to be commissioned in 2019 and would be one year old by the effective date of the valuation, so older than the hypothetical new-build assets from April 2020.

Scenario 3: liming site for which efficient new-build design would be digestion	
Background	Company long term plan is to move away from liming. Business has an existing liming operation which it will replace at some point in the future (post 2020) but the strategy, timing and funding is not defined. There is a range of options to replacing the site liming operations which include: producing a cake and transporting to an existing digestion facility with headroom, or build an AD plant at the site.
Assumption on hypothetical new-build processes vs existing processes	The company considers it highly unlikely that a hypothetical entrant would, if starting fresh on a new-build basis, develop the site on a liming basis. It decides that a reasonable assumption is that the hypothetical entrant would build an AD plant at the site. There is no plan for the company to move from liming to AD before 1 April 2020, so the existing processes for the purpose of the valuation are liming assets.
Comments on valuation approach	The hypothetical new-build cost should be those of the digestion facilities that the WASC assumes the new entrant would have. It will be necessary to make adjustments, as part of the economic value calculation, to take account of the remaining life of the existing liming assets being different to the economic life of the new-build AD plant. Given that the processes at the liming operation do not map across to similar processes at the hypothetical AD plant, the adjustment for the remaining life of the existing liming assets needs to make comparisons at the site level rather than process level. For example: • Suppose the assumed asset life for the hypothetical new-build AD processes at the site is 20 years. • Suppose estimated remaining life for existing liming processes is 8 years (NB: the total asset life for liming processes is irrelevant to the calculation in this scenario because we compare against the new-build AD design). • Suppose gross new-build cost of AD processes at the site is £12 million. • Then adjustment for remaining life of existing liming assets = £12 million * (8/20 - 1) = 12 million * (−0.6) = −£7.2 million. In addition there would a downward adjustment to reflect the NPV of higher operating costs of liming compared to AD over the remaining eight years of the life of the AD operations: suppose this adjustment is −£1.5 million. A further downward adjustment for the variance in revenues may also be applicable to reflect the additional income earned due to the operation of an AD plant versus the existing liming site: suppose this adjustment is −£2 million. On this basis, economic value of the existing liming assets at the site calculated as 12 − 7.2 − 1.5 − 2 = £1.3 million.

Scenario 4: liming operations considered to remain efficient new-build design for site	
Background	Business has an existing liming operation which it will replace at some point in the future (post 2020) but the strategy, timing and funding is not defined. Unlike scenario 3, the company's view is that the efficient approach at the site remains as liming, due to local circumstances, operational factors etc.
Assumption on hypothetical new-build processes vs existing processes	The company considers it a reasonable assumption that the hypothetical entrant would build a liming site. As with other scenarios, there will be a requirement for companies to include commentary to explain their assumptions of the hypothetical entrant.
Comments on valuation approach	Company provides valuation based on new-build costs of existing liming operation It will be necessary to make adjustments, as part of the economic value calculation, to take account of the remaining life of the existing liming assets being shorter than the economic life of the new-build liming assets For example: • Suppose gross new-build cost of liming processes is £5 million. • Suppose estimated asset life for new-build liming processes is 20 years. • Suppose estimated remaining life for existing liming processes is 8 years. • Then an adjustment for remaining life of existing liming assets made on a straight line basis = £5 million * (8/20 – 1) = 5 million * (–0.6) = –£3m. • So a downward adjustment of £3 million is applied to new-build costs to take account of shorter remaining economic life of existing liming assets. The company considers it reasonable to assume similar operating costs and revenues for the new-build liming assets as for the existing liming assets, so no adjustments are needed in respect of this. Economic value of existing liming assets calculated as: 5 – 3 = £2 million

Appendix 3: review of high-level approaches for the valuation exercise

329. This appendix sets out our review of some potential high-level approach to the valuation exercise. It is structured as follows:

(a) We first summarise Ofwat's preliminary views on the approach.

(b) We identify a number of alternative high-level approaches and provide an overview of our comparison of them against a set of specified criteria.

(c) We present a more detailed discussion of the benefits and risks of each of the approaches.

Ofwat's preliminary view on the high-level approach

330. In May 2016 Ofwat took a formal decision to adopt a focused approach to the RCV allocation for sludge, as part of its decision to introduce separate price controls for bioresources (sludge), and identified a number of ways in which the focused approach

could be carried out.[14] This followed its consultation in December 2015.[15] Since May 2016, Ofwat and wastewater companies have discussed the approach to sludge RCV allocation further, at meetings of the sludge working group organised by Ofwat.

331. At the start of this project, Ofwat shared with us its initial thinking on the most appropriate approach to the sludge RCV allocation, of which the main points were as follows:

(a) The allocation would use net MEAV estimates for sludge assets.

(b) It would be each wastewater company's responsibility to produce MEAV estimates for its sludge assets, subject to guidance published by Ofwat.

(c) Companies would revalue their sludge assets rather than rely on a roll-forward of figures from 2014/2015 regulatory accounts (which were, themselves, mainly based on a roll-forward of figures produced as part of the PR09 periodic review process).

(d) Ofwat would review and cross-check the valuations produced by wastewater companies, and have the opportunity to provide feedback to companies to enable companies to refine or revise their estimates, if necessary, before the RCV allocation for sludge is finalised.

