Final report for Spark New Zealand and Vodafone New Zealand

Response to submissions on revised draft determination

Pricing review - UCLL and UBA Final Pricing Principle

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NETWORK STRATEGIES
• Telecommunications Strategy •

0 Executive summary

In its assessment of any further potential changes to its approach for estimating the TSLRIC for unbundled copper local loop (UCLL) and unbundled bitstream access (UBA) services the Commission must be guided by the characteristics of an efficient network that the Hypothetical Efficient Operator (HEO) would deploy.

As we identified in our August report, the Commission's current fixed wireless access (FWA) model implementation is inconsistent with that of an HEO. Chorus' consultant, Analysys Mason, offers advice to the Commission that would further compound the existing inefficiencies in the Commission's approach. In particular Analysys Mason's suggested massive increase in the number of base stations to serve FWA end-users delivers completely unrealistic costs for an HEO. In fact this recommendation further supports our position that the underlying issue in the Commission's modelling is that it applies an incorrect approach to determine which customers are served by FWA.

The number of FWA customers in the Commission's model should not be based on distance from the exchange but should reflect an efficient operator's network. It is clear from Analysys Mason's map of FWA locations in the Commission's model that the selection of FWA customers based on distance from the exchange results in an unrealistic spread of FWA customers throughout the country. At the same time, fibre is deployed in the model in many rural and remote areas, including locations currently served with Multi Access Radio (MAR) technology. It is highly unlikely that locations served with MAR technology could be economically served with fibre. In fact, if economical fibre deployment was possible throughout New Zealand then we would not need the Rural Broadband Initiative (RBI) program and Ultra Fast Broadband (UFB) would be deployed across all of the country.

We have consistently advocated the efficient deployment of FWA for Zones 3 and 4 ESAs where there is no current unbundling and future unbundling is unlikely. These are the areas in which FWA is currently being deployed in New Zealand. Even Analysys Mason has recently recommended to the Finnish regulator the use of wireless technologies in areas where there is unlikely to be a business case for unbundling.

> The 2013 EC Recommendation emphasises … that a modern efficient network should be assumed. Since at least one Finnish operator has been serving some rural customers with voice/broadband services using wireless technologies, rather than maintaining the legacy wireline technology, it appears that at least some rural parts of Finland are most efficiently served by a wireless technology. This has disadvantages in that such a technology cannot be unbundled. However, **the business case for unbundling in such areas will be weak, and so unbundlers will be unlikely to seek to serve such rural customers** [our emphasis].[1]

The Commission must use an economical and efficient approach for FWA implementation and hence we recommend our FWA approach. This approach encompasses actual propagation conditions and as such is the optimal method to reflect efficient coverage.

Chorus' recommendations in respect to both FWA and aerial deployment are completely inappropriate for the HEO. In fact we find it surprising that Chorus agrees with the Commission's FWA approach since some customers in unbundled urban ESAs are now served by FWA.

We have identified a number of problems with Chorus' data and analysis relating to aerial deployment, in addition to the issue of its irrelevance in the context of an HEO deploying a nationwide network. Furthermore, we found fundamental flaws in the data used by Analysys Mason in its trenching analysis which purports to illustrate that the Commission's costs are inconsistent with real trenching costs in New Zealand. The Commission should therefore disregard this analysis.

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1 Analysys Mason (2015), *Survey of the suitability of a bottom-up LRIC+ model for Finland*, 30 April 2015, page 39.

Finally, an examination of the reports by Chorus' consultants in relation to WACC, price trends and backdating reveals no substantive evidence that the Commission should alter its proposed approach.

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1 Introduction

The Commerce Commission has received a number of submissions on its revision of the December draft determination for the pricing review for unbundled copper local loop (UCLL)[2] and unbundled bitstream access (UBA)[3]. Spark New Zealand (Spark) and Vodafone New Zealand (Vodafone) have commissioned Network Strategies Limited to review a number of issues raised in these submissions. Accordingly this report encompasses:

- commentary on issues concerning the modelling of fixed wireless access (FWA) (Section 2)
- consideration of geospatial issues (Section 3)
- a review of trenching cost information and analysis (Section 4)
- our response on issues relating to aerial infrastructure (Section 5)
- our observations on price trend proposals (Section 6)
- our remarks on issues relating to the cost of capital (Section 7)
- a review of the uplift analyses (Section 8)
- our views on backdating (Section 9)
- our conclusions and recommendations (Section 10).

Our team has had the benefit of access to confidential information (CI) and restricted information (RI) used in the modelling process. In keeping with our confidentiality undertakings any CI and RI quoted in this report is marked as such with square brackets.

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2 Commerce Commission (2015), *Further draft pricing review determination for Chorus' unbundled copper local loop services*, 2 July 2015.

3 Commerce Commission (2015), *Further draft pricing review determination for Chorus' unbundled bitstream access service*, 2 July 2015.

Spark New Zealand CI is marked **SCI**, Vodafone New Zealand CI is marked **VNZCI**, Ultrafast Fibre CI is marked **UFFCI** and Commerce Commission CI and RI is marked **CNZCI** and **CNZRI** respectively.

Although this report was commissioned by Spark and Vodafone the views expressed here are entirely our own.

2 Fixed Wireless Access

Chorus[4] and Analysys Mason[5] have recommended changes to a number of inputs and assumptions used in the Commission's FWA model. In its assessment of any potential changes the Commission must be guided by the characteristics of an efficient network that the HEO would deploy.

In this Section we demonstrate that Chorus' recommendations are inappropriate for the HEO and in fact Analysys Mason's arguments support our proposed approach for FWA implementation. The issues fall into three main categories:

- customers and areas (Section 2.1)
- coverage (Section 2.2)
- number of base stations (Section 2.3).

In Section 2.4 we have made recommendations to assist the Commission in implementing a FWA model representing the HEO.

2.1 FWA customers and areas

The Commission's revised draft determination assumes that customers across the whole country will be served by FWA if they are beyond a fixed distance (5.3km) away from the exchange, with all the remaining customers served by fibre. This threshold is based solely

4 Chorus (2015), *Submission in response to the Commerce Commission's Draft Pricing Review Determinations for Chorus' UBA and UCLL services (2 July 2015)*, August 2015, paragraphs 129-139.

5 Analysys Mason (2015), *UCLL and UBA FPP further draft determination submission – CI*, 11 August 2015, Section 7.

on the characteristics of a copper network, which has no relevance to a fibre network deployment decision by an efficient operator.

Chorus agrees with the Commission's approach of limiting FWA deployment to low-speed data or voice-only customers only:

> The number of [FWA] end-users (approximately 40,833), and criteria for identifying the categories of end-user, is in line with Chorus' experience, which is that around 2.5% of customers in the network have no or low speed broadband.[6]

The number of customers suggested by Chorus is inappropriate because it is not efficient for the HEO to deploy an FWA network to serve customers based on distance from the exchange – this has resulted in a significantly lower number of FWA customers (40 883) compared to the customers served by the RBI network (250 000)[7]. In fact the Commission also acknowledged that 'the number of customers fed by RBI felt about right'[8] for FWA coverage. We have already presented detailed arguments in our submission as to why the Commission's current use of FWA is unrealistic for the HEO:

> … when comparing the Commission's model calculations against the actual planned coverage for Vodafone's RBI network, we find that the 40 833 end users represent only 16% of the projected 250 000 homes to be served by Vodafone's RBI network. It would be illogical for the HEO to serve only 40 833 users, with its decision based on distance from the node rather than economic costs. The Commission should implement what it stated – that is, 'FWA should be used for lines where costs are particularly high and unbundling is unlikely'.[9]

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6 Chorus (2015), *Submission in response to the Commerce Commission's Draft Pricing Review Determinations for Chorus' UBA and UCLL services (2 July 2015)*, August 2015, paragraph 132.

7 Projected number of RBI customers according to Vodafone's estimation.

8 *Commerce Commission (2015), Further draft pricing review determination for Chorus' unbundled copper local loop services,* 2 July 2015, paragraph 1132.

9 Network Strategies Limited (2015), *Revised draft determination for the UCLL and UBA price review*, 13 August 2015, Section 2.3.2.

The Commission's model assumes a throughput of 1Mbit/s for low-speed customers and only 150 Kbit/s for voice-only customers. On the other hand, FWA technology in rural areas has been proven to be capable of delivering throughput up to 20-fold higher than the 1Mbit/s assumed for low-speed customers. Vodafone reported for RBI wholesale services an average download throughput of [✂……]**VNZCI** with an average maximum of [✂……...]**VNZCI**. When limiting FWA deployment for only low-speed and voice-only customers the Commission is making a conservative assumption in regards to the capability of FWA to delivery services to customers with higher throughput requirements. Therefore, taking into consideration that distance to the exchange and throughput are network characteristics which are related, we conclude that the Commission is wrong when assuming a distance threshold of 5.3km for the deployment FWA.

It is surprising that Chorus agrees with the Commission's approach which assumes that customers in unbundled urban ESAs should be served by FWA. In fact Chorus seems to be contradicting itself as Chorus has previously argued against including FWA[10] because it could not be unbundled. Hence we do not understand Chorus' new-found support for the use of FWA in areas which are already unbundled.

