REGIONAL PRICE ADJUSTMENTS

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REPORT FOR THE UTILITY REGULATOR

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CEPA

CONTENTS

1. INTRODUCTION

The Utility Regulator is minded to apply regional price adjustments (RPAs) to the capital unit cost assessment in its forthcoming price control determination for NI Water (PC15). This is in line with its previous decisions and with regulatory practice in the rest of the UK.

Ofwat has used the Building Construction Information Service (BCIS) index to adjust for regional price differences in its price control determinations for England and Wales.[1] However because there were concerns regarding the robustness of BCIS figures for Northern Ireland, the Utility Regulator developed its own adjustment index for NI Water in PC10, This bespoke index took into account the small sample size in Northern Ireland and the water industry's specific cost structure which is not reflected in the BCIS index for general construction costs. The Utility Regulator found that NI Water's costs for capital expenditure are typically below the UK average. In its final determination for PC10 the Utility Regulator found price differences of 12.2% below the UK average, which resulted in an RPA of approximately 6% for NI Water's capital expenditure.

The bespoke index used for PC10 adopts a similar approach to that used by Ofgem for DPCR5. Ofgem adjusted labour and contractor costs to reflect the regional differences in costs in the DNO areas. Ofgem applied a "labour adjustment" based on the Office for National Statistics data on the Annual Survey of Hours and Earnings (ASHE). It applied a "contractors adjustment" based on the BCIS data for construction contracts.[2]

For the PC15 price control the Utility Regulator would like to further develop its approach. CEPA has been commissioned to build a robust model of regional price differences between the capital expenditure of a typical water company in Northern Ireland compared to the rest of the UK. This model will form the basis for regional price adjustments (RPA) applied in the PC15 price control determination for NI Water. The Utility Regulator has asked CEPA to provide recommendations regarding the RPA and its application to NI Water's capital expenditure.

This report presents our methodology, analysis and recommendations. It is structured in line with the list of deliverables:

- Section 2 sets out the objectives for this work and explains the chosen methodology;

- Section 3 presents a breakdown of costs for typical capital projects;

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[1] Ofwat (2009), "Future water and sewerage charges 2010-15: Final determinations".
[2] Ofgem (2009), "Electricity Distribution Price Control Review Final Proposals - Allowed revenue - Cost assessment appendix".

- Section 4, 5 and 6 discuss, in turn, price differences for each of labour, plant and equipment, and materials respectively;

- Section 7 derives regional price adjustments from the cost breakdown and the price differences for various resources; and

- Section 8 provides recommendations regarding the application of RPAs in the price control assessment.

2. METHODOLOGY

The Utility Regulator has used RPAs for NI Water's capital expenditure in its previous price control determinations. There has been some debate between the Utility Regulator and NI Water regarding the appropriate RPA methodology.

The methodology chosen by the Utility Regulator involves three interrelated components:

- cost breakdown;

- price differences; and

- determination and application of RPA.

The breakdown into individual cost categories is closely related to the list of inputs for which price differences are determined. Similarly the categories used in the breakdown affect how the resulting RPA can be applied to categories in the cost assessment.

We review the Utility Regulator's previous approach in Section 2.1 and discuss general methodological difficulties in Section 2.2 before setting out our methodology in Section 2.3.

2.1. Previous work

For its previous decision at PC10 the Utility Regulator contracted Franklin & Andrews, an engineering consultancy, to develop RPA factors. We have not had access to the detailed method or data but we understand that the approach taken by the consultancy was engineering led and therefore bottom up: price differences were determined for wide a range of materials and machinery at a granular level and then aggregated for different activities to yield an overall RPA. The Utility Regulator applied the resulting RPA to a percentage of capital expenditure for infrastructure and non-infrastructure projects for water and sewerage services.

The granular structure of this bottom-up RPA analysis would have facilitated a more granular application of the RPA. From the detailed pricing work, several different RPAs could have been built and applied, for example at the level of individual capex programmes. However, the Utility Regulator chose to apply the RPA at the top level of the capex breakdown: a single RPA factor was determined and applied across all capex programmes (although in varying proportions for infrastructure and non-infrastructure).

We agree that the high-level application, chosen by the Utility Regulator, is the most appropriate choice for regional price adjustments in a regulatory context as it is efficient, transparent and non-intrusive into operational choices. We note, however, that a top-down application of RPA could result in a mismatch with a bottom-up

analysis of price differentials. In particular it becomes difficult to assess the robustness of the RPA as any imprecision in the bottom-up estimates accumulate in the top-down application. We consider that if a top-down approach is chosen for the application of RPA, the analysis should focus on the robustness of the pricing estimates rather than the elaborateness of the itemisation. Top-down estimates may be no more precise than bottom-up estimates but the imprecision becomes easier to analyse.

We also note that Ofwat and the Utility Regulator have previously applied the RPA to parts of total capital expenditure to reflect that not all costs are affected by regional price differences. This can be an appropriate measure in a top-down methodology. As a simple example, the overall RPA could be approximated by the difference in labour costs only (i.e. ignoring any price differences for plant, equipment and materials). The resulting RPA would then be applied to the share of capex that corresponds to the share of labour in total costs.

However, applying the RPA in this way risks some degree of double counting. We illustrate this issue in Box 2.1.

Box 2.1: Risk of double counting unaffected parts of capital expenditure

To illustrate the risk of double counting we consider a simple example. We assume that total costs are broken into two categories of 50% each. In the first cost category, regional prices are only 80% of the prices in the rest of the UK. In the second category there is no price difference, i.e. regional prices are 100% of national prices. The resulting aggregate RPA would be 90%, i.e. the weighted average of the two categories. This RPA then needs to be applied to all capex, as the unaffected part of capex is already accounted for by including the second category in the cost breakdown.

Another risk of double counting is that certain data sources may already account for the unaffected proportion of capex. For example, price information derived from tenders applies to whole projects and therefore already accounts for a share of the project not being affected by regional prices.[3]

The risk of double counting suggests that it may be better to account for the proportion of capex that is unaffected by regional prices in the cost breakdown rather than during the application of the RPA. A comprehensive, top-down cost breakdown would cover total capex including cost categories that are not affected by regional price differences; where necessary such a breakdown would use catch-all categories, such as "All other materials" to achieve full coverage. The RPA resulting from this breakdown would be directly applicable to the total capex determination. When applying the RPA there is no need to determine the fraction of total capex that is unaffected by regional prices, as this analysis is already part of the comprehensive cost breakdown.

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[3] See also NERA's alternative advice to the Utility Regulator in Utility Regulator, *Water and Sewerage Service Price Control 2010-13 – Final Determination Main Report*, (February 2010).

2.2. Difficulties

The Utility Regulator's previous work revealed a number of difficulties in setting an RPA that allows direct comparison of Northern Ireland and the rest of the UK.

There is only limited data available on regional prices for relevant inputs. Many well-established datasets on prices are gathered at a national level and are not available for individual regions such as Northern Ireland. For example, the Department for Business, Innovation and Skills (BIS) collects data on construction materials only on a national level. Similarly, the European Commission's Eurostat collects sector data mainly on the level of member states and rarely in sub-member state granularity.

A number of organisations publish specialist datasets and price books. The most relevant to recent regulatory decisions is the BCIS dataset, which is published by the RICS Building Cost Information Service under contract for BIS. The BCIS data was used as reference by Ofwat in its recent price determinations.

The BCIS dataset is constructed from real tender price information and includes estimates for regional price differences. However, the BCIS data suffers from the same limitation as any dataset that attempts to derive regional prices from observed data: The smaller the region – primarily in population terms – the fewer observations will be available in any given timeframe. This means that particular types of building projects could be dominant in an observation period, while others are missing completely. This type of issue can severely skew the sample and make the derived estimates less reliable and difficult to interpret. The problem is particularly severe when looking at a specific sector, such as water and sewerage, which has a different cost structure from other construction activities. The available BCIS sample for Northern Ireland is smaller than is the case for other regions in the UK, and the sample size has likely reduced further as building activity in Northern Ireland declined during the recession. Concerns about the robustness of the BCIS estimates led the Utility Regulator to conduct further analysis of regional price differences at PC10.

Materials price estimates suffer less from the small sample size, as the same materials are used across most construction activities which permits pooling of the available observations. However, this then raises the question of which materials are used in what proportion in the different sectors? This is the second major obstacle for calculating a robust RPA estimate: It is difficult, if not impossible, to identify a truly standard cost structure for a typical capex project other than at a very high level. The breakdown by activity and resources is necessarily industry specific and to some extent affected by genuine operational choices of the regulated company. While engineering experience can provide some estimates, there are very few formal sources that can be utilised in developing a specific capital project breakdown.

Our review of previous work suggests that for both pricing information and the cost breakdown there is a general trade-off between robustness and the granularity of the

chosen approach. More general estimates are typically more robust than very granular data on very specific items. The downside of very broad estimates is that they do not reflect the specific cost structure faced by a water company. We illustrate this trade-off with an example in Box 2.2.

Box 2.2: Trade-off between robustness and granularity

A general purchasing parity index (PPI) could be used to approximate regional price differences. However it is based on an underlying basket of goods which may not match the inputs required for a water business. Similarly, engineering "rules of thumb" can be used to create an approximate cost breakdown, but such estimates can be skewed by civil engineering projects that are very different from, say, water mains and water reservoirs.