(e) The RCV allocation between sludge and wastewater network plus at PR19 would be a once-and-for-all allocation.

332. Ofwat emphasised to us that these points reflected its preliminary ideas and that it was important that we challenged these as part of the project and considered alternative options drawing on other regulatory precedent.

Initial set of high-level approaches

333. We identified an initial set of high-level approaches that could be applied to produce estimates of the economic value of each wastewater company's sludge assets (see Appendix 1 for an explanation of what we mean by economic value).

334. We summarise the key features of these approaches in Table 7 and indicate the respective roles that Ofwat and wastewater companies would have under each approach. These approaches include one which is intended to capture the type of approach envisaged by Ofwat in its preliminary thinking (approach B), and five alternatives that differ from this in various ways.

[14] Ofwat (2016) *Water 2020: Our regulatory approach for water and wastewater services in England and Wales*, May, pages 118-119.

[15] Ofwat (2015) *Water 2020: Regulatory framework for wholesale markets and the 2019 price review*, December, pages 62-69.

Table 7 High-level approaches for estimating the economic value of sludge assets

	Roles and responsibilities	Key features
A	• Company responsible for valuation in the first instance • Ofwat carries out review of company valuations before determining RCV allocation	• Starting point is net MEAV from regulatory accounts, which is based on the approach to the AMP valuation at 31 March 2008 used for purposes of PR09 • No significant changes to the regulatory accounting guidance for MEAV used for these purposes • Limited scope for companies to revise existing valuations, other than for additions and disposals since the PR09 valuation, application of RPI indexation and adjustment for boundary changes
B	• Company responsible for valuation in the first instance • Ofwat carries out review of company valuations before determining RCV allocation	• Starting point is net MEAV concept from regulatory accounts, but companies re-visit valuations to produce up-to-date estimates and reflect revised guidance and boundary changes • Potential for significant changes to the regulatory guidance on MEAV estimates • Companies may draw on range of techniques including bottom-up models or new-build engineering costing for process or outputs (subject to regulatory guidance)
C	• Company responsible for valuation in the first instance • Ofwat carries out review of company valuations before determining RCV allocation	• Starting point is the historical purchase price and depreciation information used for statutory accounts, with adjustments for inflation but without re-valuation • Explicit assumptions for inflation adjustment (e.g. transparent indexation rules) • Mapping of asset inventory to sludge treatment and disposal based on allocation used for regulatory accounts • Information may not be available for all assets, and some extrapolation / estimates may be needed for the gaps
D	• Ofwat responsible for valuation exercise • Companies provide requested information	• Development of database of notional or standardised assets used in sludge treatment and disposal activities • Each company provides information on the number of its actual assets within each standardised asset category, drawing on information in its asset inventory • Common industry-wide assumptions made for unit costs of the modern versions of the standardised assets (on gross MEAV basis), potentially with adjustments for regional cost differences • Adjustments for age, running costs and revenue potential of each company's actual assets based on high-level industry-wide estimates/modelling (e.g. actual assets x% higher opex on average than modern assets; average depreciation = 0.5 gross asset value) • May require some company-specific valuations for bespoke assets or adjustments for special circumstances
E	• Ofwat responsible for valuation exercise • Companies provide requested information	• Development of bottom-up model of hypothetical new entrant sludge (and energy) company • Scale up model to estimate assets required to meet estimated output volumes/capacity of the actual wastewater company • Potential to take account of company-specific features (e.g. number and size of sewage treatment sites; disposal opportunities, etc) within the design and input data of the model

	Roles and responsibilities	Key features
		• The model produces estimate of gross value of assets for each company on a new-build basis • Economic value calculated by taking that estimate and making adjustments for age, running costs and revenue potential of each company's actual assets • These adjustments based on high-level industry-wide estimates/modelling (e.g. actual assets x% higher opex on average than modern assets; average depreciation = 0.5 gross asset value) • May require some company-specific valuations for bespoke assets or adjustments for special circumstances
F	• Ofwat responsible for valuation exercise, drawing heavily on input from single set of consultants • Companies provide requested information	• Ofwat appoints consultants to carry out bespoke assessment of the new-build costs for each wastewater company's sludge activities • Take location of sewage treatment works and volumes of sludge produced as given. and then base costings on optimal modern design given these constraints • Consultants would need to estimate adjustments for differences between actual assets and assets under assumed optimal modern design (e.g. differences in operating expenditure) • Use of same engineers for valuation across all companies to provide a degree of consistency in approach

335. In compiling the approaches listed in Table 7, we drew on Ofwat's Water 2020 publications, our high-level review of regulatory precedent and copies of presentations from Ofwat's sludge working group. These approaches represent possible packages of options, tailored to the requirements of Ofwat's RCV allocation exercise, rather than off-the-shelf solutions.

336. The approaches in Table 7 are better seen as potential starting points for the development of a methodology for the sludge RCV allocation rather than as the end point. For any of these approaches, there are a variety of ways in which it could be implemented, which cannot be captured within the high-level categorisation. Approaches that at face value seem quite different could end up converging, depending on the details of how they are applied in practice.