Analysys Mason has mapped the FWA customers selected in the Commission's model.[11] It is evident from Analysys Mason's map that the selection of FWA customers based on distance from the exchange results in an unrealistic spread of FWA customers throughout the country and in fact supports our point[12] that it leads to inefficient deployment from a network planning perspective. Analysys Mason does not explicitly suggest a method for selecting FWA customers but recommends the exclusion of FWA from areas where UFB or HFC options are available:

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10 Chorus (2015), *Submission in response to the Commerce Commission's Draft Pricing Review Determinations for Chorus' UBA and UCLL services (2 July 2015)*, August 2015, paragraph 40 and Chorus (2015), *Submission in response to Draft Pricing Review Determinations for Chorus' Unbundled Copper Local Loop and Unbundled Bitstream Access Services (2 December 2014) and Process and Issues Update Paper for the UCLL and UBA Pricing Review Determinations (19 December 2014)*, 20 Februrary 2015, paragraph 82.1.

11 Analysys Mason (2015), *UCLL and UBA FPP further draft determination submission – CI*, 11 August 2015, Section 7.3.1.

12 Network Strategies Limited (2015), *Revised draft determination for the UCLL and UBA price review*, 13 August 2015, Section 2.3.2.

> …the Commission should not use FWA in any areas covered by Chorus UFB, non-Chorus LFC or HFC networks, because the modelled FWA solution is inferior to all of these.[13]

Hence by implication Analysys Mason does not agree with the Commission's approach which has resulted in 40 833 FWA customers. This implies that Analysys Mason also does not agree with Chorus which believes that the Commission's FWA customer estimate is realistic.

Analysys Mason recommends that the Commission implements a 'superior' FWA model by considering FWA for non HFC and UFB areas based on distance from the exchange and testing its feasibility against a defined threshold:

> Based on a threshold (set by a side investigation calibrated by the FWA costs) such as a minimum of 30 premises per grid cell, test whether the number of premises on road segments with range >5.3km from the serving cabinet or exchange in each grid cell is high enough to merit the use of FWA in that area and exclude the use of FWA in such grid cells which fail this test. Following this, note the number of remaining grid cells and include in the cost model a minimum of 1 base station per grid cell in which there are sufficient FWA-served premises.[14]

It is simply unsupportable that Analysys Mason expects an efficient operator to exclude FWA across most of rural and remote New Zealand in favour of a fibre solution without even performing any comparative cost analysis. If economical fibre deployment was possible throughout the country then New Zealand would not need the RBI program and UFB would be deployed across all of the country.

We investigated Analysys Mason's assumption using the building densities in ESAs considered for the sample areas used in our FWA model (Exhibit 2.1). Using Analysys Mason's coverage area of 64km^2 per base station[15] and the Zone 4 density of [✂…]**CNZRI** buildings per km^2, it can be estimated that there will be around

13 Analysys Mason (2015), *UCLL and UBA FPP further draft determination submission – CI*, 11 August 2015, Section 7.10.

14 *Ibid,* Section 7.11.

15 *Ibid,* Section 7.3.1.

[✂…]**CNZRI** buildings in the suggested coverage area. As this is considerably below Analysys Mason's proposed threshold of 30 premises, Analysys Mason's recommendation is to exclude FWA for our FWA sample areas, and that the HEO deploy fibre. This is completely unrealistic and suggests that Analysys Mason does not appreciate the geographical conditions in New Zealand. In many sparsely populated rural and remote areas with low customer density, fibre connectivity is simply not feasible due to difficult terrain and geotypes. Consequently Analysys Mason's approach is far from 'superior' and is in fact unrealistic and illogical for an efficient FWA model.

Zones	*Building density (buildings per km²)*		
	Minimum	*Average*	*Median*
Zone 4	[✂…	…	…
Zone 3b	…	…	…
Zone 3a	…	…	…]**CNZRI**

Exhibit 2.1: *Building densities for sample areas [Source: Network Strategies]*

In addition to recommending an inefficient approach to the Commission, it is notable that Analysys Mason is providing inconsistent and contradictory advice to different regulators. Earlier this year (in April 2015) Analysys Mason recommended that the Finnish Communications Regulatory Authority (Viestintävirasto) use wireless technologies for cost modelling in rural parts of Finland where unbundling is unlikely:

> The 2013 EC Recommendation emphasises on numerous occasions (e.g. recital 39, point 31) that a modern efficient network should be assumed. Since at least one Finnish operator has been serving some rural customers with voice/broadband services using wireless technologies, rather than maintaining the legacy wireline technology, it appears that at least some rural parts of Finland are most efficiently served by a wireless technology.
>
> This has disadvantages in that such a technology cannot be unbundled. However, the **business case for unbundling in such areas will be weak, and so unbundlers will be unlikely to seek to serve such rural customers** [our emphasis]. Therefore, we propose that while use of wireless technology to serve highly rural customers in a bottom-up model

> is not unreasonable, given the commercial decisions of actual Finnish operators, the definition of where it is used must be developed with care.[16]

However in New Zealand Analysys Mason has recommended that the Commission does not use FWA at all in its cost model since it cannot be unbundled. This recommendation is made with no regard to evidence that both Spark and Vodafone are deploying fixed wireless broadband services for primary lines in rural areas of New Zealand. Analysys Mason's advice to the Finns was based on exactly the same evidence: real world operators selecting fixed wireless as the efficient technology in rural areas.

Furthermore, in respect to wireless technologies Analysys Mason suggests to the Finnish regulator approaches that would reflect efficient forward-looking decision-making by the HEO. For example Analysys Mason offers two options:

> - the actual areas that are currently not served by wireline technology, or the areas where the wireline network is planned to be decommissioned, could be obtained from operators and captured in the model (although this would not be entirely consistent with a hypothetical operator and may not accurately reflect potential future deployments)
>
> - more complex algorithms could be used to determine whether it is more cost-effective to serve a location using wireline or wireless technology.[17]

We note that Analysys Mason's first option mirrors aspects of our own approach which involved identifying areas in which unbundling was not present currently and not planned in the future, as well as areas in which wireless technologies were currently being deployed or planned to be deployed in the future.

Analysys Mason's second option is in stark contrast to its recommendations for a superior version of the Commission's model in which the decision to fibre is based on distance from the exchange, together with low density of buildings beyond the distance-related exchange boundary.

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16 Analysys Mason (2015), *Survey of the suitability of a bottom-up LRIC+ model for Finland*, 30 April 2015, page 39.

17 *Ibid*.

Once the relevant wireless areas have been identified, Analysys Mason recommends excluding the costs and demand relating to these locations and modelling the remaining locations with wireline technology. At no stage does Analysys Mason recommend to the Finnish regulator a distance from the exchange criterion.

It is difficult to reconcile the radical difference in Analysys Mason's suggested approaches for the two countries. Clearly Analysys Mason's advice to the Finnish regulator is based on the application of an efficiency standard. However in its recommendations to the Commission, Analysys Mason fails to apply a similar efficiency standard for New Zealand.

In the New Zealand proceedings, based on the Commission's approach of selecting FWA customers throughout the country (using a distance from the exchange criterion) Analysys Mason argues that the FWA spectrum cannot be used for other services:

> It is no longer possible for other stakeholders to argue that FWA is only used in rural areas. Given the wide geographic coverage area of the FWA use now assumed by the Commission, use for FWA would essentially prevent this spectrum being used for other services in New Zealand.[18]

This argument also supports our view that the current selection of FWA customers is not logical. It is not efficient for the HEO to buy spectrum to serve only 40 883 FWA customers nationwide and not use it for any other services. In fact the HEO would attempt to maximise efficiency by using the spectrum to serve FWA customers (in Zones 3 and 4) and for other services in Zones 1 and 2. Consequently if the Commission persists with its current approach then it should assume the HEO also offers mobile services and split the spectrum costs accordingly.

So what can we conclude about the optimal extent of FWA in the Commission's model:

- Chorus supports an unrealistic and inefficient FWA deployment which considers only a fraction of RBI customers that are spread throughout the country (including unbundled urban areas).

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18 Analysys Mason (2015), *UCLL and UBA FPP further draft determination submission – CI*, 11 August 2015, Section 7.5.

- Analysys Mason does not agree entirely with the Commission's approach as, unlike Chorus, it suggests that FWA should not be considered in areas in which UFB and HFC are present. Nevertheless Analysys Mason has also not suggested any clear approach regarding which customers should be included for FWA.
- Analysys Mason's recommendation to the Finnish regulator is very clear and aligns with our suggested approach of including all customers in areas which are currently not unbundled and are not likely to be unbundled in the future.

We have consistently highlighted (in our previous reports[19]) the importance of efficiency and selecting areas which are not unbundled for identifying suitable FWA customers. As illustrated by the Finnish example above, this approach has been suggested in other countries as well and is certainly more realistic and economically efficient than choosing customers based on distance from the exchange.