While a more detailed cost breakdown might better reflect the industry's specific structure; the potential gains of this approach can be outweighed by the unavailability or imprecision of available data.

The compromise struck by Ofwat in its previous decisions, was to use construction price data based on a broad index to determine regional price differences. Ofwat used the BCIS Location factors, which are based on tender information. The BCIS Location factors cover a wide range of construction and civil engineering work and are therefore not specific to the water industry. The BCIS's wide coverage yields robust estimates for regional price differences in most regions in the UK. As discussed above however, the small sample and the fact that many of the observable projects are not specific to the water industry means that the BCIS Location factor may not be a good indicator of regional price differences in Northern Ireland.

Compared to creating an appropriate breakdown of costs and the estimation of regional prices, the aggregation of the resultant data into an RPA is fairly straightforward. However the aggregation and application of RPAs are connected via the structure that is being used for the RPA analysis and the cost assessment respectively:

- A granular application of RPA needs to be supported by a granular cost breakdown and pricing analysis.

- A top-level application may be more robust when supported by high-level analysis.

The cost structure in the cost assessment plays an important role in the application of RPAs. It is therefore important to ensure that the RPA analysis is structured in a way that is compatible with the capex cost assessment.

2.3. CEPA's Approach

The Utility Regulator's objective for this project is to obtain a range of estimates that can be used for a robust application of RPAs with well understood sensitivities around

the underlying assumptions. The resulting RPA needs to be practical and applicable in the Utility Regulator's price control determination.

Our analysis of the Utility Regulator's previous approach and our review of issues that are faced in creating RPAs for Northern Ireland leads us to conclude that a top-down approach for determining and applying the RPA will be the most appropriate. While a more detailed approach might have some attractions these are only meaningful if data is available to support a degree of granularity. For the reasons set out above we have concluded that this is not the case for Northern Ireland. However, we note that the Utility Regulator is looking for the most robust approach practicable and we therefore include a number of cross-checks and sensitivities to increase confidence in the robustness of our RPA estimates.

The Competition Commission (CC) took a similarly pragmatic approach in its provisional determination for the NIE price control.[4] The CC recognised an "absence of other publicly available data" besides labour cost data. The CC further argued that not being able to account for all possible factors should not prevent the CC from applying those adjustments that are practically possible. The CC applied an adjustment for labour cost differences as the only regional price adjustment.

2.3.1. Top-down analysis and application

Our top-down approach ensures that the available data is used effectively and avoids a level of detail for which reliable data cannot be obtained. It also allows us to focus on those areas of the cost base that have the largest impact on the RPA.

A top-down approach favours robust estimates and understanding of limitation over (potentially) spurious precision and micro-management: Even if data could be obtained in great level of detail, e.g. prices for individual items of plant and equipment, this would not necessary improve the RPA estimates. A regulated company should retain flexibility for its operational choices. A carefully constructed high-level RPA estimate remains applicable across a broad range of management decisions.

Our approach therefore starts from a high level breakdown of capex by activities. Expenditure for each sub-programme is further broken down by resources. Resources are refined into subcategories, but only so far as there is reliable information available and the refinement contributes significantly to the RPA estimate. The cost breakdown is described in Section 3.

Wherever possible we estimate price differentials from robust sources such as the ASHE survey. However, even with a top down approach there are some areas where no reliable sources can be identified. In these instances we make assumptions. These

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[4] Competition Commission, *Northern Ireland Electricity Limited Price Determination, Provisional Determination,* November 2013

assumptions use other cost items as proxies where possible and are backed by general economic arguments but not necessarily by empirical data. The price differences for labour, plant and equipment, and materials are discussed in detail in Sections 4, 5 and 6 respectively.

In order for the developed RPA to be applicable, it is important that the structure of the RPA model is robust and flexible enough to match the structure of the Utility Regulator's efficiency assessment. Here a top-down approach has advantages compared to a detailed bottom-up approach which might not easily be reconcilable to the actual cost assessment.

Pursuing a top-down approach for the cost breakdown and the comparison of regional prices also brings the RPA methodology into line with the Utility Regulator's previous application of the RPA to whole categories of capex.

2.3.2. Time trends

In this work we develop a single RPA for the whole control period. This is in line with the Utility Regulator's previous approach and the methodology adopted by Ofwat.

Historic trends can be considered in the analysis for setting the RPA but we do not attempt to forecast changes in price differences over the control period on an annual basis. Where possible we provide historical background as a check on whether regional price differences vary significantly over time. This is primarily to confirm whether price differences are entrenched rather than a result of a temporary fluctuation.

In this context the exceptional impact of the recession on prices should also be highlighted. The contraction of the building industry in Northern Ireland and even more severely in the Republic of Ireland, will have led to overcapacity in the market. This is likely to be reflected in depressed prices. Where Northern Ireland was more affected by the recession than the rest of the UK, or where its economic recovery lags the recovery in the rest of the country, the regional price differential will be larger than it was prior to the financial crisis. We would expect the price differential to narrow again when Northern Ireland's recovery catches up with the rest of the UK. We recommend taking this into account when setting a constant RPA for the whole control period, rather than estimating separate RPAs for each year.

In some areas overcapacity could be so high that observed prices, e.g. from tender information, might not cover costs if businesses bid to reduce their losses from fixed costs. Such prices are not sustainable and would eventually lead to defaults and consolidation in the industry.[5] While NI Water should benefit in the short term from depressed prices, it becomes a policy question how to treat unsustainably low prices.

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[5] For the Republic of Ireland, see Bruce Shaw Handbook 2012.

For example, NI Water could purchase at exceptionally low prices from third parties, but cannot be expected to recreate internal structures to match these prices.

2.3.3. Cross check

Given the specific cost structure of the water industry and the limitations of the available datasets, some of the assumptions and estimates in our analysis are necessarily imprecise and to some extent arbitrary.

This is not a fundamental problem in producing the likely range of RPAs but the necessary imprecision of our estimates does emphasise the importance of cross-checks and thorough sensitivity analysis which will allow the Utility Regulator to reach a view of the point estimate(s) that it applies.

We use three approaches to increase confidence in the RPA estimates:

- **Sensitivity analysis of the model.** Sensitivity analysis identifies which factors have large impact on the RPA estimate and how the model reacts to changes in the underlying assumptions.

- **Cross-checks of assumptions against other opinions.** Other parties may have views on the assumptions made in the model. Such views may not be suitable as inputs for the model, but nevertheless provide a valuable cross-check. For example, data obtained for an individual project would not provide a statistically significant verification of assumptions but might still strengthen the Utility Regulator's overall position. Similarly, NI Water may have a view, e.g. on the typical resource mix for its projects, which could make for an insightful comparison.

- **Comparison against other methodologies.** It may be possible to obtain RPAs from other methodologies for comparison. For example, the RPA from PC10 or a pure labour adjustment are possible comparators.

We consider that robust top-down estimates will enable the Utility Regulator to make strong, defensible decisions about the appropriate regional price adjustment and its application. This position can be further strengthened by cross-checks and thorough understanding of the RPA model's sensitivities and limitations.

3.   COST BREAKDOWN

A practical RPA methodology needs to be consistent with company cost structure and the Utility Regulator's cost assessment for the price control review. We therefore use previous regulatory decisions by the Utility Regulator and Ofwat as the starting point for our approach.

Our RPA model breaks capital expenditure into Water infrastructure, Water non-infrastructure, Sewerage infrastructure, and Sewerage non-infrastructure. Within these broad areas capital expenditure is broken into sub-programmes as shown in Table 3.1.

Table 3.1: Water and sewerage capex sub-programmes

Water infrastructure	Sewerage infrastructure
• Mains (laying) • Mains (rehabilitation) • Communication pipes • Household meters	• Sewer (laying) • Sewer (rehabilitation)
Water non-infrastructure	**Sewerage non-infrastructure**
• Water treatment works • Water pumping stations • Water storage	• Sewerage treatment works • Sewerage pumping stations • Sewer structures • Sludge treatment and disposal

The same breakdown into sub-programmes was used in Ofwat's PR09 determination.[6] It is also consistent with the more granular breakdown into capex sub-programmes used by the Utility Regulator in PC13, but more aggregated.[7] We have assumed that a very similar breakdown will be used by the Utility Regulator in the current price control review. An RPA model based on this breakdown should therefore be directly applicable for the Utility Regulator's determination.

Within the capex sub-programme costs are broken down by resources into:

- labour;

- plant and equipment; and

- materials.

The three resource categories are discussed in turn in the following sections.

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[6] Ofwat, *Future water and sewerage charges 2010-15: Final determinations*, (2009).
[7] Utility Regulator, *Water and sewerage service – Price Control 2013-2015 Northern Ireland Water*, (2012).

We have made a number of assumptions regarding the breakdown into capex programmes and the proportion of resources within each sub-programme. We re-visit these assumptions as part of our sensitivity analysis.

Assumptions

Based on the Utility Regulator's previous determination we assume a broadly equal share of capital expenditure on water and sewerage services. This splits into:

- 30% water infrastructure;

- 20% water non-infrastructure;

- 20% sewerage infrastructure; and

- 30% sewerage non-infrastructure.