337. These potential approaches do not exhaust the set of possible approaches, but they represent those which we considered most important to expose and review at the start of the project. One further possibility which Ofwat mentioned in its December 2015 consultation paper was to base the focused RCV allocation for sludge on "net capex spend over a relevant period of time".[16] However, we did not identify a way to estimate the economic value of sludge assets that would be based primarily on measures of capital expenditure yet would differ significantly from an approach based on historical purchase prices (e.g. approach C above), though estimates of future spend could form part of the cross-checks on other approaches.

[16] Ofwat (2015) *Water 2020: Regulatory framework for wholesale markets and the 2019 price review*, December, page 65.

Review of high-level approaches

338. While much can turn on the details of how a particular approach is implemented, the starting point is likely to have a substantive influence on the outcome and risks. We carried out an initial review and comparison of the high-level approaches. We first set out in Table 8 the main assessment criteria that we used to compare them and summarise why these matter. These do not capture all of the relevant differences in approach, but we tried to expose what seemed most important.

Table 8 Assessment criteria applied to comparison of high-level approaches

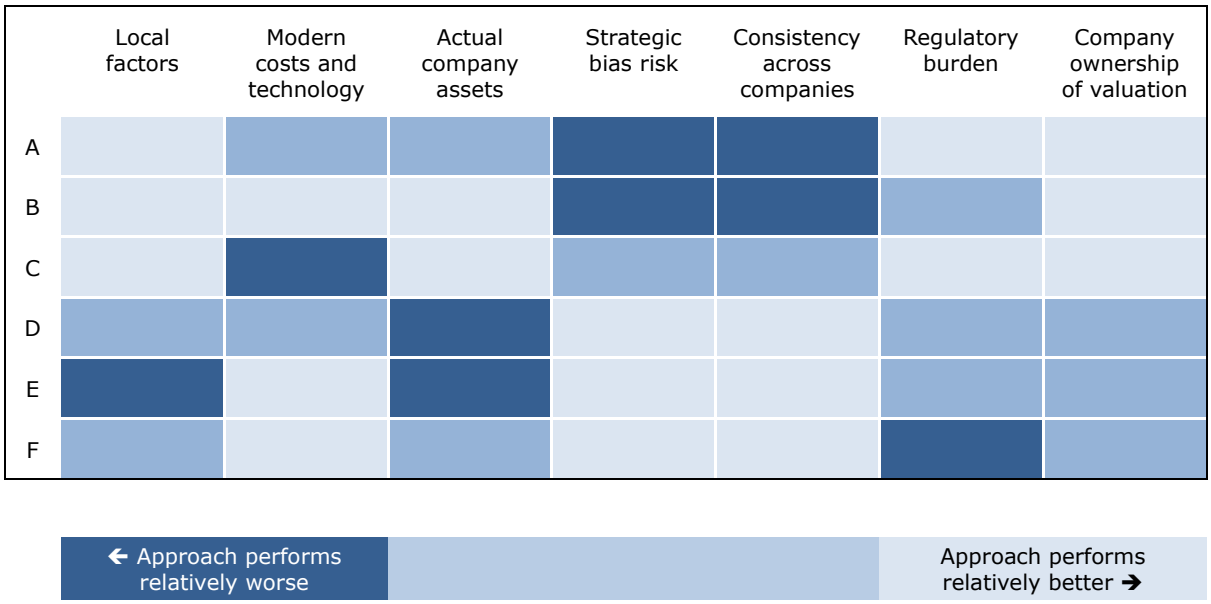
Criterion	Why it matters
Accuracy of approach in capturing the economic value of sludge assets We used four separate sub-criteria that contribute to accuracy and aid a comparison of approaches: • Account of local factors (e.g. demand, rurality, disposal opportunities) that affect the asset requirements of the company • Account of modern costs and technologies and in the estimation of economic value of assets • Valuation of assets of each wastewater company takes account of the actual assets owned by that company • Vulnerability to risk of strategic bias by wastewater companies in valuation exercise[17]	• Affects the extent to which the RCV allocation for sludge will achieve Ofwat's objectives for the focused RCV allocation in terms of the role of markets (e.g. ensuring that competition in wider waste markets is not distorted and sending the right price signals to third party service providers) • Depending on Ofwat's approach to PR24 and subsequent price control reviews, inaccuracy in the valuation may bring risks in the future of unduly high prices for captive wastewater customers or unduly low returns for investors • Inaccuracy in the PR19 valuation may make it more difficult to introduce further regulatory or legislative changes in the future to develop the role of markets (e.g. if doing so would provide companies and their investors with large windfalls at the expense of captive wastewater customers)
Consistency across wastewater companies in methods and assumptions used for valuation	• Perceptions of inconsistency in the valuation may mean that the valuation is not credible to external parties, such as other market participants who may be deterred by concerns about unfair competition • Inconsistency may lead to difficulties in setting future price controls for sludge (e.g. PR24) that draw on cost comparisons between companies, posing risks of unduly high prices for captive wastewater customers or unduly low returns for investors
Regulatory burden for Ofwat, water companies and other stakeholders from the valuation process	• Need to avoid disproportionate costs from the valuation exercise • Water 2020 programme requires input from Ofwat and other stakeholders across a number of challenging issues and there is a risk that excessive time and resource on RCV allocation could compromise other tasks

[17] This risk reflect the combination of the subjectivity in the valuation exercise and the potential that a wastewater company has a strategic interest in the outcome of the exercise (e.g. because it affects the level of RCV retained in network plus or has implications for its pricing in sludge and organic waste markets). We cannot draw firm conclusions about each company's interests in the RCV allocation outcome. Companies will have their own commercial and regulatory strategies and will prioritise different issues. But overall we considered it unlikely that each company will be indifferent to the amount of its RCV that is allocated to the bioresources price control. It seemed probable, though not certain, that companies would favour a low allocation of the RCV to sludge.