The Commission's model must satisfy TSLRIC principles and consequently FWA should be deployed in areas where it is feasible and economical to do so rather than restricting it by distance and underutilising its coverage and capacity. As discussed earlier an efficient operator is likely to deploy FWA for customers in Zones 3 and 4 areas where there is no current unbundling and future unbundling is unlikely: [20]

> We also assumed that there would be no further unbundling during the model timeframe. We believe this is a reasonable assumption since the impact of the introduction of geographical averaging for UCLL prices is uncertain, and furthermore the Commission is not actively seeking to encourage unbundling in this review…
>
> While it is impossible to predict with absolute certainty the impact of the outcome of this price review on further unbundling, on the balance of probabilities it is unlikely to increase given interested service providers' public statements on the issue. Moreover the decrease in rural prices as a result of geographic de-averaging may not be sufficient to support a business case for further unbundling in rural areas, particularly in current circumstances in which the Government is extending RBI funding. In addition we note that the

19 Network Strategies Limited (2015), *Revised draft determination for the UCLL and UBA price review*, 13 August 2015, Section 2.4 and Network Strategies (2015), *Modelling Fixed Wireless Access*, 20 February 2015, Report Number 34020, Section 3.2.

20 Network Strategies (2015), *Modelling Fixed Wireless Access*, 20 February 2015, Report Number 34020, Section 3.2.

> Commission's constant demand assumption effectively precludes the possibility of further unbundling.

The use of FWA in our recommended Zones 3 and 4 areas[21] will result in [✂……..]**CNZRI** FWA customers which is comparable to the number of RBI customers and hence represents a more realistic HEO deployment.

2.2 Coverage

Analysys Mason has suggested that the FWA analysis should be performed considering base station coverage areas in the form of grid cells (which are defined as 8km×8km squares):[22]

> Based on our own estimates of the possible practical coverage area of a FWA site in rural New Zealand for an operator seeking to provide a high level of coverage of premises, we have tested a grid size of 8km×8km.

It seems that Analysys Mason is unaware of radio planning techniques as it is performing coverage analysis for square grids whereas wireless/base station coverage analysis should be performed for hexagonal grids, which are generally approximated as circular grids. Analysys Mason's lack of radio planning knowledge is also evident by its suggested coverage value of 64km^2 per base station for rural areas. This is far too conservative for LTE in the 700MHz band and in fact Vodafone's link budget analysis estimates that cell radius in rural areas should be greater than [✂…]**VNZCI**. This translates to a theoretical coverage area of around [✂……..]**VNZCI** which is [✂…]**VNZCI** times higher than Analysys Mason's assumed value.

In addition Analysys Mason argues that the Commission's assumption of 100% coverage is unsuitable due to propagation factors, and has suggested the use of additional equipment to mitigate the issue:

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21 Suggested Zones 3 and 4 areas refer to areas in Zones 3 and 4 where there is no current unbundling and future unbundling is unlikely.

22 *Ibid,* Section 7.3.1.

> As we have previously submitted, a fraction of the premises notionally served by FWA will in fact not be so served due to factors that are either omitted or only treated statistically in the propagation models (local clutter, shelter belts, etc.) and will require remedial measures (such as deployment of FTTH or remotely sited antennas).
>
> One way to implement the required change to the model would be to include an additional asset type representing additional capital expenditure needed to provide coverage for a small fraction of the FWA served end-users. This could be based on costs for a specific type of intervention (e.g. a pole-mounted antenna outside the shelter belt and a 30m trench and cable to lead in to the premise).[23]

The Commission's approach and suggestions by Analysys Mason are both based on theoretical assumptions that do not represent an actual network. On the other hand, our FWA model calculates the number of base stations and repeaters required to achieve 100% coverage by considering the actual propagation conditions:

> To mitigate any coverage problems that may arise for existing base stations (resulting in insufficient signal strength at the customer premises), the RF planning (performed for our cost model) adds extra base stations and repeaters which ensure that adequate signal strength is received by all customers. The costs of these base stations and repeaters have been included in our FWA cost model results.
>
> Finally we believe that the Commission should adopt our FWA model as this addresses the coverage and availability issues in both the network planning and costing.[24]

In fact our FWA model addresses propagation constraints in detail by considering four geotypes to account for difference in regions, terrain and customer densities. The geotype approach also means that our model results for sample areas can be easily extended to other areas across New Zealand.

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23 Analysys Mason (2015), *UCLL and UBA FPP further draft determination submission – CI*, 11 August 2015, Section 7.7.

24 Network Strategies Limited (2015), *Review of issues from UCLL and UBA submissions*, 20 March 2015, Section 2.4.

We conclude that the Analysys Mason recommendations regarding coverage are completely inappropriate, and that the optimal way to reflect efficient coverage is to adopt an approach that encompasses actual propagation conditions.

2.3 Number of base stations

Analysys Mason has presented an extensive discussion on the required number of base stations to cover the FWA customers in the Commission's model.

> The number of base stations derived is however far too low, because it does not take the need for coverage into account. Constraints due to radio propagation limit the practical size of the area covered by each base station and taking this into account will lead to a significant increase in the number of FWA base stations required to serve the road sections identified by the Commission's modelling.[25]

Consequently Analysys Mason undertook a review of the distribution of road sections served by FWA in the Commission's model. According to this analysis the number of FWA radio sites assumed in the model ([✂…]**CNZCI** sites) could not serve these widely dispersed road sections. Analysys Mason states that a total of 1447 base stations would be required to provide FWA coverage.[26] Analysys Mason's reasoning is based on the distribution of customers by distance from the exchange. We have already explained (in Section 2.1) that this approach is unrealistic from a network planning perspective and in fact Analysys Mason's recommended number of base stations supports our stand because it represents an unrealistic deployment, not compatible with the efficiency required of the HEO.

According to Vodafone's RBI coverage plan, it is estimated that the projected network will provide access to more than 250 000 rural homes through 530 sites.[27] Despite the challenge that terrain in rural areas represents for network planning, Vodafone's RBI coverage is

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25 Analysys Mason (2015), *UCLL and UBA FPP further draft determination submission – CI*, 11 August 2015, Section 7.3.

26 *Ibid,* Section 7.3.1.

27 Vodafone (2014), *RBI flyer*, available at http://www.vodafone.co.nz/cms/documents/1375774069267/.

performing satisfactory. As reported by Vodafone, the percentage of failed installations of RBI Wholesale services attributed to coverage problems due to terrain (e.g.: hills blocking the line of site to cell towers) is less than [✂..][28] **VNZCI**. It would be unreasonable for any HEO to deploy a network based on Analysys Mason's recommendation – with almost three times more sites (1447 base stations[29]) than Vodafone's RBI network to serve only 40 833 customers, a fraction of the estimated total of 250 000 RBI customers (**Exhibit 2.1**). Although the Commission's model is required to represent an efficient operator it covers only 40 833 customers with [✂...]**CNZCI** sites whereas Vodafone's RBI deployment covers over six times more customers with just [✂...]**CNZCI** times the number of sites.

The Commission's FWA deployment is based on the Vodafone RBI which is a 900MHz deployment:

> Conservative coverage assumptions: we agree that using the 700 MHz band would increase the coverage area compared to the 900 MHz band that Vodafone uses. We are also aware that topology and other factors can reduce coverage within existing coverage areas. We chose a conservative range to mitigate this factor.[30]

In fact the Commission's FWA deployment should be more efficient than RBI as it should be based on LTE technology in the 700MHz. band which delivers superior performance compared to that of the 3G technology in higher spectrum bands used for RBI.[31]

Note that for comparative purposes we have also included (in Exhibit 2.2) the number of customers and sites modelled by the Commission in its December draft determination.

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28 Annual average for 2014/2015.

29 Analysys Mason (2015), *UCLL and UBA FPP further draft determination submission – CI*, 11 August 2015, Section 7.3.1.

30 *Commerce Commission (2015), Further draft pricing review determination for Chorus' unbundled copper local loop services,* 2 July 2015, paragraph 1132,

31 Network Strategies (2015), *Modelling Fixed Wireless Access*, 20 February 2015, Report Number 34020, Section 2.2.2.

	Vodafone's RBI	*Commission's model (December)*	*Commission's model (July)*	*Analysys Mason*
Customers	250 000[1]	[✂…..	…..	40 833
Sites	530	…..	…..	1 447
Customers per site	472	…..	…..]**CNZCI**	28

1 Projected number of RBI customers according to Vodafone's estimation

Exhibit 2.2: *Customers and sites for FWA [Source: Network Strategies Limited]*

We do not believe that the number of base stations suggested by Analysys Mason could represent an efficient operator's network. In fact if 1 447 sites are used to serve 40 833 customers, there will be an average of 28 customers per site rather than the 472 customers per site for RBI deployment. This will result in extremely high costs – a simple cost analysis suggests the total FWA annual cost would be around [✂….]**CNZCI** million (for 1 447 sites) rather than [✂…]**CNZCI** million (for [✂…]**CNZCI** sites). This translates to an annual cost of [✂……]**CNZCI** per customer which is significantly higher than Commission's corresponding value of [✂….]**CNZCI** per customer.

Thus Analysys Mason's recommendation of increasing the number of base stations to serve FWA end-users delivers unrealistic costs for an HEO. In fact this recommendation further supports our position that the underlying issue in the Commission's modelling is that it applies an incorrect approach to determine which customers are served by FWA.

Assuming FWA is used for all customers in the Zones 3 and 4 areas (which are not unbundled or likely to be unbundled), the number of FWA customers should be [✂…….]**CNZRI**. Based on the Commission's approach of using RBI deployment and costs, we estimate that [✂…]**CNZRI** base stations will be required and the total FWA annual cost would be around [✂…]**CNZRI** million (or [✂…]**CNZRI** per customer). Note that we do not recommend the use of RBI deployment and costs because, as the Commission is aware, these are based on 3G technology with spectrum bands higher than 700MHz[32].