The breakdown into sub-programmes is shown in Table 3.2. The proportions reflect NI Water's relative capex allowances for PC13.[8] As long as the breakdown into resources is similar for the sub-programmes, the proportion of capex programmes will have only limited impact on the derived RPA.

Table 3.2: Capex sub-programme as percentage of total capital expenditure.

Water (50%)		
Water infrastructure		**30%**
	Mains (laying)	7.5%
	Mains (rehabilitation)	16.5%
	Communication pipes	4.5%
	Household meters	1.5%
Water non-infrastructure		**20%**
	Water treatment works	6.0%
	Water pumping stations	6.0%
	Water storage	8.0%
Sewerage (50%)		
Sewerage infrastructure		**20%**
	Sewer (laying)	10.0%
	Sewer (rehabilitation)	10.0%
Sewerage non-infrastructure		**30%**
	Sewerage treatment works	7.5%
	Sewerage pumping stations	7.5%
	Sewer structures	7.5%
	Sludge treatment and disposal	7.5%

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[8] Utility Regulator, *NIAUR financial model PC13*, (12 December 2012).

Within each programme we split expenditure by resources into:

- labour;

- plant and equipment; and

- materials.

Resources are split into subcategories where appropriate. For example, labour is split into general and specialist labour, and materials is split into subcategories such as concrete, rebar, pipes and disposal costs.

We use the same resource mix across all capex programmes, with some adjustments where appropriate. For example, we assume the resource split for mains laying in water and sewerage to be very similar. Further adjustments are then made with regard to the proportion of individual materials. For example, concrete may make up a larger share of material costs for reservoirs than for communication pipes.

Similarly, we assume the same split of resources into subcategories across capex programmes. For example, we assume that labour typically splits into 20% specialist and 80% general labour. Where appropriate we then adjust our initial assumption as described in the following sections, which discuss labour, plant and equipment, and materials in turn.

It is difficult to estimate the proportion of resources with certainty. The resource mix typically varies from sector to sector and could differ from project to project.

Work by the World Bank suggests a high proportion of materials relative to labour: 20% labour, 30% equipment and 50% materials.[9] However, in our opinion the high materials costs for general civil engineering in the World Bank study could be skewed by high value components and heterogeneous materials used in "building-like" infrastructure as opposed to, for example, laying water mains.

Ofgem in comparison used much smaller shares for materials and equipment and a larger share for labour in its price control for gas distribution networks. The resource split for Ofgem's calculations of real price effects in the GD1 price control was:[10]

- 56% labour (11% direct labour and 45% contractor labour);

- 4% plant and equipment;

- 19% materials; and

- 21% other.

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[9] World Bank, *International Comparison Program*, (2011).
[10] Ofgem, *RIIO-T1/GD1: Initial Proposals – Real price effects and ongoing efficiency appendix*, (July 2012).

Gas distribution network operator UKPN responded to Ofgem with estimates based on its company data suggesting 65% labour; 8% plant and equipment; 20% materials and 7% other.[11] The work required for capex programmes for a gas distribution network is at least similar to the capex programmes delivered by a water company. Furthermore, the Ofgem estimates are for the UK while the World Bank study covers a wide range of countries. We therefore give greater weight to Ofgem's estimates in our analysis.

For the RPA model we assume proportions that lie between the resource splits by Ofgem and World Bank:

- 40% labour;

- 20% plant and equipment; and

- 40% materials.

To be clear, this is an approximation rather than a precise estimate based on empirical data. The proportions are consistent with our own experience in various sectors and with the Utility Regulator's previous work and with its PC10 and PC13 determinations. We re-visit the resource split in our sensitivity analysis in Section 7.

Another option for cross-checking the resource mix would be to request details for a sample project from NI Water. The resource split for a sample project should be readily available from NI Water and could be compared to our breakdown.

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[11] NERA for UKPN, *Estimating Real Price Effects and Ongoing Efficiency*, (April 2013).
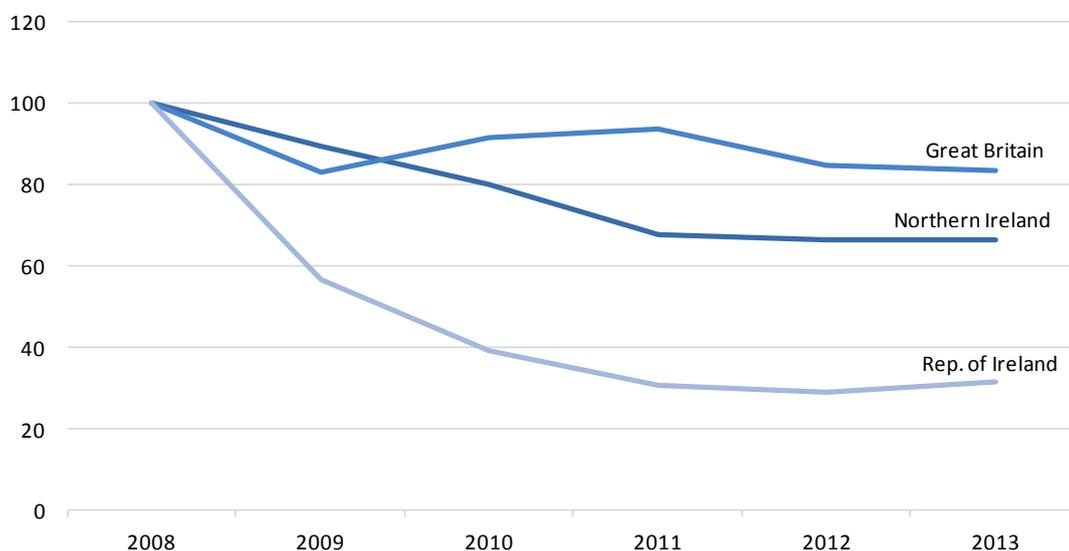
4.   LABOUR

Labour is the single largest item in the capital expenditure of a water and sewerage company. It is also a resource that is procured almost entirely at a local or regional level. Therefore estimating a regional difference in wages between Northern Ireland and the rest of the UK is a central part of our RPA estimate.

Labour costs in Northern Ireland are lower than in the rest of the UK and as our analysis in this section shows, are structurally entrenched. Furthermore the Northern Ireland economy has been more severely affected by the economic recession and stagnation than most other parts of the country. We expect to see a larger wage differential particularly for workers in the construction sector and for low-skilled workers for whom the recession has had the most significant effect.

Figure 4.1 below shows the evolution of output in the construction sector in Northern Ireland, Great Britain and the Republic of Ireland since 2008. The construction sector in Northern Ireland has seen a larger decline than construction in the rest of the UK although this was not as severe as the decline seen in the Republic of Ireland. We would expect that the sharper decrease in output in Northern Ireland compared to the rest of the UK would also be reflected in the difference in prices for labour and other materials produced locally.

Figure 4.1: Construction output in Northern Ireland, Great Britain and Ireland (Q1, 2008 = 100)

Source: ONS, NISRA, CSO

The labour market in Northern Ireland is however characterised by a shortage of highly skilled workers with as much as 28% of vacancies being hard to fill due to skill-shortages.[12] This pushes wages closer to the UK average for categories of specialised

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[12] UK Commission for Employment and Skills, *Employer Skills Survey 2011: Northern Ireland National Report,* (October 2012)

skilled workers such as engineers. As a result we expect a greater wage differential for lower skilled employees than for highly skilled employees.

Data on labour costs in Northern Ireland is more readily available than data for other resources considered in our RPA model. The main data source we have used to estimate the labour cost differential is the Annual Survey of Household Earnings (ASHE) published annually by the Office of National Statistics (ONS). ASHE data for Northern Ireland has previously been collected and produced by DETI. Since April 2011 responsibility for the Northern Ireland ASHE data collection rests with the Northern Ireland Statistics and Research Agency (NISRA).

4.1.   ASHE data

The ASHE is a UK wide survey that provides information on hourly, weekly and annual earnings broken down by region, sector, industry and occupation. Starting with ASHE 2011 the ONS changed the classification of occupations and replaced the previously used Standard Occupational Classification 2000 (SOC 2000) with the new SOC 2010. Therefore the occupational categories available since the ASHE 2011 data are slightly different from the ones available in the previous years. According to ONS, in 2011 the SOC 2010 figure for median full-time weekly wages was 0.5% lower than the figure based on the SOC 2000.[13] As the SOC forms part of the methodology for weighting ASHE data to produce estimates for Northern Ireland, there may be some discontinuity in the data series.

We have calculated regional wage differences for a number of categories:

- all employees median wages (full-time and part-time);

- full-time median wages;

- full-time private sector median wages; and

- median wages in a number of industry sectors.

Hourly and weekly wages

We have considered both hourly and weekly wages in our calculation. Hourly wages excluding overtime were used by the Utility Regulator at PC13 to determine the allowance for a regional wages special factor within the operating cost models. Weekly wages were used by the CC in the NIE Provisional Determination and by the Utility Regulator at PC10. The wage differences resulting from using either measure are very similar as can be seen in Table 4.1 so the choice of using either weekly or hourly wages will not have a large impact on the final RPA estimate. The main difference between the two estimates is that weekly wages reflect both hourly pay

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[13] ONS, *Statistical Bulletin 2011 Annual Survey of Hours and Earnings (based on SOC 2010),* (March 2012)

and the number of hours worked. For example, lower hourly wages are not necessarily more efficient since lower labour productivity could mean that the same task takes more hours. We therefore recommend using weekly wages in the RPA model.