Criterion	Why it matters
Extent to which each company has ownership of the valuation of its assets used for the sludge RCV allocation	• Ofwat's regulatory approach has sought to promote greater company ownership of elements of the regulatory framework, such as price control business plans, customer engagement and charging compliance issues, at least where Ofwat considers appropriate from a risk-based perspective

339. We summarise in Table 9 our assessment of the high-level approaches from Table 7 against the assessment criteria from Table 8.

Table 9 Assessment of high-level approaches



340. We provide further comments on our review of each approach in the sub-sections that follow.

Approach A: simple update to MEAV figures from 2014/15 regulatory accounts

341. One approach to the RCV valuation would be to draw primarily on the net MEAV figures for sludge produced by each wastewater company for the purposes of the 2014/15 regulatory accounts. These represent a roll-forward and update to the MEAV valuation exercise carried out for the purposes of the PR09 periodic review. The same regulatory accounting guidance would apply as used for the 2014/15 figures. The main updates would be for outturn investment since 2014/15 and forecasts of investment in the period to 31 March 2020.

342. This approach performs relatively well in terms of the regulatory burden, because it would draw heavily on existing guidance and existing figures.

343. In terms of accuracy, we highlight the following:

(a) We would expect companies to have taken account of local factors that affect their asset requirements in carrying out their MEAV valuation for PR09.

(b) The use of a form of MEAV approach for the PR09 valuation and updating since then for recent investment means that the approach would take some account of modern technologies. However, the extent of technological and commercial changes in sludge management since the PR09 valuation means that we would expect there to be significant limitations in the accuracy of these figures.

(c) At the time of the PR09 MEAV exercise, Ofwat's work on accounting separation was in its early stages. Sludge was not separated out until 2009/10. It is likely that 2014/15 MEAV figures for sludge would reflect allocations of figures produced before the relevant accounting separation of sludge, which could bring inaccuracy. Furthermore, there have been subsequent changes to the regulatory accounting boundary between sludge and other wastewater activities. Finally, the targeted review carried out for Ofwat by CEPA identified a number of issues and inconsistencies with companies' reporting of sludge costs.[18]

344. This approach would provide companies with limited ability to influence the figures used for its RCV valuation for sludge, as it would be draw heavily on the figures from 2014/15 regulatory accounts. Nonetheless, this approach is vulnerable to strategic bias risk because the MEAV figures that wastewater companies submitted to the PR09 periodic review process may have been affected by strategic considerations concerning the use of the figures in the PR09 price control determinations (quite a different role than the use of MEAV for the purpose of the sludge RCV allocation).

Approach B: company-led MEAV valuation tailored to the sludge RCV allocation exercise

345. We defined Approach B to capture a high-level approach along the lines of that suggested by Ofwat at the start of the project. In describing Approach B in Table 7 we fleshed this out further, to ensure that it is directed at the economic value concept that we proposed to use.

346. This approach performs relatively well in its ability to take account of local factors affecting a company's assets and costs, of technological and commercial developments and the state and capabilities of its existing assets. It would make use of the fact that information on companies' actual assets and the local factors that would affect new-build asset requirements is dispersed across companies and is difficult to centralise.

347. There seems a risk that the accuracy of the RCV allocation process is compromised by strategic behaviour of wastewater companies, who may seek to achieve a low RCV valuation; this could harm Ofwat's objectives for market development and poses risks of inadvertently transferring value from captive customers to investors. There may also be concerns about inconsistency across companies in the methods and assumptions used, which could reduce the credibility of the outcome. These issues are exacerbated by the extent of subjective judgment and uncertainty involved in the approach.

[18] CEPA (2016) *Targeted review of sludge and water resources*

348. Furthermore, though this approach performs no worse in our comparison than any of the others in terms of reflecting modern costs and technology, it may still fall short against this criterion on an absolute basis. Each individual company can develop a view of what would be an efficient and up-to-date approach if it were to redesign and rebuild its sludge processes, but this is somewhat limited by the information, culture, practices and experience of that company and its advisors.

349. As with some of the other approaches, there is considerable scope for variation in how Approach B is implemented. The extent to which the drawbacks and risks above arise in practice will depend, in part, on what measures Ofwat takes to achieve greater consistency and the nature and effectiveness of the risk-based review that it carries.

Approach C: company-led valuation based on historical costs adjusted for inflation

350. An alternative to the MEAV-based approaches under A and B above would be to take the information on historical purchase prices and accumulated depreciation that a wastewater company has used for its statutory accounts as the starting point for the valuation. Adjustments could then be made to move towards measures of modern costs and economic value by applying transparent indexation rules (e.g. CPI or RPI indexation) to the historical data. Although the statutory accounts do not report data at the level of sludge assets, figures for sludge could be developed by mapping the company's asset inventory to the asset allocations used for regulatory accounts (though these may need updating).