32 Network Strategies (2015), *Revised draft determination for the UCLL and UBA price reviews*, 13 August 2015, Section 2.3.1.

2.4 Recommendations

The number of FWA customers in the Commission's model should not be based on distance from the exchange but should reflect an efficient operator's network. We have consistently advocated the use of FWA for Zones 3 and 4 ESAs where there is no current unbundling and future unbundling is unlikely. We have noted that even Analysys Mason has recently recommended the use of wireless technologies in areas where there is unlikely to be a business case for unbundling.[33]

In addition to identifying the correct number of customers, the Commission should ensure that its model represents the HEO rather than an inefficient operator. One possible option is identify customers that would be efficiently served by FWA and then exclude these customers and costs completely from the model. This means that the cost model should only consider ESAs which have been unbundled or are likely to be unbundled. This is consistent with Analysys Mason's recommendation to the Finnish regulator in April 2015:

> … propose that both the costs and demand of the locations served by wireless technology are then excluded from the bottom-up model; that is, it is assumed that they are not relevant to the costs of wholesale products in relation to Markets 4 and 5. This is consistent with recital 39 of the 2013 EC Recommendation.
>
> In line with the practice in other countries, we would then assume that all remaining buildings are passed by the modelled wireline network.[34]

We recognise that due to TSO obligations the Commission has decided that the HEO must serve all TSO customers. Hence the Commission must include customers in rural areas that are best served by FWA. The Commission must use an economical and efficient approach for FWA implementation and hence we recommend the adoption of our FWA approach. As discussed in our report[35], our FWA model:

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33 Analysys Mason (2015), *Survey of the suitability of a bottom-up LRIC+ model for Finland*, 30 April 2015, page 39.

34 *Ibid*.

35 Network Strategies Limited (2015), *Revised draft determination for the UCLL and UBA price review*, 13 August 2015, Section 2.4.

- accounts for complex terrain and propagation factors while providing an efficient solution for a HEO
- can easily be adopted by TERA – we have already suggested a feasible approach to apply our model results to rural areas
- is based on a reasonable assumption that no further unbundling is expected during the modelling period.

Finally if the Commission still wishes to persist with its current theoretical approach to FWA, then it should use the appropriate number of customers and areas to rectify the existing unrealistic and inefficient deployment. Hence the Commission should:

- include all customers in Zones 3 and 4 which are not unbundled or likely to be unbundled
- use microwave backhaul for rural sites as it is unrealistic to assume only fibre backhaul will be deployed by the HEO for all FWA sites.[36]
- correct the model issues identified in our report:[37]
  - the calculation of cost per Mbit/s for FWA
  - the discrepancies between model documentation and implementation
  - the method for allocating premises to fibre and FWA
  - the approach for calculating UCLL cost in rural areas.

36 *Ibid,* Section 2.3.5.

37 *Ibid,* Section 2.5.

3 Geospatial issues

3.1 MAR locations in TERA model

Chorus states that all TSO connections that existed in December 2001 must be included in the modelling regardless of technology and broadband availability[38]. Clearly this includes connections that use Multi Access Radio (MAR).

By definition, customers using MAR technology are located in terrain which is difficult and costly to serve (Exhibit 3.1 and Exhibit 3.2). Consequently we undertook a GIS analysis to investigate MAR locations and their inclusion in the Commission's model.

38 Chorus (2015), *Submission in response to the Commerce Commission's Draft Pricing Review Determinations for Chorus' UBA and UCLL services (2 July 2015)*. August 2015. Paragraph 74.

Exhibit 3.1: *MAR station – Ongarure, North Island [Source: Spark New Zealand, Google Maps]*

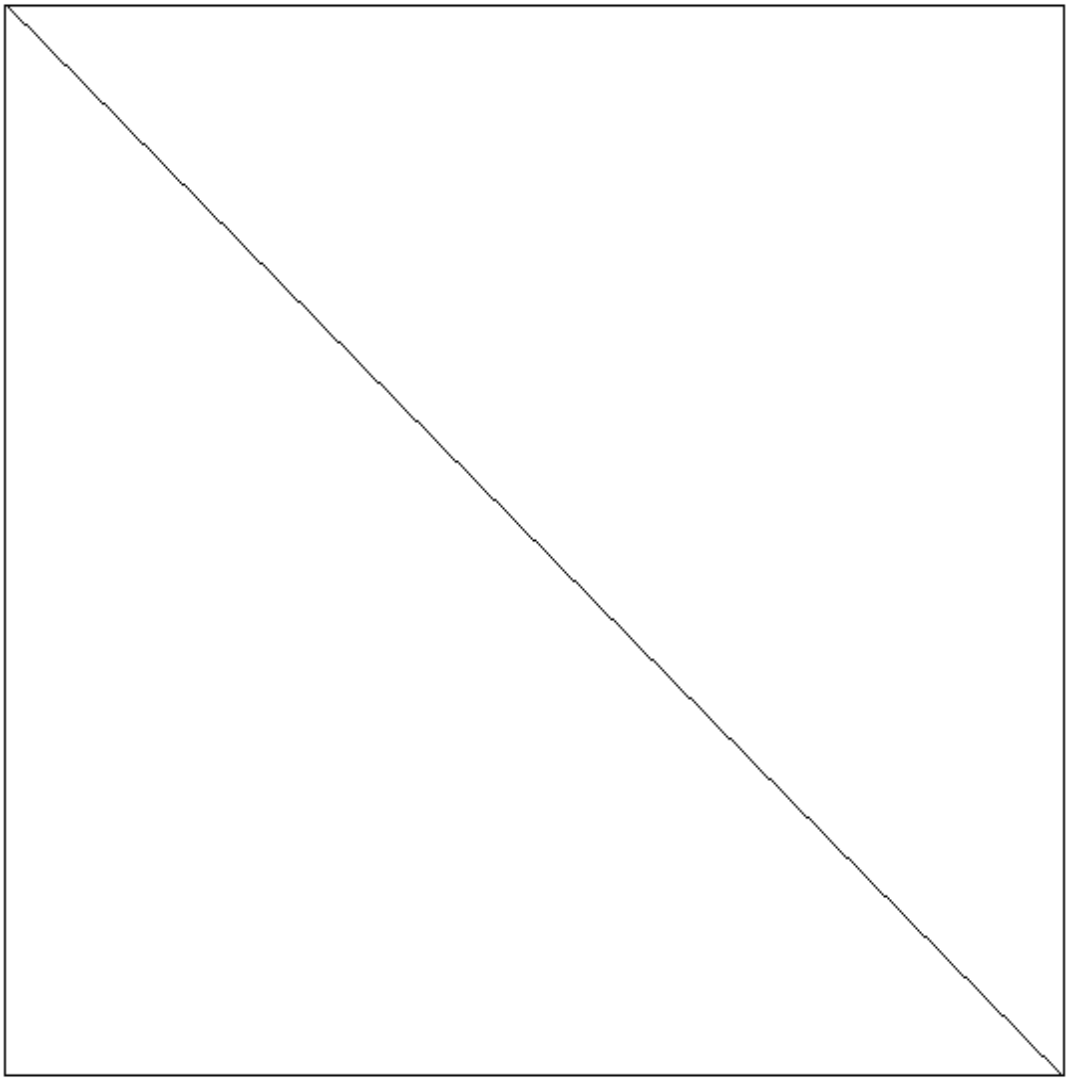
Exhibit 3.2: *MAR station – Napier, North Island [Source: Spark New Zealand, Google Maps]*

Using information sourced by Spark our analysis shows that a number of customers served by MAR are located within the TSO boundary. Our analysis estimated that out of the [✂…]**SCI** MAR connections which are within the TSO area, around [✂…]**CNZRI** and

[✂…]**CNZRI** are coincident with TERA's modelled Fibre and FWA served buildings, respectively.

It is highly unlikely that locations currently served with MAR technology could be economically served with fibre technology in a forward-looking model. However the following exhibits (Exhibits 3.3 and 3.4) provide several examples of TERA modelled FTTH (and FWA) buildings which are currently being served by MAR.