We have used median rather than average wages as these are less likely to be affected by extreme values and the skewed distribution usually associated with earnings data. This is consistent with the approach taken by the Utility Regulator in previous price reviews. The CC in its provisional determination uses average rather than median wages, as it considers average more appropriate for estimating the cost across a group of staff. Using average rather than median wages in our RPA model would reduce the overall baseline RPA estimate by around one percentage point (from 93.8% to 92.6%). Table 4.1 below shows the regional wage differential for the various categories estimated.

Table 4.1: Regional wages as percentage of UK wages (ASHE 2013 data)

Wage category	Regional wage difference	
	Hourly	Weekly
All employees	88%	88%
Full-time	87%	89%
Private sector full-time	81%	82%

The figures for wage differentials across the entire workforce (both full and part-time and full-time only) are around 88-89% of UK wages which is broadly similar with those observed at PC10. The differential for private sector wages is larger as private sector wages in Northern Ireland are lower than the UK average while public sector wages are very close to the UK average. Public sector work accounts for a larger proportion of employees in Northern Ireland than in the rest of the UK, and has a strong impact on the regional wage difference for all employees.

In the following sections we use weekly wages for our analysis.

4.2. Wages by industry

We have also considered wage differences in industries comparable to the water and sewerage industry. The industries selected from the ASHE data are shown in Table 4.2.

Table 4.2: Regional wages by industry (as percentage of UK wages) (ASHE 2013)

Industry	Regional wage difference
Construction	82%
Manufacturing	86%
Electricity and gas	125%
Water, sewerage and waste management	85%

An interesting observation from the ASHE data is the contrast between wages in the electricity and gas sector and wages in the water, sewerage and waste sector. The ASHE figures for the water supply, sewerage and waste management industry show lower wages in Northern Ireland compared to the UK average – by around 15%.

The difference might derive from the fact that the water, sewerage and waste management category covers a wide industry area including waste collection and disposal activities which impedes us from drawing clear conclusions about differences in wages in the water sector. In addition the small sample size in Northern Ireland means that the ASHE estimates for this industry are classified as unreliable which casts further doubt on the accuracy of the estimates.

Further disaggregation of the "water supply, sewerage and waste management" category is available in the ASHE data for the water supply and the sewerage industry. This shows wages in the water supply sector in Northern Ireland being closer to the UK average (97% differential) while wages in the sewerage industry are significantly lower in Northern Ireland than in the rest of the UK as a whole (86% differential).

However, neither the water supply and sewerage subcategories nor the whole water, sewerage and waste category are suitable for the RPA calculations because we would expect NI Water's own labour costs to have a biasing impact on this category which would distort the RPA assessment. NI Water is the only water and sewerage company in Northern Ireland and employs over 1,300 people.[14] There is no estimate of the total number of jobs in Northern Ireland in this sector in the ASHE data but the fact that the sample size is too small to be reliable would suggest that the total job number is below 4,000.[15]

A relatively small wage difference in the water supply subcategory and the electricity and gas sectors could be explained by the premium paid in Northern Ireland for skilled

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[14] The NI Water Response to PC13 Draft Determination (November 2012)
[15] Wage estimates are provided in the ASHE dataset for industry categories with over 4,000 jobs.

workers such as engineers. However, it could also be due at least in part to inefficiency in regulated, less competitive industries.

4.3. Composite occupational wage

The overall and industry-based wage differentials may not accurately reflect the labour resources used by a water and sewerage company in a capex programme. Relying on these aggregate estimates could result in an adjustment factor for labour costs that captures the effect of occupational categories that are not relevant to the capex programmes of a water and sewerage company. For this reason, we have also calculated a composite occupational wage that seeks to better reflect the labour resources used in NI Water's activities. The composite occupational wage is calculated based on an estimated split of the labour cost into skilled and general labour similar to the one used by the Utility Regulator at PC10:

- 20% skilled labour; and

- 80% general labour.

The composite occupational wage makes use of the more granular occupational data which incurs the risk of relying on figures based on smaller sample sizes and thus on less reliable estimates. We therefore try to balance this risk by using broader occupational categories (2-digit and 3-digit SOC) rather than the more detailed 4-digit SOC in order to obtain a more robust estimate.

We include the following categories as part of our composite occupational wage (SOC codes in brackets):

For skilled labour:

- Engineering professionals (212);

- Science, engineering and technology associate professionals (31);

- Corporate managers and directors (11); and

- Administrative (41);

For general labour:

- Skilled construction and building trades (53);

- Plant and machine operatives (81); and

- Elementary construction (912).

Table 4.3: Composite occupation wages (as percentage of UK wages)

Wage	Estimated price difference
Composite occupational wage	89%

Our composite estimate of 89% is higher than the estimate for the general construction industry and just over the economy-wide estimates presented above. We consider that the composite estimate reflects regional differences for labour costs in the water industry better than the more general estimates presented above. We therefore use the composite estimate in our baseline analysis. We revisit this assumption during our sensitivity analysis.

4.4.   Historical trend

The use of the ASHE data in our analysis reflects the wage differential in the latest year (2013) which may not capture trends that should be taken into account when setting an RPA for the next price control period. We note that the CC, in the NIE Provisional Determination, used a five-year average of ASHE data to determine the wage adjustment. We have therefore considered headline ASHE wage measures over the last few years to check whether the wage differentials differ significantly year on year. The analysis of all employee and full-time wages is summarised in Table 4.4.

Table 4.4: Historical regional wages (as percent of UK wages)

Wages	2007	2008	2009	2010	2011	2012	2013	Average
All	88%	89%	89%	88%	89%	89%	88%	**89%**
Full-time	88%	87%	90%	88%	89%	90%	89%	**89%**

The historical comparison presented above suggests that in practice wage differences tend to change relatively little from one year to another especially at the all employee level. The regional price difference for labour appears to be entrenched rather than driven by asynchronous economic cycles. The historical average of 89% is in line with our estimates for current year wage differences. We therefore use the most recent ASHE data (2013) in our analysis.

Eurostat data

We have also checked the ASHE derived estimates of the regional wage differences against data produced by Eurostat.[16] Eurostat publish labour cost data for sectors on sub-national level (NUTS 1). The latest available dataset is from 2008 and reports average monthly wages.

The dataset lists four relevant sectors:

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[16] Eurostat, *Labour Cost Survey*, (2008).

- water supply; sewerage, waste management and remediation activities;

- water collection, treatment and supply;

- sewerage; and

- waste collection, treatment and disposal activities; materials recovery.

For all four sectors average wages in Northern Ireland are very close to the wages in the rest of the UK.

There is very little that can be inferred from the Eurostat data as it is older than the ASHE data and reports average rather than median wages, which we consider to be more appropriate for the RPA assessment.

The same concerns regarding the suitability of sector data apply as for ASHE data. As a result we do not recommend using the Eurostat data for the RPA model.

5.   PLANT & EQUIPMENT

Plant and equipment cost accounts for only a relatively small share of capital expenditure; 20% or less. There is a wide range of plant and equipment that could be relevant to capex programmes in the water and sewerage sectors. This resource category covers construction equipment from concrete mixers to excavators as well as specific plant such as water pumps and specialist tools for pipes.

The wide range of possible equipment rules out a comprehensive market review while the specific equipment rules out more general price data. The input and output Machinery and Equipment Producer Price Indices (PPI) published by ONS have been used by Ofgem to calculate price changes for equipment and plant. However we cannot use this to derive regional price differences as these indices are not available on a regional basis.

We therefore do not split plant and equipment into further subcategories in the RPA model and apply qualitative arguments rather than empirical data to its treatment in the model. For our analysis we discuss purchased plant and plant hire separately.

High value plant and equipment is traded nationally or even globally and therefore should not be subject to regional price differences. Transportation costs however are non-negligible for large plant and equipment and these costs could differ on a regional basis. Such costs are likely to be higher in a relatively remote region such as Northern Ireland than in some other parts of the UK. Nevertheless the impact of these extra transportation costs will vary significantly from case to case depending on the type of equipment involved, the transportation method employed, the location of relevant warehouses or the policy of the supplier (some suppliers may charge fixed transportation fees covering wider geographical regions). Furthermore, such extra costs would not be specific to Northern Ireland but are also likely to be incurred by companies operating in other UK regions located at a distance from major transportation hubs or warehouses. It is the case then that the relevant difference is not between transportation costs to Northern Ireland compared to a major hub region but rather between Northern Ireland and the average costs incurred by companies operating across the whole of the UK. This should reduce the *difference* in transportation costs as a proportion of total costs for acquiring plant and equipment. Therefore we consider that the cost to purchase plant and equipment in Northern Ireland and the rest of the UK to be broadly the same.[17]

For plant hire the market is clearly more regional in nature, depending on the value and typical utilisation of the equipment. Regional price differences for plant hire are driven by two main factors:

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[17] Ofwat makes a similar argument in its PR09 price control for "large plant" but allows for a limited local premium in high-cost regions. See Ofwat, Cost base feedback report, (December 2009).