351. This approach performs less well than other approaches in taking account of modern costs and technology. The extent of technological and commercial changes in sludge management over recent years means that the application of an inflation index to convert from historical costs to modern costs is crude. Some assets will have become obsolete. However, against this, the shorter assets lives for some sludge assets compared to other parts of water and wastewater activities means that the distance between historical purchase and today will tend to be less, creating less of a divergence between historical and modern costs than for very long-lived asset.

352. This approach would involve less subjectivity and uncertainty in the valuation process, and seems less vulnerable to strategic bias risks and inconsistencies than Approaches A and B above. It also has a relatively low regulatory burden.

353. There may be a possibility of using an approach along these lines as a cross-check on estimates produced from another approach (e.g. requirements for company-led MEAV valuations to be reconciled with historical cost used for statutory accounts).

Approach D: valuation built up from common asset unit costs assumptions

354. Approach D would be based on the development of a database of notional or standardised assets used in sludge treatment and disposal activities, and calculations to produce an asset valuation for each company. The companies would provide input data on the number of their assets in each of a series of defined categories, drawing on information in its asset inventory. These would be combined with common industry-wide assumptions made for unit costs of the modern versions of the standardised assets (on gross MEAV basis). The valuation would then need to take account of how actual

assets may differ from hypothetical modern assets. This could be done using approximations within the industry-wide valuation tool (e.g. an assumption that actual assets typically have X% higher operating costs on average than modern assets or that average depreciation is half of the gross asset value). There may then be a case for considering company-specific valuations for bespoke assets or adjustments for special circumstances.

355. This approach performs relatively well in terms of consistency and limiting the risks relating to strategic bias. This comes from the emphasis on cross-company standardisation in the valuation calculations.

356. It performs less well than some of the other approaches in its ability to take account of local factors, actual assets and modern costs and technologies. Because the tool would be built up from information on existing assets, rather than on processes or outputs, we think it would be hampered in its account of modern technologies: specific assets might be revalued on a modern equivalent basis but this could miss important opportunities for redesign of processes or new ways of organising and managing sludge treatment and disposal. Furthermore, it would use a very approximate approach for taking account of each company's actual assets, which would affect its accuracy and may be particularly contentious with companies that feel unfairly treated.

Approach E: valuation based on bottom-up model of hypothetical new-build costs

357. Approach E provides an alternative to Approach D as a way to promote consistency across companies and tackle the risks of strategic bias. The starting point is the set and volume of services that the sludge treatment and disposal business would need to provide the wastewater network plus business, defined in terms of the volumes (average and peak) of sludge produced at each sewage treatment site. The valuation would be based on a model, or series of models, than can produce estimates of asset requirements and costs to treat the specified volumes of those services. These could represent the assets required by a hypothetical new entrant. The same model would be used for all wastewater companies, and the model could draw on input data that reflects local characteristics and the locations of sewage treatment site.

358. As with Approach D, a further step would be needed to produce an estimate of the economic value of a wastewater company's actual assets using the estimated new entrant or new-build asset costs. This would involve assumptions for factors such as depreciation for the existing assets and differences in running costs and revenue generation capabilities.

359. This approach performs relatively well in taking account of modern costs and technologies, and the use of a common model across the industry would help to bring consistency and limit risks from strategic bias. The primary drawbacks of this approach are that it performs relatively badly against the criteria of reflecting local costs and companies' actual assets. These would act against the accuracy of the approach and may be particularly contentious with companies that feel unfairly treated by the model outputs.

360. We would be much more encouraging of an approach involving the development of a bottom-up model if this would also be used as the basis for setting the sludge price

control for PR19: i.e. the asset valuation and the price control calculation for sludge would be a combined exercise (e.g. as for price controls in the UK telecoms sector). This would allow for a greater degree of internal consistency and make more use of the time and effort required for the sludge asset valuation. However, Ofwat has already decided to use a totex building blocks approach for sludge at PR19 and has not indicated its preferred approach to subsequent sludge price controls.

Approach F: bespoke MEAV valuation for each WASC carried out by a single consultancy

361. Under Approach F, a single consultancy company would be appointed by Ofwat to carry out a bespoke assessment of economic value for each of ten wastewater companies. This would involve detailed work with each company to develop a plan of what modern efficient approach would be in that company's region and to understand the condition and capabilities of the company's existing assets.

362. The role of the single consultancy would contribute to the consistency of the approach and limit risks of strategic bias by supporting common methods, assumptions and judgements in the valuation exercise.

363. The use of bespoke assessments for each company would help to take account of the local costs and actual assets. But we would not expect this to be to the same degree as if the company had done the valuation itself as there will be limitations to the extent to which the consultants can get on top of all the relevant aspects.

364. In our assessment, we consider that this approach would have the largest regulatory burden of the high-level approaches identified. It would involve extensive and detailed requirements from the consultants, considerable input from wastewater companies, and further input from Ofwat in an oversight role.

Appendix 4: regulatory precedent

365. We set out in Table 10 a summary of a high-level review of some UK regulatory precedent. These are focused on decisions relating to the allocation of RCV, to the determination of RCV and, in the case of the judgment by the Competition Appeal Tribunal, on the relevance of considering costs of a hypothetical new entrant. We have sought to provide in the table some context to each precedent and to highlight those points in each decision/report that seemed to us to be of greatest relevance to the work in hand.