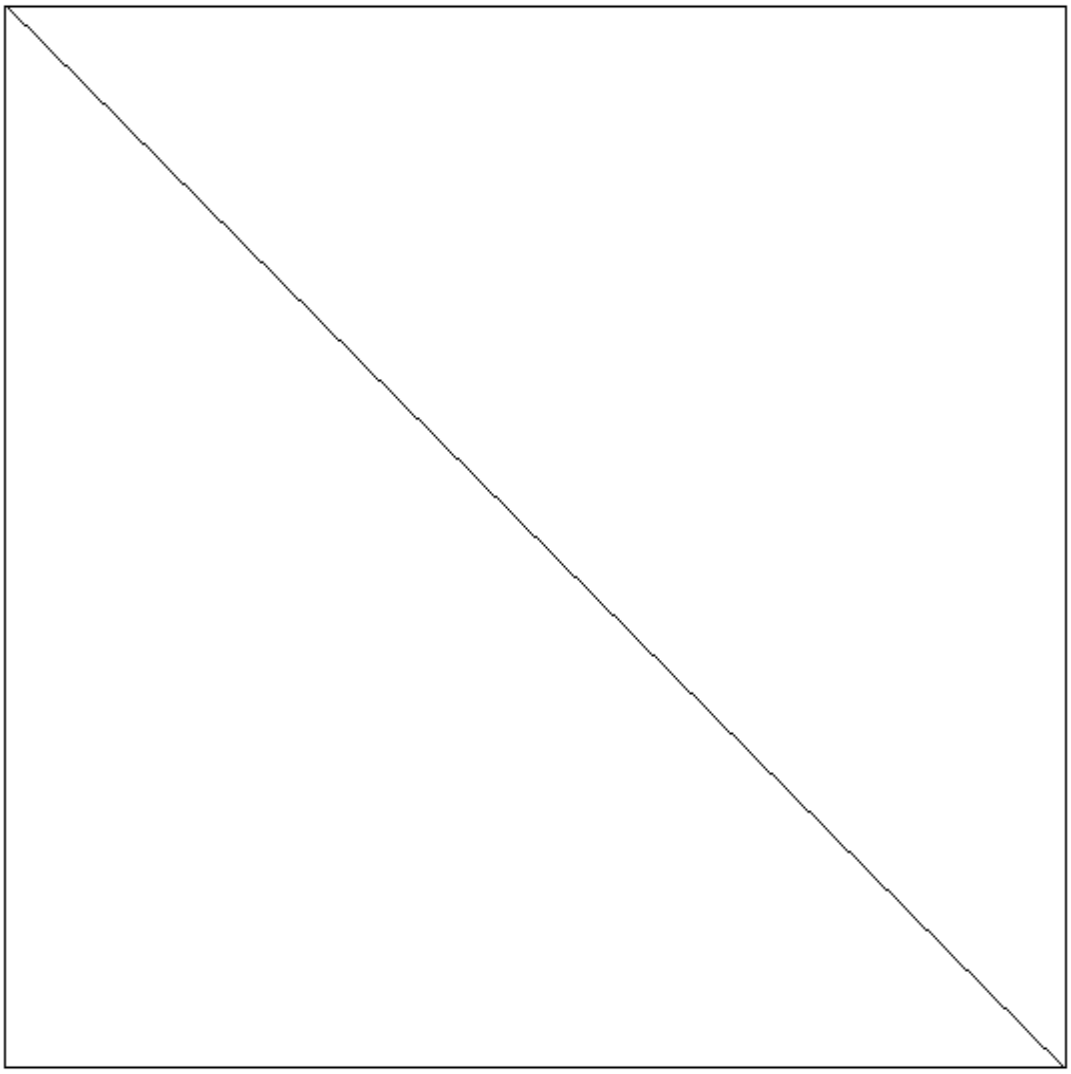
[



]**CNZRI**

Exhibit 3.3: *MAR customers – Tahora, North Island [Source: Network Strategies Limited]*

[



]CNZRI

Exhibit 3.4: *MAR customers – Kohi, North Island [Source: Network Strategies Limited]*

3.2 Other GIS issues

In this section we review claims by Analysys Mason that have been supported using GIS analysis. This includes commentary on:

- the distribution of road sections served by FWA[39]
- the alleged incorrect mapping of buildings to road segments[40].

Distribution of road sections served by FWA

Analysys Mason undertook a review of the distribution of road sections served by FWA in the TERA model. We have been able to reproduce this analysis (Exhibit 3.5 and Exhibit 3.6). According to Analysys Mason the number of FWA radio sites assumed in the model ([✂…]**CNZCI** sites) could not serve these widely dispersed road sections. Analysys Mason states that a total of 1447 base stations would be required to provide FWA coverage.[41]

Analysys Mason's reasoning is based on a distribution of customers which is unrealistic from a network planning perspective, as we have already discussed in Section 2.[42] Any coverage analysis based on this distribution will lead to results which do not represent efficient deployment of an HEO.

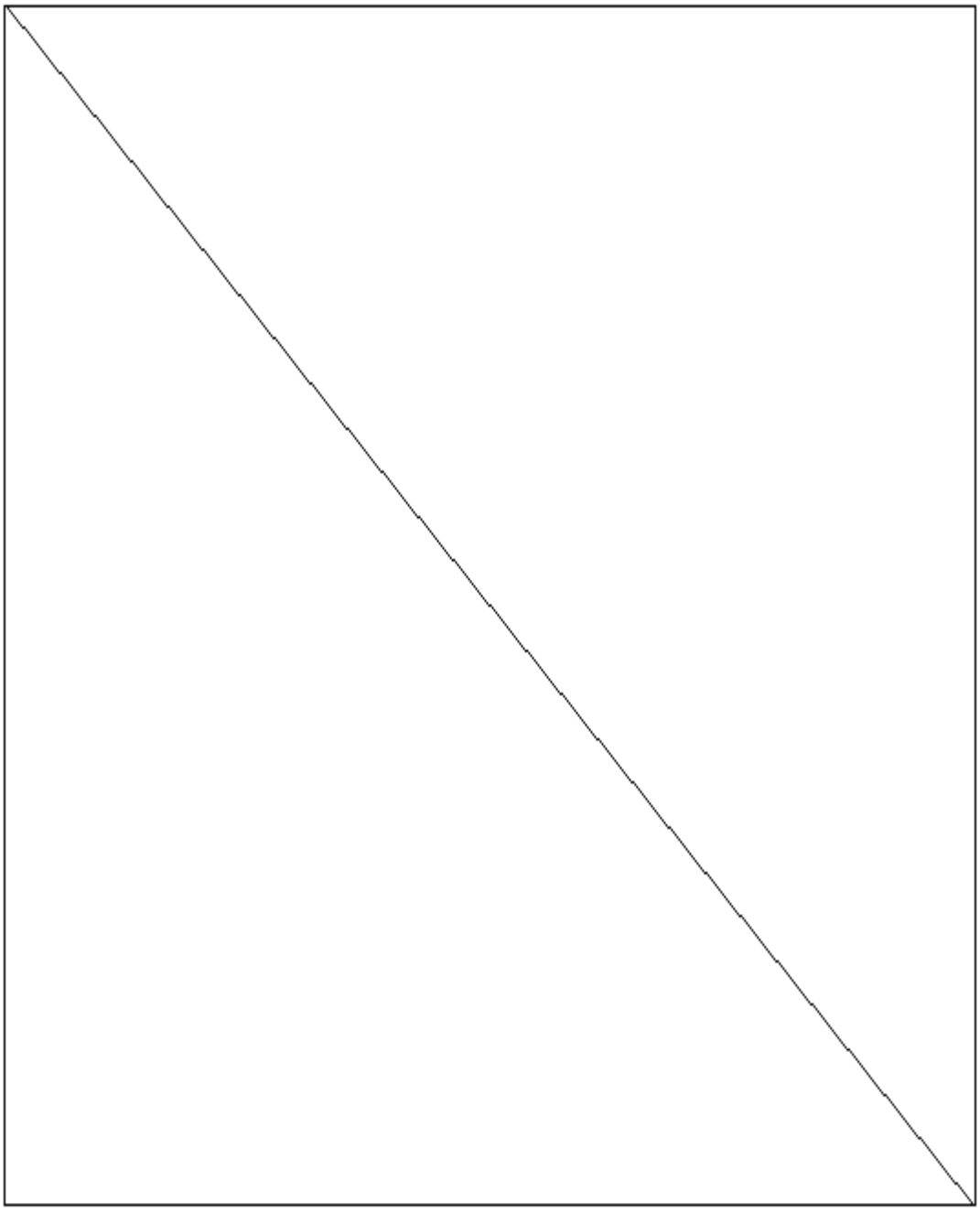
39 *Ibid*, Section 7.3.1.

40 Analysys Mason (2015), *UCLL and UBA FPP further draft determination submission – CI*, 11 August 2015. Section 2.4.

41 *Ibid*, Section 7.3.1.

42 Also see Network Strategies Limited (2015), *Revised draft determination for the UCLL and UBA price review*, 13 August 2015, section 2.3.2.