- labour costs, especially if equipment is hired with operator; and

- regional over-capacity.

Furthermore, hire rates are likely to vary considerably based on seasonal demand and length of time hired making it more difficult to establish a price estimate.

Hire rates are constrained by the option of purchasing plant and equipment in the national market, unless for equipment whose utilisation is too low to make purchase a viable alternative.

With little difference in purchase prices we would expect the price difference for plant hire to be limited in the long run. However, the reduction in construction activity in the recession could have caused some over-capacity and depressed rental rates.

Based on the analysis above we consider that plant and equipment costs should be broadly similar in Northern Ireland and the rest of the UK although some small differences could arise due to transportation costs and regional hire rates. Given that the impact of these factors is uncertain, not systematic and that the overall impact on our model is likely to be low, we adopt a conservative approach in our baseline analysis and assume a 100% adjustment factor. To account for these potential differences we revisit our estimate in the sensitivity analysis by assuming that prices in Northern Ireland could vary by ±5% compared to prices in the rest of the UK.

6. MATERIALS

Construction materials, together with labour, represent the majority of resources used in capex projects in the water and sewerage industry. The types and quantity of materials used will vary according to the nature and scale of each individual project but the main materials likely to be used in such projects include:

- concrete;
- rebar;
- pipes;
- other building materials such as aggregates, bricks, steel and timber; and
- mechanical parts such as water meters, valves and pumps.

Due to operational limitations or high transport costs relative to the value of the product, some construction materials can only be sold and purchased in local markets. It is the price for these materials that is likely to show the most significant regional price variation. Most other materials are likely to be traded in national or even global markets. Prices for these products should therefore be similar in different regions except potentially for small differences due to transportation costs.

We also consider disposal costs together with materials costs in our model. In the following sections we discuss each of these materials in turn.

6.1. Concrete and cement

Cement and concrete are heavy building materials with high transportation costs relative to the value of the material. There are significant economies of scale for cement manufacturers due to the energy intensity of the production process and its dependence on a local supply of limestone. The cement industry is therefore dominated by very few, large production sites which cater for a regional catchment area.[18] With only two major cement producers in Northern Ireland we would expect less competition in the market, which can lead to inflated prices compared to a more competitive market.

Concrete uses cement and aggregates as inputs. Any regional price difference for cement is therefore also reflected in the price of concrete. Furthermore, ready-mix concrete has to be used within a relatively short period of time and can therefore only be purchased locally. Concrete prices will therefore vary by region. While the regional nature of the ready-mix concrete market constrains competition, this effect will be the same in Northern Ireland and the other regions of the UK with similar population density.

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[18] Competition Commission, *Aggregates, Cement and Ready-Mix Concrete Market Investigation*, (2012).

We expect that the recession and the different pace of recovery between Northern Ireland and the rest of the UK will also have an impact on the regional price difference for ready-mix concrete. The need for local distribution implies sunk costs and therefore costly overcapacity caused by the recession, which will depress prices in Northern Ireland relative to the rest of the UK where recovery has been stronger.

Compared to ready-mix concrete, precast concrete can be transported over longer distances. We have found examples of precast concrete producers from GB delivering their products to Northern Ireland and vice versa. This suggests smaller regional price differences for precast concrete than for ready-mix concrete. However, due to transportation cost this price convergence would be stronger for high-value pre-cast concrete, and less so for simple standard parts such as pipes. In our analysis we do not split concrete into subcategories rather we focus on estimating price differentials for concrete in general. In the following we use concrete as a generic term that comprises ready-mix concrete, simple precast concrete and cement.

Based on the Utility Regulator's previous work we assume that concrete makes up around 10-20% of the total materials cost or around 5-6% of total costs. We assume a higher share of concrete for sewerage capex than for water capex to account for precast concrete pipes being used for sewerage but not for water.

Concrete prices depend on a variety of factors such as transport costs (determined by the distance from the plant), competition in the market, quality of aggregates used, availability of raw materials, etc. The price is also likely to vary depending on quantity purchased, mix specification and method of discharge. These factors together with the paucity of comparable data on concrete and other materials prices for Northern Ireland make estimating a price differential with the rest of the UK particularly difficult.

Due to concerns regarding price coordination in an industry with very few major players, the Competition Commission explicitly opposed the timely publication of price information for cement and concrete. The BIS publishes price indices for various building materials. BIS' publication includes indices for cement and concrete products, but with a delay to address the CC's competition concerns. However, the indices published by BIS are at national level and allow no inference of regional prices or price differentials.

The international consultancy firm EC Harris produces average price estimates for key construction materials including concrete for each region in the UK.[19] We produce an estimate of the price differential between Northern Ireland and the UK by averaging concrete prices over the last four quarters of available data (Q4, 2012 – Q4, 2013). Other estimates for concrete prices are available for the Republic of Ireland and the UK as a whole. These estimates are based on turnover and volume of production data

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[19] These estimates are published quarterly in the Construction News magazine.

provided by the European Ready-Mix Concrete Organisation (ERMCO) and building materials prices from the International Construction Cost Survey published by the construction consultancy Gardiner & Theobald. The latest available data from both sources is for 2012.

The fact that there are no legal or regulatory barriers to trade means that a cross-border market in concrete can develop across the island of Ireland. While operational restrictions limit the degree of market integration, we would expect prices to be broadly similar or at least more closely linked between Northern Ireland and the Republic of Ireland than between Northern Ireland and the rest of the UK. However, the currency exchange rate between Pound Sterling and Euro needs to be taken into account when using price information from the Republic of Ireland to estimate prices in Northern Ireland.

Northern Ireland producers are generally considered to have a competitive advantage compared to producers in the Republic of Ireland due to lower labour costs and lower overall overhead costs.[20] This would suggest prices in Northern Ireland for construction materials could be lower than in the Republic of Ireland. On the other hand, the decline in the construction sector in the Republic of Ireland has been significantly more severe than in Northern Ireland (as shown in Section 4 above) which could lead to larger over-capacity and thus lower prices in the Republic of Ireland. Therefore we consider that while these estimates should be treated with caution, prices for Republic of Ireland can serve as an indication of prices in Northern Ireland. Estimates of the concrete price differential based on the above sources are shown in Table 6.1.

Table 6.1: Regional difference in concrete prices

Source	Regional price difference (as % of UK price)
EC Harris (for NI)	75%
ERMCO (for ROI)	64%
Gardiner & Theobald (for ROI)	52%

From the available data sources, the Gardiner & Theobald data seems to be least robust, exhibiting a high level of volatility both across time and across different sets of materials. We therefore put less weight on this estimate when setting our regional price difference for concrete. We take it into account when setting the range of estimates for our sensitivity analysis. In our baseline analysis we use a value of 70%, roughly in the middle of the EC Harris and ERMCO estimates. We then revisit this estimate in our sensitivity analysis.

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[20] Grant Thornton, *InterTrade Ireland – Report on a Competitive Analysis of the Construction Materials Sector in Ireland* (March 2012)

6.2.   Rebar

Rebar normally refers to steel or iron bars commonly used in reinforced concrete to strengthen a structure. As a rule of thumb the value of rebar in reinforced concrete constructions is between a third and a half of the value of the concrete.[21] In the RPA model we therefore assume that the costs for rebar are a third of the costs for concrete. We have chosen a value at the lower end of rule of thumb range as water capex programmes will involve less structural concrete than for example, buildings and bridges. Under this assumption rebar accounts for approximately 2% of total costs.

Metals such as steel, iron and copper are commodities that are traded globally. These commodities are sourced nationally or globally. Any regional price differences for building materials based on these metals are constrained by the global market price for the metal itself. Exchange rate fluctuations, which generally play a role for globally traded commodities, have no impact on regional price differences between Northern Ireland and the UK due to their common currency. We therefore expect only very small regional price differences for building materials made from metal. The largest price difference would arise for rebar which is produced from iron. Iron itself is relatively low in value, which means that transportation costs play a larger role than for steel and copper. To produce rebar iron rods are bent and spliced into shapes which require equipment and labour while potentially making transportation more costly (depending on the shape of rebar required). For these reasons rebar is more likely to be purchased locally. We therefore assume that rebar is cheaper in Northern Ireland than in the rest of the UK due to cheaper labour in local production and over-capacity of production facilities during the recession. However, the price difference should be much smaller than for concrete as the input price for raw iron is set on a global level.

As for concrete, estimates for regional rebar prices are difficult to obtain. The EC Harris data mentioned above however also includes estimates for regional rebar prices. We followed the same approach taken for concrete and averaged regional rebar prices over the last four quarters.

Table 6.2: Regional difference in rebar prices

Source	Regional price difference (as % of UK price)
EC Harris	90%

We use the resulting 90% value as the central estimate for rebar regional price differences in our baseline analysis. Given the inevitable degree of uncertainty

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[21] Pelger Engineering & Construction Inc., *Construction Knowledge Database and Blog*, http://www.constructionknowledge.net/concrete/concrete_basics.php (web content retrieved on 27 November 2013).

surrounding an estimate based on a single data source we use a ±10% range in our sensitivity analysis (i.e. we assume rebar prices could be 80% of UK prices in the lowest case scenario or equal to UK prices in the highest case scenario).