Table 10 Summary of regulatory and legal precedents

Report / Decision	Comment
Monopolies and Mergers Commission (1995) *Scottish Hydro-Electric Plc: A report on a reference under section 12 of the Electricity Act 1989*	• Report deals with reference relating to the price controls on Scottish Hydro-electric's (HE) distribution and supply activities. At time of privatisation, HE was allowed to cross-subsidise distribution (as well as transmission) from its generation business; called the "hydro benefit" to cover their higher costs.

Report / Decision	Comment
	• The MMC decision estimates the value of the "hydro benefit"; does so by valuing HE's generation business. MMC adopts approach of doing this on basis of valuing stream of revenue — based on forecast energy prices and sales —and costs of HE's generation (covering operating costs, depreciation and return on assets).
Ofgem (2001a) *Review of Transco's price control from 2002 Initial thoughts consultation document* Ofgem (2001b) *Review of Transco's Price Control from 2002 Final proposals* Monopolies and Mergers Commission (1997) *BG plc – A report under the Gas Act 1986 on the restriction of prices for gas transportation and storage services*	• Ofgem set separate price controls for (i) the National Transmission System (NTS) in its role as transmission asset owner; (ii) the 12 local distribution zones in aggregate; and (iii) metering and meter reading. • To implement the separate controls, Ofgem attributed Transco's regulatory asset value across the three sets of activities. Two questions: (i) how to value Transco's assets as a whole; and (ii) how to allocate this across the three activities. • In respect of question (i), Ofgem revisited the discussion of focused vs unfocused approach of valuing the assets of Transco as of 31 December 1991. That discussion had been rehearsed by MMC in its 1997 and 1993 report, and by Ofgas in its proposals in 1996. (Ofgem 2001a, para 7.49). The two approaches refer to alternative ways of valuing the assets of British Gas that are associated with its unregulated activities, namely its exploration and production business; the valuation of those assets would then be deducted from Transco's overall regulatory value with a view to obtaining a value of Transco's regulated assets. Under a focused approach, the unregulated assets would be valued at "market value or at their full current cost book"; under an unfocused approach, they can be valued at their current book value adjusted for the market-to-asset ratio (MAR) of 60 per cent. The MAR refers to the ratio of British gas's market value in 1991 to its current cost book, and is often referred to as reflecting the "privatisation discount". Ofgem chose to follow the unfocused approach to calculate Transco's overall regulatory asset value. • In respect of question (ii), Ofgem also chose to follow an unfocused approach, allocating Transco's overall RAV across the three businesses (transmission, distribution and metering) subject to separate price controls according to the relative book value of the assets. • In its final proposals, Ofgem outlines Transco's view that "the RAV [Regulatory Asset Value] for the metering business is greater than depreciated replacement cost, and that this would lead to the stranding of metering assets." On these grounds, Transco had proposed that the allocation of the overall RAV across the three activities on the basis of relative book value of assets be adjusted with a transfer from metering to transportation to reflect the costs of those stranded metering assets. Ofgem did not accept that adjustment.
Ofgem (2001) *Review of Transco's Price Control from 2002 Final proposals* Ofgem (2003) *Separation of Transco's distribution price control: Final proposals*	• Ofgem decision on how to allocate the RAV across the regional gas distribution networks. Includes discussion of two approaches: (a) allocated on basis of physical assets; (b) allocation on basis of charging levels and cash flows. • Transco had submitted evidence on how to allocate RAV on basis of physical assets; it did this on basis of the Net Book Value of each of the regional networks. In turn, that was calculated on basis of a bottom-up model, which was built up by considering asset-category by asset-category for each of the regional networks. • Ofgem was concerned that Transco's approach of allocating the RAV on basis of net book value (NBV) would affect charges across regions; it emphasised importance of minimising "unnecessary disturbances" in charges. As such, it chose to allocate RAV on the basis of charging levels and cash flows, such that it would match the allowed revenue allocated (or forecast) for each of the regional networks under the price control for Transco that was then in place.