[



]CNZRI

Exhibit 3.5: *Distribution of proposed FWA served customers, North Island [Source: Network Strategies Limited]*

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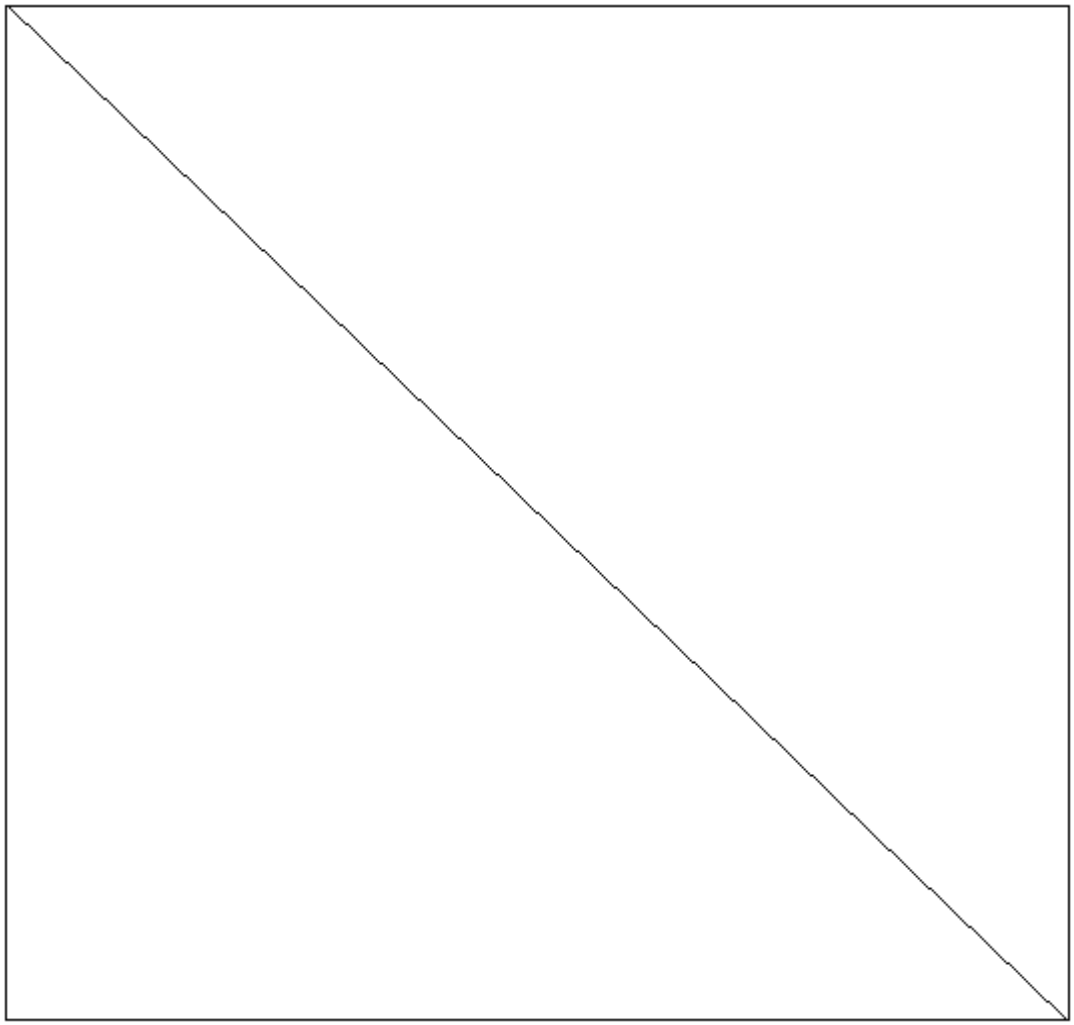

]CNZRI

Exhibit 3.6: *Distribution of proposed FWA served customers, South Island [Source: Network Strategies Limited]*

Incorrect mapping of buildings to road segments

As in its February 2015 submission, Analysys Mason is reiterating that TERA's mapping of buildings to road segments is incorrect – buildings are not allocated to the closest road section.

Using GIS analysis we were able to verify that this modelling issue does exist and it produces anomalous results such as the example cited by Analysys Mason.[43]

3.3 Summary

GIS analysis provides a useful cross-check on the implications of the Commission's model. We have found that some anomalies remain in the model which the Commission should address:

- the distribution of road sections served by FWA is clearly inconsistent with the efficient deployment of this technology, and in serving unbundled customers with FWA the Commission has violated its own principles
- the mapping of buildings to road segments remains incorrect
- it is highly unlikely that locations currently served with MAR technology could be economically served with fibre technology as implied by the Commission's model.

43 *Ibid*. Section 2.4.

4 Trenching analysis

4.1 Trenching model

Analysys Mason, on behalf of Chorus, undertook a statistical analysis of trenching costs[44]. This analysis is based on actual Chorus costs for UFB and RBI projects and determines a per-metre cost of trenching for selected ESAs via a statistical model that incorporates parameters for the proportions of the ESA across:

- five clutter (land use) types
- three road types
- four rock types.

Note that a key assumption for this model is that the proportions for clutter type, for road type and for rock type should each sum to one.

Chorus uses the results of Analysys Mason's statistical analysis to demonstrate that Chorus' 'optimised national average trenching costs' are significantly higher than rates being used by the Commission, suggesting that these so-called real-world rates would be more suited to the HEO.[45]

This statistical model was developed in the application R based on data for a sample of ESAs. The resultant model was then incorporated into a spreadsheet model that calculates

44 Analysys Mason (2015), *UCLL and UBA FPP further draft determination submission – CI*, 11 August 2015. See Annex A.

45 Chorus (2015), *Submission for Chorus in response to Draft Pricing Review Determinations for Chorus' Unbundled Copper Local Loop and Unbundled Bitstream Access Services (2 July 2015)*, August 2015, executive summary.

the estimated cost for ESAs either from the statistical model or from extrapolating actual UFB and RBI project costs, depending upon the ESA.

We have been provided with copies of:

- inputs to and outputs from the R application
- the spreadsheet model for estimating trenching costs.

In order to assess whether the statistical analysis and its results reflect real-world costs, we have undertaken a detailed review of the statistical model, the spreadsheet model and the input data.

4.2 Cost data

Chorus states that:

> The average trenching costs in the Analysys Mason model were derived from analysis of our years 3 and 4 of the UFB and RBI programmes and are therefore optimised.[46]

However, upon examination of the itemised project data in the spreadsheet model the actual cost data is based on UFB projects in the third and fourth years of the rollout and RBI projects from the first to fifth years of the rollout. Analysys Mason states that only the most recent data is used for both UFB and RBI[47], yet the spreadsheet model clearly includes the oldest data from the initial few years of RBI rollout. This older data may not reflect Chorus' increasing efficiency gained in more recent times.

Chorus has been on record in discussing the reduction in deployment costs over time:

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46 Chorus (2015), *Submission for Chorus in response to Draft Pricing Review Determinations for Chorus' Unbundled Copper Local Loop and Unbundled Bitstream Access Services (2 July 2015)*, August 2015, paragraph 91.

47 Analysys Mason (2015), *UCLL and UBA FPP further draft determination submission – CI*, 11 August 2015, sections A.2.3 and A.2.5.

> The [UFB] rollout is on schedule and communal costs are tracking in line with expectations, as the build programme shifts from more expensive central business district areas into residential zones and aerial deployment options also become available (subject to access conditions).
>
> On 23 December Chorus announced that it has agreed a new fixed price UFB deployment contract with Visionstream for the Auckland UFB area. The contract replaces the targeted cost regime previously agreed in April 2013 and provides Chorus with additional certainty on deployment costs through the remainder of the UFB deployment period…
>
> …The average cost of connection for standard residential end-user premises was approximately $1,350 for the period, excluding the long run average cost of layer 2 equipment. On 25 November Chorus announced that new service company agreements had enabled it to update its connections cost guidance for the current financial year from a previous range of $1,300 to $1,500 (excluding layer 2 and for standard installations only), to a new range of $1,150 to $1,350 (excluding layer 2 and including standard installations and some non-standard single dwelling unit installations). Chorus' total programme view for the average cost to connect standard residential premises (including layer 2) remains $900 to $1,100 in FY12 dollars, or approximately $1,000 to $1,200 in FY15 dollars.[48]

UFB cost data

Several cost components are incorporated within the per-metre UFB project costs:

- trenching rate per trench metre
- reinstatement rate per trench metre
- drilling and thrusting rate per drill/thrust metre
- laterals, which appears to be expressed as a cost per trench metre.

Analysys Mason applies a percentage mark-up to each of these costs, representing overheads.

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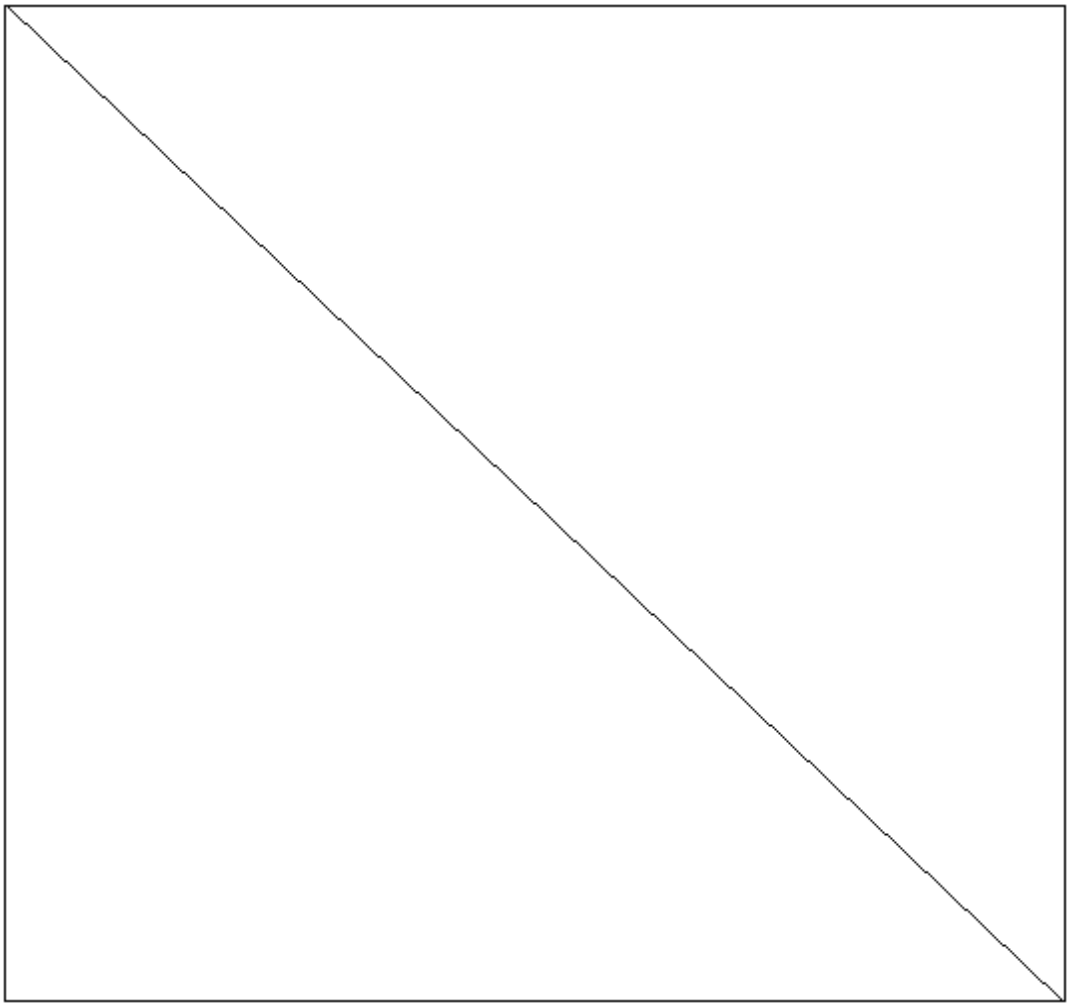
48 Chorus (2015), *Chorus Half Year Report for the six months ended 31 December 2014*, 23 February 2015, pages 4-5.