6.3. Pipes

Pipes represent the largest proportion of construction materials used in the majority of capex programmes for the water and sewerage industry. Based on the Utility Regulator's previous work we assume that pipes account for up to 50% of materials costs in some capex programmes. This means that pipes make up around 15% of total costs under the capex breakdown set out in Section 3.

Pipes used in the water and sewerage industry would generally be of two types: PE pipes and concrete pipes (where concrete is used only for large sewers).

PE pipes can be transported relatively easy across the UK and Ireland. As a cross-check for our analysis we identified suppliers in continental Europe and in Asia who deliver PE water pipes globally. We therefore consider that PE pipes are traded in a national market and would not be subject to regional price differences.

Concrete pipes can also be transported fairly easy, but due to their weight and volume transportation costs are higher relative to the value of the pipes. The value of concrete pipes is relatively low compared to more complex precast concrete parts. Concrete pipes will therefore be traded in geographically smaller markets than PE pipes and regional price differences are not fully arbitraged away. The regional price of concrete pipes depends primarily on the regional price of concrete. If price differences for concrete are large, we would expect that locally produced pre-cast concrete pipes would also be cheaper. The price differentials for concrete are significant (estimated 25% to 50% lower than in the rest of the UK) which should be reflected in lower prices for concrete pipes. To account for this effect without splitting pipes into subcategories, we increase the share of concrete for sewers compared to water mains from 10% to 15% of material costs and reduce the share of pipes correspondingly from 50% to 45%.

For the remaining (PE) pipes we use an adjustment of 100% in our RPA model.

6.4. Other building materials

Other building materials individually make up a small share of total material costs. Together they account for approximately 12% of total expenditure and comprise a wide range of products. In this section we therefore discuss bricks, aggregates, metals and other materials, although not all of them are included in the RPA model.

Bricks, sand and aggregates are similar to concrete in that transportation costs are high relative to the value of the material. These materials will therefore be typically

sourced locally. However the relevant markets are less concentrated and thus potentially more competitive.

In particular aggregates are typically produced in local quarries and only transported over longer distances if the required material cannot be found locally. The Office of Fair Trading (OFT) conducted a market study and consultation on aggregates, cement and ready-mix concrete in the UK in 2011. Regarding aggregates the OFT found Northern Ireland to be a separate geographical market from the rest of the UK.[22] While the OFT did not conclude whether the market in Northern Ireland is competitive, it found that vertical integration and concentration are less severe in Northern Ireland than in the rest of the UK.

Given the distances over which aggregates are typically transported in the UK[23], Northern Ireland and the Republic of Ireland are likely to have an (at least partially) integrated market for aggregates. For example, a reduced Aggregates Levy was applied for eligible quarry operators in Northern Ireland until 2010 in light of competition with operators in the Republic of Ireland.[24]

Fixed and sunk costs for the production of aggregates are potentially lower than for cement, as the production process is less energy intensive and the materials are easier to store. Nevertheless, production of aggregates is a capital intensive business that will be affected by price pressure from over-capacity during the recession. We therefore expect that there are price differences for aggregates between Northern Ireland and the rest of the UK, but that these price differences are less extreme than the difference for concrete. The remaining building materials are summarised in our model as "other" materials. Each individual item in this mix will have a small share of the total cost and very little impact on the overall RPA. Therefore we do not aim to estimate a regional price difference for individual materials separately but we try to estimate an average price differential that we can apply to this category in our model. For this we use the EC Harris average prices for steel, bricks and timber over the last four quarters to derive an unweighted average estimate for other building materials.

Table 6.3: Regional price difference in other building materials

Source	Regional price difference (as % of UK price)
EC Harris	91%

The 91% figure gives us a rough estimate of the regional price difference affecting these building materials. It suggests that prices are generally lower in Northern Ireland

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[22] OFT, "Aggregates – The OFT's reason for making a market investigation reference to the Competition Commission", (January 2012), OFT1358ref.

[23] See Mineral Products Association (2012) "The mineral products industry key facts at a glance" for a map of interregional trade of aggregates in England and Wales.

[24] Quarry Product Association NI (QPA), "A Northern Ireland Perspective into the Local Aggregates Sector", Submission to the OFT, (October 2010).

even if there are individual materials which are more expensive than in the rest of the UK.

Clearly this estimate excludes a wide range of materials and does not account for the different proportions in which other materials might be used in the water and sewerage industry. The necessary data for more detailed analysis are not available. For this reason, we adopt a conservative approach and make no adjustment for regional price differences in this category in our baseline analysis. We do however use the 91% estimate in our sensitivity analysis to test the impact that the likely lower prices for such materials in Northern Ireland would have on our overall RPA.

For mechanical components such as pumps, valves and water meters the same arguments apply as for plant and equipment: the components are relatively high in value compared to transportation costs and are therefore likely to be traded on national or international level. There is no reason to expect these mechanical components to have significant regional price differentials that would have any impact on the overall RPA.

6.5. Disposal costs

We assume disposal costs account for around 5% of total costs and we include these costs under the "Materials" heading of our RPA model. Disposal costs are largely made up of landfill taxes, which have increased significantly in recent years, and landfill gate fees (charged by the landfill operators where the waste is disposed).

Landfill taxes have increased each year by £8/tonne over the last few years. The standard rate of landfill tax is currently £72/tonne and it will increase to £80/tonne from April 2014. However, the same rate of landfill tax is applied across the whole of the UK. Therefore no adjustment has to be made in our model for regional prices in Northern Ireland in this respect.

Gate fees can be subject to regional price differences as the level of these fees will vary for each facility depending on a range of factors, such as the level of competitiveness in the market, location, size of the facility, revenues generated by the facility from sale of recovered materials, etc.[25]

We have estimated a regional price difference for Northern Ireland based on the median non-hazardous landfill gate fees quoted in the Waste and Resources Action Programme (WRAP) Gate Fees Report 2013. These fees exclude landfill taxes and haulage. Based on these fees we have also calculated a regional price difference including landfill taxes as shown in the table below.

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[25] Waste and Resources Action Programme (WRAP), Gate Fees Report, (2013)

Table 6.4:Regional price difference in disposal costs

Source	Regional price difference (as % of UK price)
WRAP report (excluding landfill taxes)	114%
CEPA calculation based on WRAP report gate fees (including taxes of £72/tonne)	103%

We consider that the 5% of total costs represented by disposal costs also includes the landfill taxes paid. Therefore in our baseline analysis we use the price difference value including taxes of 103%.

7. AGGREGATED REGIONAL PRICE ADJUSTMENT

In this section we calculate an aggregated regional price adjustment based on our estimated price differences and cost breakdown and we perform sensitivity analysis to test the robustness of our RPA estimate. Our estimated price differences for labour, plant & equipment and materials from Sections 4, 5 and 6 are summarised in Table 7.1.

Table 7.1: Estimated price differentials

Resource	Range	Source/reasoning
Labour	0.82 – 0.89	Calculated from ASHE data
Plant & equipment	0.95 – 1.05	CEPA analysis: • Purchase – National market with limited low transportation cost relative to value. • Hire – Driven by labour cost and local supply. Differences limited by purchase option.
Materials		
Concrete	0.52 – 0.75	Industry publications (EC Harris, Gardiner & Theobald, ERMCO)
Rebar	0.80 – 1.00	Industry publication (EC Harris) and CEPA analysis: Low value metal, thus high transportation cost relative to value. Price difference not as large as for concrete, as raw iron is globally traded.
Pipes	1.00	CEPA analysis: PE pipes traded nationally and globally. Significant transportation costs, but similar across the UK including Northern Ireland.
Meter	1.00	CEPA analysis: Traded nationally and globally.
Other	0.91 - 1.00	Industry publications (EC Harris) and CEPA calculations.
Disposal	1.03 – 1.14	WRAP report: median non-hazardous landfill gate fees and CEPA calculations

Box 7.1: Share of capex affected by regional prices

> Ofwat estimated that only 35%-45% of capital expenditure is affected by regional prices.
>
> The Utility Regulator's corresponding estimate in PC10 was between 33%-75% depending on sub-programme. The effective 6% RPA used in PC10 implies that the Utility Regulator applied an RPA to approximately 50% of total capex.

Our RPA model assumes that labour accounts for 40% or more of total costs. Concrete, rebar and disposal costs together make up another 13% of total costs in the model. Labour, concrete, rebar and disposal are considered to have regional prices. The high-level breakdown in the model therefore already covers the majority of capex that is subject to regional prices.

From the cost breakdown described in Section 3 and the price differentials summarised above we aggregate an overall regional price adjustment. The aggregate RPA consists of the adjustment factor for the individual resources weighted by their share of total costs. While the breakdown into resources is very high-level it covers the majority of capex that is affected by regional prices (see Box 7.1). We consider that the aggregation therefore yields a robust estimate of the overall RPA. The aggregated RPA is presented in Table 7.2.