Report / Decision	Comment
Ofgem (2003) *Electricity distribution price control review – metering issues. Initial consultation* Ofgem (2004) *Electricity distribution price control review: final proposals* Ofgem (2006) *Metering price control review*	• At the 2004 price control for electricity distribution companies (DNOs), Ofgem set a separate price control on the DNOs provision, installation and maintenance of meters. • Ofgem split the regulatory asset value of the DNOs between distribution and metering with a view to setting the separate price control for metering. • Ofgem considered options of valuing the metering assets on basis of (i) depreciated historical cost basis, or on basis of (ii) purchase price of a modern equivalent metering asset, depreciated in line with the DNO's depreciation policy to reflect the age of the asset. • Ofgem adopted the second approach. The difference between the historic value and the depreciated replacement cost remained with the distribution regulatory assert value. • Ofgem notes that "The benefit of this approach is that it will provide a more market orientated value to the metering asset thus facilitating competition and it will mean that the DNOs recover the difference between what they were obliged to purchase as the result of licence obligation and the market value of the asset" (Ofgem, 2004 para 6.9) • Ofgem also notes that its chosen approach "does not unduly restrict the sale of metering assets or businesses to third parties". (Ofgem 2003, para 5.4) • Ofgem recognises that approach to valuing the DNOs' metering assets is different from that taken to valuing Transco's metering assets at the 2002 Transco price control review. For that exercise, Transco's metering assets were based on "adjusted depreciated historical cost". Ofgem states that this was to ensure consistency with the approach taken by the MMC in 1997 in valuing Transco's assets in general. Ofgem considers that it would not be appropriate to use that as a precedent. (Ofgem, 2003, para 5.5).
Ofcom (2004) *Valuing BT copper network*	• Relates to BT's network assets between its telephone exchange and each user of telecommunications services. Costs associated with these form part of costs of some services provided by BT to other providers to enable these to provide services to their customers. The review centred on approach to valuing those assets, with knock-on effects on charges that BT would set. • Review brings out relation between use of historical and current cost accounting (HCA, CCA), and intended regulatory objective: (a) In 1996/97, Oftel had concluded that BT's use of HCA, and the setting of charges on that basis, did not provide appropriate signals to BT, competitors and consumers. It mandated BT to produce regulatory accounts on a CCA basis. (b) In 2004, Ofcom took view that it would be unlikely that BT would face competition from a new entrant in near future. Given this, Ofcom's concern became one of ensuring price paid for using BT's network is not too high, rather than concerns that price would be such as to allow/attract entry. • In its 2004 review, Ofcom assesses merits of retaining CCA and of returning to HCA. It notes (i) HCA would ensure lower prices; (ii) CCA involves degree of judgement as to deciding on MEAV; (iii) preparing CCA is resource intensive; (iv) HCA gives poor signal to investment and to consumers; and (v) use of CCA is consistent with use of LRIC standard, used in controls on network charges. Ofcom takes view that use of CCA remains appropriate. • Within the context of using CCA, Ofcom considered a number of options to value BT's copper network, spanning different choices made with respect to whether it should be based on BT's current network of assets or on basis of optimised deployment, on current or new technology.

Report / Decision	Comment
	• With respect to options of constructing a model of a hypothetical network, Ofcom ends up concluding that it is not appropriate to value BT's copper network on basis of what it would cost someone else to a build a brand new network, rather than replacing what BT has "as there is great subjectivity in the modelling and it is important that the model is right if it is to be used." Also points that use of such modelling would involve Ofcom becoming "intrusively involved in BT's internal network planning and investment decisions, [and that] it is better to base costs on something real, i.e. BT's network." • Ofcom decided to create a RAV to represent the value of the pre 1997 assets (i.e. those prior to BT moving from HCA to CCA). That RAV was set equal to HCA of those assets as of the 2004/2005 financial year, and indexed with RPI. This was considered to deal with the risk of BT over-recovering for those assets that were already in place when the change from HCA to CCA was made. (There would be no over-/under-recovery on assets deployed after 1997 as these had been consistently treated under CCA). • Further points of interest: (a) Ofcom took view that it is not appropriate to reduce BT's valuation to account for spare and surplus network assets, or for fact that some of its assets are no longer available new. As above, this was based on view that such adjustments would be subjective and that is best to base costs on BT's actual network. (b) Ofcom took view that BT's estimate of the manpower cost of building network was the most objective estimate available of what it might be if the network were to be replaced.
Ofcom's *Review of Mobile Cost Termination* Competition Commission (2003) *Vodafone, o2, Orange and T-Mobile,* December Competition Commission (2009) *Mobile phone wholesale voice termination charges - Determination*, January Ofcom (2015) *Mobile call termination market review 2015–2018 – Statement on the markets, market power determinations and remedies*, March Ofcom (2011) *Wholesale mobile voice call termination Statement*, March	• Ofcom sets maximum charges on mobile cost termination on operators deemed to have significant market power. • The cap is set to reflect the competitive price level, largely on efficiency grounds; a signal to entrants and to existing operators. • Cap determined on basis of a bottom-up model of a hypothetical efficient operator. The model is designed by Ofcom's consultants. • Model involves designing the network that such an operator would run (i.e. not based on networks of existing operators), and assumes use of current technology (does not necessarily reflect that of current operators). Draws on unit cost data from operators to estimate cost of hypothetical network. • The model determines how the estimate of the lifetime operating and capital expenditure of network are to be recovered over time to reflect "economic depreciation", which matches the cost of equipment to its actual and forecast usage over the long term. • Whilst the model is of a hypothetical efficient operator, the model is then calibrated against actual data from the largest providers to ensure model produces reasonable estimates of their costs. This is focussed on the asset counts for key equipment, and on checking against operators' actual accounting costs. (Appendix 9) • From 2011, Ofcom opted to move from LRIC+ to LRIC standard. The former included the recovery of common costs (common to the mobile cost termination services and to other services), whilst the latter does not. Use of LRIC backed by decisions of CC, and in line with European directives. • Design and updating of the model appears to be resource-intensive. But it is drawn on periodically, as part of Ofcom's review of MCT charges, rather than used for a one-off exercise.