There is also a per-metre cost for 'other project costs' and 'design costs'. It is not specified what this per-metre cost covers, so it is not possible to verify if there is any overlap (or double counting) with overheads. We note that the percentage mark-up for overheads is applied to all project costs except other project costs and design costs.

We would expect project costs to include both a variable and a fixed component, and that design costs are likely to have a large fixed component. All of the costs considered by Analysys Mason are expressed on a per-metre (variable) basis. If fixed costs have been converted to an average per-metre cost, then the costs of short-length projects are likely to be understated, and those for long-length projects understated.

We find that there is evidence to suggest that there is an inverse relationship between cost per metre and length – as the project length decreases, the cost per metre increases (Exhibit 4.1). This suggests that there may be a fixed cost component within UFB project costs. However as is clearly shown in this chart, there is an extremely long tail, with some projects with relatively short lengths having a very high cost per line – note that we have excluded projects of less than 50 metres, as does Analysys Mason in its analysis.

[



]CNZCI

Exhibit 4.1: *Project cost per metre compared with project length for UFB project data [Source: Analysys Mason, Network Strategies]*

RBI cost data

The RBI project costs are compiled from several cost components:

- drilling/thrusting
- trench – grass

- trench – concrete
- trench – asphalt
- design
- 'other'
- Chorus internal costs
- third party civil contractors.

In contrast to the UFB cost data, all these raw RBI costs are expressed as totals for the project, and are converted in the spreadsheet model to per-metre costs by dividing by the total length (the sum of the lengths for drilling/thrusting, and the three trench types).

The spreadsheet also includes costs for aerial distribution, installing fibre in buildings, installing manholes, fibre splicing and haul, but these are not included in the analysis.

Note that the cost component 'other' is fully allocated to trenching costs – it is possible that some portion of this component should be allocated to the activities not included within the trenching costs. The 'other' component ranges between [✂…]**CNZCI** and [✂…]**CNZCI** of the total cost, with an average of [✂…]**CNZCI**, so it represents a significant part of the costs for some ESAs. Also note that there are a small number of projects for which this 'other' component is negative[49] – for example [✂…….]**CNZCI**.

Analysys Mason applies a percentage mark-up to the costs for contractor overheads – note that this [✂…]**CNZCI** mark-up differs from the [✂…]**CNZCI** overhead mark-up used for UFB projects. No explanation is provided regarding the reasons for the difference – we would expect overheads to be lower in the rural RBI areas than in urban UFB areas. The RBI project data also includes a cost component for third party civil contractors. It is unclear why the costs should include both the third party civil contactor cost as well as a contractor overhead, even if the former is zero (which occurs in around 88% of the RBI projects) suggesting that no third party contractors had been used for the project. This implies that the assumed contractor overhead may significantly inflate the RBI costs for many projects.

49 There is also an instance of negative costs for installing manholes, but as noted this cost is not included within the analysis.

Across the RBI projects, there is considerable variation in the design costs, varying from [✂…]**CNZCI** to [✂…]**CNZCI** per metre. The median is [✂…]**CNZCI** per metre, which is considerably lower than the [✂…]**CNZCI** design cost uplift applied to the UFB project costs. Indeed many of the RBI projects incurred no design costs at all, and around [✂…]**CNZCI** of RBI projects have a per-metre design cost lower than the assumed UFB design cost. This suggests that applying an 'average' design cost to the UFB projects overstates the costs of most UFB projects and understates the remainder. The UFB costs therefore do not fully address the variation in complexity (and costs) that may occur from project to project.

4.3 Choosing actual costs vs modelled costs

Analysys Mason recommends that actual trenching costs be used for seven CBD ESAs and for the 125 ESAs in which actual data is available for at least three projects. For the remaining 646 ESAs, Analysys Mason suggests that its statistical model be used to estimate the trenching costs.

Where actual data is used, the resultant cost per metre is an average of the cost per metre of the individual projects, weighted by the project lengths.

We believe that Analysys Mason's threshold of three projects is somewhat arbitrary, and does not take into consideration whether or not those projects are typical of the ESA characteristics.

The actual data – from UFB and RBI projects – covers only a portion of the area within each of these ESAs. The nature of the rollout for these projects is such that the project areas will be largely urban and suburban (for UFB) and very rural (for RBI), and thus areas such as rural fringes or remote areas may be under-represented. It is clear from the locations of these 125 ESAs (Exhibits 4.2 and 4.3) that the actual project costs may not be representative of the costs across the whole ESA.

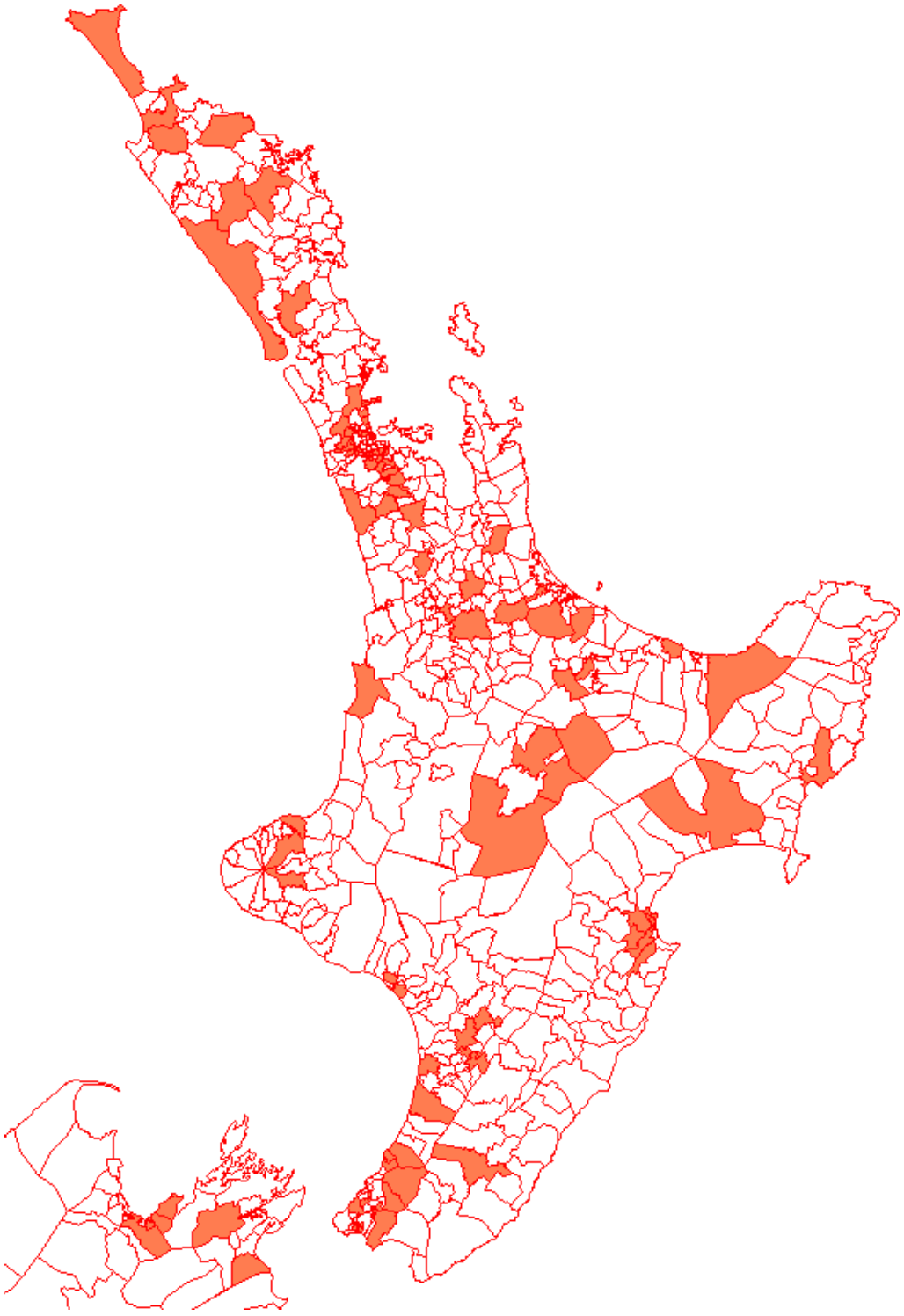


Exhibit 4.2: *North Island ESAs for which trenching costs are extrapolated from UFB and RBI project costs [Source: Network Strategies]*