Table 7.2: Aggregated RPA based on baseline weights and price differences

Resource	Share of total capex	Baseline estimates	Minimum estimate	Maximum estimate
Labour	40%	0.89	0.82	0.89
Plant & equipment	20%	1.00	0.95	1.05
Materials	40%			
Concrete	6%	0.70	0.52	0.75
Rebar	2%	0.90	0.80	1.00
Pipes	14%	1.00	1.00	1.00
Meter	<1%	1.00	1.00	1.00
Other	12%	1.00	0.91	1.00
Disposal	5%	1.03	1.03	1.14
Aggregated RPA		**0.938**	**0.873**	**0.959**

Our aggregated RPA number is 0.938 which means that the capex costs of a water and sewerage company in Northern Ireland are 6.2% lower than in the rest of UK. This compares to an RPA value of around 6% which the Utility Regulator applied for PC10.

7.1. Sensitivity analysis

The overall RPA is aggregated according to the weights in the cost breakdown. This means that the sensitivity of the overall RPA to estimates of price differentials for individual resources can be read directly from the cost breakdown.

Labour accounts for the largest share in the aggregation comprising 40% of total expenditure across the capex programmes in our resource breakdown. This means that the adjustment factor for labour has the largest impact on the aggregate RPA. The next highest shares are for the plant and equipment category (with 20% of total

cost) and the other materials and pipes subcategories of materials (with 12% and 14% respectively).

Labour has an adjustment factor smaller than 1, i.e. wages in Northern Ireland are lower than in the rest of the UK. The next two largest (sub) categories, which together account for 34% of total costs, are not affected by regional prices and thus have an adjustment factor of 1. The other building materials subcategory is likely to have an adjustment factor lower than 1 but we have opted for a conservative estimate of 1 in our analysis. Disposal costs which account for about 5% of total costs is the only category that has an adjustment factor higher than 1. The percentages and direction of the adjustment is shown in Table 7.3 for the full resource breakdown.

Table 7.3: Percentage of total costs and direction of price adjustment

Resource	Percentage of total cost	Direction of RPA
Labour	40%	<1
Plant & equipment	20%	1
Material		
Concrete	6%	<1
Rebar	2%	<1
Pipes	14%	1
Meter	<1%	1
Other	12%	(<)1
Disposal	5%	>1

We now systematically analyse the sensitivity of the RPA model with respect to:

- the weights in the cost breakdown; and

- the estimated price differences for individual resources.

We estimate the sensitivity of the RPA model to the weights assumed in the cost breakdown by calculating RPAs for different weights scenarios. Our sensitivity analysis creates additional scenarios as following:

- **Baseline** – 40% labour, 20% plants and equipment, and 40% materials.

- **Scenario 1** – low labour cost scenario: we decrease the assumed share of labour by 10% (percentage points) and concurrently increase the share of plant & equipment and materials by 5% each.

- **Scenario 2** – high labour cost scenario: we increase the assumed share of labour by 10% and concurrently decrease the share of plant & equipment and materials by 5% each.

- **Scenario 3** – high materials cost scenario: we increase the assumed share of materials by 10% and concurrently decrease the share of plant & equipment

and labour by 5% each. In order to maximise the impact on the RPA we consider the increase in the share of materials is due to increases in the shares of those materials (concrete, rebar, other materials, disposal) for which regional price differences have been estimated.

- **Scenario 4** – Drawing on Ofgem's RIIO-GD1 cost breakdown we increase labour by 15% (to 55% of total expenditure) and reduce plant & equipment by 15% (to 5% of total costs).

Table 7.4 below presents the sensitivity weights scenarios used in our analysis relative to the baseline weights resulted from our cost breakdown.

Table 7.4: Sensitivity weights scenarios

Sample	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Labour	- 10%	+ 10%	- 5%	+15%
Plant & Equipment	+ 5%	- 5%	- 5%	-15%
Materials (of which):	+ 5%	- 5%	+ 10%	-
Concrete	+ 1%	- 1%	+ 3%	-
Rebar	+ 1%	- 1%	+ 3%	-
Pipes	+ 1%	- 1%	-	-
Meters	-	-	-	-
Other	+ 1%	- 1%	+2%	-
Disposal	+ 1%	- 1%	+2%	-

For each scenario we also calculate a lowest and a highest RPA factor by using the lowest/highest regional price difference estimates available for each of our inputs. These numbers therefore show the highest and lowest RPA factor that results when the price adjustment for individual resources are set to the lowest and then highest values in the estimated ranges.

The results of the sensitivity analysis are presented in Table 7.5 below.

Table 7.5: Sensitivity of overall (low/high) RPA

Scenario	Selected RPA factor	Low RPA factor	High RPA factor
Baseline (40-20-40)	93.8%	87.3%	95.9%
Scenario 1 (30-25-45)	94.5%	88.2%	97.1%
Scenario 2 (50-15-35)	93.1%	86.5%	94.7%
Scenario 3 (35-15-50)	93.2%	86.3%	95.7%
Scenario 4 (55-5-40)	92.2%	85.3%	93.5%

The analysis shows the sensitivity in two dimensions:

- **Cost breakdown.** The sensitivity regarding the cost breakdown can be read off Table 7.5 for a fixed choice of estimated price differences (i.e. along one of the columns). Varying the breakdown across the four scenarios changes the RPA by approximately 3 percentage points. The scenarios cover a wide range of plausible variations: Over the four scenarios the share of labour ranges from 30% to 55%, plant and equipment from 5% to 25%, and materials from 35% to 50%.

- **Estimated differences for individual resources.** The sensitivity to the individual estimates can be read off for a fixed cost breakdown (i.e. from the lowest and highest RPA factor in one of the rows in Table 7.5). The RPA changes by approximately 9% between the lowest and highest adjustments for all resources.

Over all scenarios the possible RPA ranges from just over 85% (in Scenario 4) to just over 97% (in Scenario 1).

As expected, labour has the highest impact on the RPA estimate. Labour accounts for 2-5% of the 9% range of RPAs within each scenario. Keeping the estimated adjustment factor for labour fixed and varying the other estimates between their lowest and highest values narrows the range of possible RPAs across all scenarios as shown in Table 7.6.

Table 7.6: Sensitivity of overall (low/high) RPA with fixed adjustment factor for labour

Scenario	Lowest RPA factor	Highest RPA factor
Baseline (40-20-40)	90.4%	95.9%
Scenario 1 (30-25-45)	90.5%	97.1%
Scenario 2 (50-15-35)	90.3%	94.7%
Scenario 3 (35-15-50)	89.0%	95.7%
Scenario 4 (55-5-40)	89.5%	93.5%

Our estimate for the labour cost adjustment uses a composite of different occupational wages. Changing the weights of occupations within this composite can have an impact on the RPA. The proportion of skilled to unskilled labour has a clear impact on the overall RPA as the wage difference for unskilled labour is significantly wider than for skilled labour. In comparison the proportion of the different occupations has a minor impact on the overall RPA as the wage differentials for all occupational categories used in the model fall largely within a relatively narrow range (between 87% and 93%). Varying the proportions of occupations, which all have similar wage differences, will have only a limited impact on the labour RPA. The only occupational category in the composite estimate that falls outside this range is administrative occupations (where wages in Northern Ireland are 99% of UK wages). However, administrative occupations only make up a small proportion of our

composite estimate so that their impact on the overall RPA is minimal.[26] Additional sensitivity analysis of the composite wages is therefore not necessary.

Given the uncertainty regarding the individual estimates we perform another very aggressive robustness test of the RPA model. We challenge all estimates except those for labour and concrete, where we have a range of reliable estimates. The test is described in Box 7.2.

Box 7.2: Aggressive robustness test of RPA model

We use the 40-20-40 resource split from the Baseline scenario. For labour and concrete we use values from our estimated ranges, as these are based on robust data: we use our composite wage estimates for labour (0.89) and our estimated RPA for concrete (0.70).

For all other resources we set an adjustment of 1.05, i.e. we hypothetically allow that all prices in Northern Ireland except for labour and concrete were 5% higher than in the rest of the UK.

The resulting RPA under this hypothetical setup is 96.6%, which is just 3 percentage points higher than the Baseline estimate of 93.8%.

Using the lower end of estimates for labour and concrete together with the 1.05 adjustment for all other materials yields an RPA of 92.3%.

This challenge of all estimates for which there is significant uncertainty regarding the price estimate confirms the overall robustness of the RPA model.

7.2. Comparison to other methodologies

The sensitivity analysis in the previous section shows that the RPA model is well-behaved and robust regarding its individual components. While labour has a large impact on the overall RPA, there is no component in the RPA model where a small change of input value would cause a sudden change in the model output. Nevertheless, the range for the RPA estimate is rather large due to the range for the individual price differences and the choice of weights in the cost breakdown.

We therefore cross-check the model output against RPA estimates derived with different methodologies.

7.2.1. Labour only adjustment

Our sensitivity analysis has shown that the labour adjustment has the strongest impact on the RPA model. Fortunately, there is robust data available for regional wages from the ONS's ASHE data set.

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[26] Even doubling the share of administrative occupations in total labour costs shifts the overall RPA by less than 0.05.

We now consider an approach of applying an RPA only to labour costs. This is in line with the approach adopted by the CC in the NIE Provisional Determination. The CC applied an adjustment to NIE's cost data to reflect wage differences. The CC acknowledged that regional price differences might also exist for other expenditure items but cannot be properly accounted for in the benchmarking exercise.[27]

We have calculated a labour only RPA for our estimated cost breakdown as well as for each of the sensitivity scenarios described above. The results are presented in Table 7.7 below.