Report / Decision	Comment
Civil Aviation Authority (2002) *Heathrow, Gatwick and Stansted Airports' price caps, 2003–2008: CAA recommendations to the Competition Commission* Competition Commission (2002) *BAA plc A report on the economic regulation of the London airports companies (Heathrow Airport Ltd, Gatwick Airport Ltd and Stansted Airport Ltd* Competition Commission (2008) *Stansted Airport Ltd, Q5 price control review*	• The 2002 Reference by the CAA to the Competition Commission (CC) includes discussion of approach to splitting the regulatory asset base between aviation activities and commercial activities, as part of the CAA's proposed move from a "single till" to a "dual till" approach to price control. • The CC decided to maintain a single till approach, and so did not need to decide on approach to splitting RAB between activities. • Following MMC recommendations, the CAA created a RAB for each of the London airports for the third price control period, starting in April 1997. The CAA created the RAB values based on the individual airports accounts for the year 1990/1991, which were prepared on a CCA basis, updated for actual, or forecast, capex, depreciation and RPI movements for the following six years to 31 March 1997. • The CC notes in a footnote to its 2008 decision on Stansted that, other than drawing on CCA figures, other methodologies for establishing an RAB "may include pure historical cost, replacement cost or value-based methodologies such as fair market value or deprival value." (Footnote 2, Annex E, CC (2008))
ORR (2005) *Disaggregating Network Rail's expenditure and revenue allowance and the future price control framework: a consultation*, June ORR (2005b) *ORR's approach to regulation in Scotland: Conclusions,* December	• As part of Government policy to transfer responsibility for rail strategy and funding in Scotland to Scottish Ministers, in 2005 the ORR set out its approach to regulation in Scotland. This included its approach to disaggregating Network Rail's RAB (at 1 April 2006) between England and Wales, and Scotland. • It followed a "composite" approach, which considered the effects of both the underlying value of the assets and that level of use that the assets incur. It involved three steps: (i) It determined a split on the basis of the expenditure allowance for the access charge review in 2003. This was a proxy for a split on the basis of the value of the assets. This split was then weighted by share of renewals expenditure that does not vary with use. (ii) It determined a split on basis asset usage, on basis of total gross tonne kilometres travelled in each area. This split was then weighted by the share of renewals expenditure that does vary with use. (iii) It combined (i) and (ii). • Ahead of settling on its preferred approach, ORR had consulted on a number of options for disaggregating the RAB. These fell into two camps: (i) Calculating an "inferred RAB", whereby the regional access charge income Network Rail would have received if there were no grants and the existing regional costs are used to infer an opening value of RAB in Scotland. The ORR provides little detail on this. (ii) Calculating an "assessed RAB", where the GB-wide RAB is disaggregated using a proxy measure for the value of Scottish assets. The ORR considered various such proxy measures including ones based on asset volumes; current revenue; past expenditure levels; forward expenditure requirements MEA. (ORR 2005, pp. 49 ff)
ORR (2013) *Final determinations of Network Rail's outputs and funding for 2014–19* ORR (2016) *2018 periodic review of Network Rail (PR18) Initial consultation*, May	• For the 2018 periodic review of Network Rail (PR18), ORR proposes to allocate the total RAB at a route-level. This sits within ORR's proposals to focus its approach to regulation on individual routes, mirroring the increased devolution by Network Rail to its route business units. (ORR, 2016c, p. 1)

Report / Decision	Comment
ORR (2016b) *2018 period review of Network Rail (PR18) Response to initial consultation* ORR (2016c) *Working paper 1; Implementing route-level regulation*, PR18 working paper	• For the previous price control review, in 2013, (PR13), the ORR had already calculated RAB for the nine operating routes in England and Wales, though these were merely indicative. This was based on allocating the RAB for England and Wales across the set of routes. This drew on Network Rail's methodology for disaggregating the Fixed Access Track Charges (FTAC) — the revenue requirement of Network Rail net of its variable track charges, regulated station charges, network grants and other single till income —, which in turn was based on the route-level assessments of long-run renewal costs. (ORR, 2013, p.896) Regulatory financial statements, which include information on maintenance and renewals spend, are produced at route-level. • ORR is due to consult further on the allocation methodology in December 2016.
Competition Appeal Tribunal, *Albion Water v Water Services Regulation Authority (Shotton case)*, judgment of 6 October 2006 and judgement of 7 November 2008 on unfair pricing.	• The judgment by the Competition Appeal Tribunal (CAT) considers the relevance of alternative costing and asset valuation approaches (including hypothetical new entrant) for the purposes of examining Ofwat's decision on allegations of excessive and unfair and pricing by a dominant water company under UK competition law. • In its main judgment, the CAT finds that, in that context, it was not relevant to consider the costs of a hypothetical new entrant, and that the focus should be on the actual costs of the dominant water company in providing the service. • In its judgment on unfair pricing, the CAT assesses the unfairness of the prices charged by the dominant water company by references to the economic value of the services provided by the dominant water company. (CAT judgment 7 November, para 220 to 249). The CAT considers that the economic value of the service provided will reflect the costs of supplying that service (plus a reasonable return) and, if relevant to the case at hand, of "non-cost related factors". i.e. "factors other than the cost of supplying a product or a service but which mean that a product or a service has a particular enhanced value from the customer's perspective" (para 222). The CAT reviews a number of such factors put forward by the water company and concludes that in the case before it these are not relevant.