Table 7.7 RPA for labour only

Scenario	Selected RPA factor	low RPA factor	high RPA factor
Baseline (40-20-40)	95.8%	92.7%	95.8%
Scenario 1 (30-25-45)	96.8%	94.5%	96.8%
Scenario 2 (50-15-35)	94.7%	90.9%	94.7%
Scenario 3 (35-15-50)	96.3%	93.6%	96.3%
Scenario 4 (55-5-35)	94.2%	90.0%	94.2%

This methodology obviously produces higher RPA estimates than the aggregate RPAs that also use adjustments for other resources including concrete. Nevertheless, the resulting range from 90% to 96.8% remains plausible. It contains the RPA of approximately 94% (or -6%) applied by the Utility Regulator in PC10.

Our Baseline estimate of 93.8% lies around the middle of this range for the labour only RPA.

7.2.2. RPA from other regulatory decisions

In its final determination for PC10 the Utility Regulator estimated a regional price difference of 87.8%. This means that prices in general are 12.2% lower in Northern Ireland than in the rest of the UK. The Utility Regulator applied this estimate to a share of capex which resulted in an overall RPA of approximately 94%.[28] This compares to our Baseline estimate of just under 94%.

The effective RPA rate of around 94% implies that the Utility Regulator applied RPAs to approximately 50% of total capex. This is consistent with the estimate in our RPA model, where just over half of all capex is affected by regional price differences in the baseline analysis. Labour, concrete, rebar and disposal costs are affected by regional prices and account for around 53% of total capex; plant and equipment, pipes, water

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[27] Competition Commission, NIE Provisional Determination, p. 8-13
[28] Utility Regulator, Water and Sewerage Service Price Control 2010-13 Final Determination Main Report, (February 2010)

meters and other materials are unaffected by regional price differences and make up the remaining 47% of capex.[29]

Ofwat used the BCIS index for regional price adjustments in its price control PR04 and PR09. In PR09 Ofwat calculated regional price differences for regions in England and Wales between -8.4% and +13.9% compared to the average. The resulting RPA was applied to different fractions of expenditure depending on the capex programme.[30] In its analysis for PR04 Ofwat found regional price differences between 4% and 18% compared to the England and Wales average, which led to RPA between 0.8% and 17.5% for different water companies.[31] While there is only limited detail about the exact methodology in Ofwat's publications, these values seem broadly consistent with the Utility Regulator's previous determination and the current RPA model.

7.2.3. More general estimates of regional price differences

While more general price estimates will not capture the specifics of the water industry, we have researched a range of sources to cross-check our RPA model:

- **BCIS.** The BCIS regional factor used by Ofwat to adjust for regional prices has also been one of the options considered by the Utility Regulator for PC10. The regional factor for Northern Ireland in 2010 was 0.67 which the Utility Regulator and NI Water both considered to be excessively low.

- **Spon.** The Spon's Price Books 2013 contain estimates of regional variations in prices. The third update to the 2013 edition of the books estimate a regional variation factor for Northern Ireland of 0.54-0.56.[32]

These low estimates may partly reflect the depressed economic environment in Northern Ireland particularly in the construction sector for domestic houses. The estimates may therefore not be an accurate reflection of actual cost differences in the water industry. However they strongly suggest that regional prices in Northern Ireland are significantly lower than in the rest of the UK and therefore confirm the direction of adjustment applied in our RPA model.

Furthermore it is interesting to note that the estimates are similar to our lower end estimates of regional price differences for concrete, which is a material common across all construction activities. This strengthens confidence in our estimates and reinforces the fact that we have adopted a conservative approach in our analysis.

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[29] Although, as discussed previously, there is evidence suggesting prices of other building materials are lower in Northern Ireland. In our baseline analysis we have adopted a conservative approach and assumed that there is no difference in prices of other materials.

[30] Ofwat, Cost base feedback report, (December 2009)

[31] Ofwat, Future water and sewerage charges 2005-10: Final determinations – Appendix 4, (2004). See also Water Industry Commission for Scotland, Methodology Information Paper 25: The cost base approach, (2009).

[32] Spon's 2013 Price Books Update 3

## 8.	CONCLUSIONS AND RECOMMENDATIONS

In Section 2 we set out our methodology for estimating and applying the RPA. In Sections 3 to 6 we estimated a resource breakdown and presented estimates for the regional price differences for individual materials. The sensitivity analysis in Section 7 explored the robustness of the estimates and the range of possible aggregate RPAs.

We have set out a top-down methodology to derive a robust RPA. To estimate cost proportions and price differentials we used a range of data sources as well as insights from the Utility Regulator's previous work. A key issue for the RPA model is the limited availability of reliable price data on a regional basis. While there is detailed data on regional labour cost there is very little data on the other inputs required for capital projects in the water and sewerages sector. Where no data was available we made assumptions based on our own research and our sector experience, backed by theoretical economic arguments. Wherever possible we have cross-checked our estimates and assumptions against other data sources. In our sensitivity analysis we tested the robustness of the RPA model regarding the cost breakdown as well as the estimated price differentials.

Throughout our report we have discussed a range of options. In this section we make recommendations for choosing the appropriate approach and suitable estimates from the available ranges. Where we already made recommendations in previous sections, we repeat them here for ease of reference.

### 8.1.	Application

We recommend a top-down application of RPA to overall capex. The RPA should be applied to the whole expenditure as the unaffected parts of costs are already accounted for in the cost breakdown.

- A top-down application of the RPA to total capex is consistent with the Utility Regulator's previous method and with the recent decision by the CC in relation to the NIE price determination.

- The top-down application is well supported by the top-down analysis in the RPA model.

- A top-down approach is easy to understand and transparent. It is simple to apply and therefore cost efficient.

- Application of the RPA to total capex is less likely to interfere with operational decisions of the regulated company.

- The simplicity of the method reduces the likelihood of spurious challenges to irrelevant details during the consultation.

- There is a risk of imprecision and over-simplification. However, a more granular approach can only deliver improved precision if it is based on reliable granular data, which is not available in this case.

In its previous decision at PC10 the Utility Regulator applied different RPAs for infrastructure and non-infrastructure capex.

8.2. Estimates

We have set out range estimates for the cost breakdown and the price differentials for individual resources. Within these ranges we recommend:

- **Labour:** We recommend using a 40% share of labour within the cost base. As adjustment factor we recommend using a composite occupational estimate (89%). A higher share of labour could be justified following Ofgem's GD1 determination and there is some discretion regarding the estimated adjustment factor.

- **Plant and equipment.** We recommend a 20% share and an adjustment factor of 100%. The share could be lower (e.g. 5-10%) following Ofgem's GD1 decision. The adjustment factor could be higher (105%) following Ofwat's reasoning in PR09. However our sensitivity analysis shows that neither variation would have a great impact on the overall RPA.

- **Concrete.** In the RPA model concrete accounts for 10-20% of material costs depending on capex programme, which results in concrete accounting for 6% of total capex. As adjustment factor we recommend using a value of 70% in between the two more robust estimates from industry sources. There is some discretion regarding these estimates. The choice of values should take into account: (1) that our RPA model uses the concrete category to also capture cement and concrete blocks; and (2) the potential impact of the recession/recovery on the construction sector in Northern Ireland.

- **Rebar.** We derived the share for rebar as one third of the share for concrete (approximately 2% of total capex). Our analysis suggests that there are regional price differences for rebar. However, they would be smaller than for concrete and our sensitivity analysis shows that they would not have a significant impact on the overall RPA. We recommend using an adjustment factor of 90% based on the industry source available.

- **Pipes, meters and mechanical components.** We recommend using an adjustment factor of 100% for these materials. There is no reason to expect significant price differences for these materials and our sensitivity analysis shows that their impact on overall RPA is small.

- **Other materials.** The materials included in this category (aggregates, bricks, metals, timber, etc.) individually represent a small share of total costs and any regional price difference would have a minimal impact on the overall RPA. We recommend adopting a conservative approach and using an adjustment factor of 100% for this category. However, based on data from industry sources, we believe there are strong indications that prices for these building materials could be lower in Northern Ireland.

- **Disposal:** In our RPA model, disposal costs account for around 5% of total capex and are included under the materials category of the cost breakdown. Our research suggests that disposal costs are higher in Northern Ireland compared to the rest of the UK. The magnitude of this price differential depends however on whether landfill taxes are included in this calculation or not. We recommend using an adjustment factor of 103%.

Our RPA model yields an RPA range between 87.3% and 95.9% for the baseline assumptions described in this report. Under the conservative recommendations described above the model yields an overall RPA of 93.8% (or −6.2%). Our recommendations are however assumptions based and rely on the use of some discretion in choosing the inputs to the model which consequently impacts the overall RPA estimate. We therefore suggest that the Utility Regulator reviews our recommendations again prior to its final determination to take into account any new information from updated data sources and consultation responses.

As explained in the beginning of this section, we recommend applying the RPA figure equally to all capex expenditure types, consistent with a top-down approach. The overall RPA is a weighted average of the RPAs for the different expenditure areas (water and sewerage, infrastructure and non-infrastructure) and therefore no further adjustment is needed when applying the RPA to the different expenditure categories.