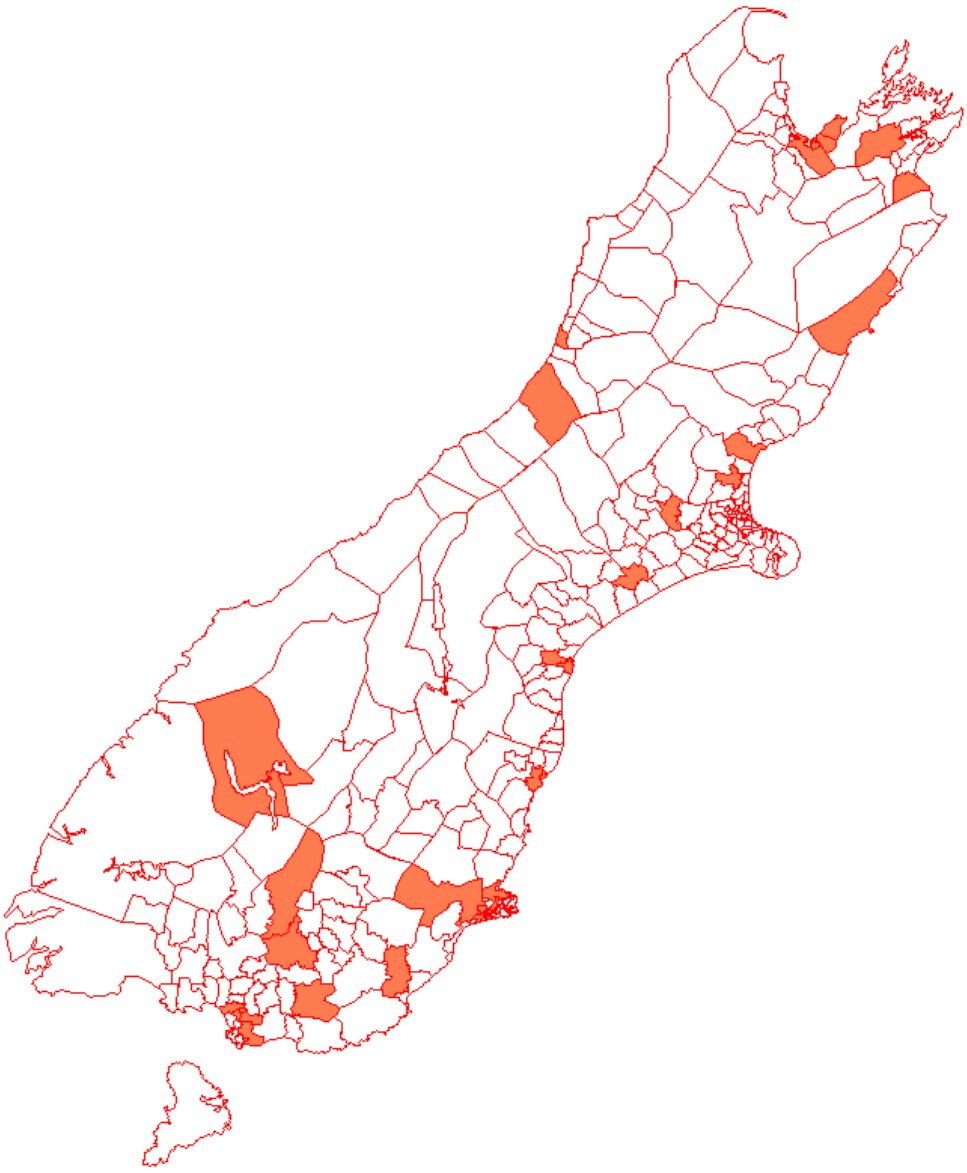


Exhibit 4.3: *South Island ESAs for which trenching costs are extrapolated from UFB and RBI project costs [Source: Network Strategies]*

In fact, the actual data for almost half of the 125 ESAs with at least three projects comprises less than 5% of the total road length in the ESA (according to the data within the Analysys Mason spreadsheet model). Of those 61 ESAs, 11 have actual data for less than 1% of the total road length. In some cases, costs are being extrapolated for an ESA with

hundreds of kilometres of road based on actual data from just a few hundred metres of trenching (Exhibit 4.4). This would not be a problem if those short distances are typical of the entire ESA – but if not the extrapolated project results may be misleading and thus subject to a high margin of error.

ESA	*Total projects used*	*Total ESA route across projects (m)*	*Total road length in ESA (m)*	*Project routes as % of total road length*
[✂…	…	…	…	…
…	…	…	…	…
…	…	…	…	…
…	…	…	…	…
…	…	…	…	…
…	…	…	…	…
…	…	…	…	…
…	…	…	…	…
…	…	…	…	…
…	…	…	…	…
…	…	…	…	…
…	…	…	…	…
…	…	…	…	…]**CNZCI**

Exhibit 4.4: *Comparison of project routes against total road length for selected ESAs with at least three projects [Source: Analysys Mason]*

On investigating one example, the ESA [✂…]**CNZCI**, we find that there are significant differences between the characteristics of its three projects and those assigned by Analysys Mason to the entire ESA. The cost for this ESA is heavily influenced (with a weighting of [✂…]**CNZCI**) by the actual data for project 1, the characteristics of which are very different to those of the whole ESA (Exhibit 4.5). We therefore conclude that for this ESA using the actual project costs may incur considerable error.

	[✂…	…	…	…
Total length (metres)	…	…	…	…
Weights (for average cost)	…	…	…	…
Clutter type				
Industrial and commercial	…	…	…	…
Extremely dense urban	…	…	…	…
Dense urban	…	…	…	…
Village/urban	…	…	…	…
Other	…	…	…	…
Road type				
Highways	…	…	…	…
Level 2 roads	…	…	…	…
Other	…	…	…	…
Rock type				
Urban	…	…	…	…
Soft	…	…	…	…
Hard	…	…	…	…
Lava	…	…	…	…]**CNZCI**

Note: in some cases the proportions in the spreadsheet model do not sum to one.

Exhibit 4.5: *Characteristics of the ESA [✂…]**CNZCI** and the projects within the ESA [Source: Analysys Mason]*

A second example is the ESA [✂…]**CNZCI**, where the characteristics of the two most heavily weighted projects are very dissimilar to those of the whole ESA (Exhibit 4.6).

[✂…	…	…	…	…	…
Total length (metres)		…	…	…	…	…
Weights (for average cost)		…	…	…	…	…
Clutter type						
Industrial	…	…	…	…	…	…
Dense urban	…	…	…	…	…	…
Village	…	…	…	…	…	…
Other	…	…	…	…	…	…
Road type						
Highways	…	…	…	…	…	…
Level 2 roads	…	…	…	…	…	…
Other	…	…	…	…	…	…
Rock type						
Urban	…	…	…	…	…	…
Soft	…	…	…	…	…	…
Hard	…	…	…	…	…	…
Lava	…	…	…	…	…	…]**CNZCI**

Note: in some cases the proportions in the spreadsheet model do not sum to one.

Exhibit 4.6: *Characteristics of the ESA [✂…]**CNZCI** and the projects within the ESA [Source: Analysys Mason]*

We suggest that a more appropriate threshold be assigned to determine whether actual costs or estimated costs are used. This threshold should not be based purely on the number of projects – it should consider the suitability of the projects for extrapolation to the entire ESA.

4.4 Input data flaws

We have found many flaws within the input data for road lengths by ESA. This data is used by Analysys Mason to determine the proportions of road by rock type, by road type and by clutter type. These proportions are then used to estimate the parameters for the statistical model, as well as in the application of the statistical model to derive an estimated trenching cost.

4.4.1 ESA level data

The ESA level data is used to estimate the resultant trenching cost by application of the statistical model. It is therefore essential that the ESA is accurately characterised by the parameters associated with clutter type, road type and rock type. If not, the estimated costs will be incorrect.

Rock type

The spreadsheet model includes input data on:

- total road length by ESA (in metres)
- ESA road lengths by rock type (in metres).

The proportion of the ESA associated with each rock type is calculated by dividing the ESA road lengths by rock type by the input total road length. However the sum of the ESA road lengths by rock type is less than the total road length for 60% of the 778 ESAs.

This means that the sum of the proportions by rock type is less than 100% for many of the ESAs (Exhibit 4.7), violating a key assumption of the statistical model (that is, the proportions must add to one). If the statistical model were to be applied to these ESAs, the result would be incorrect.

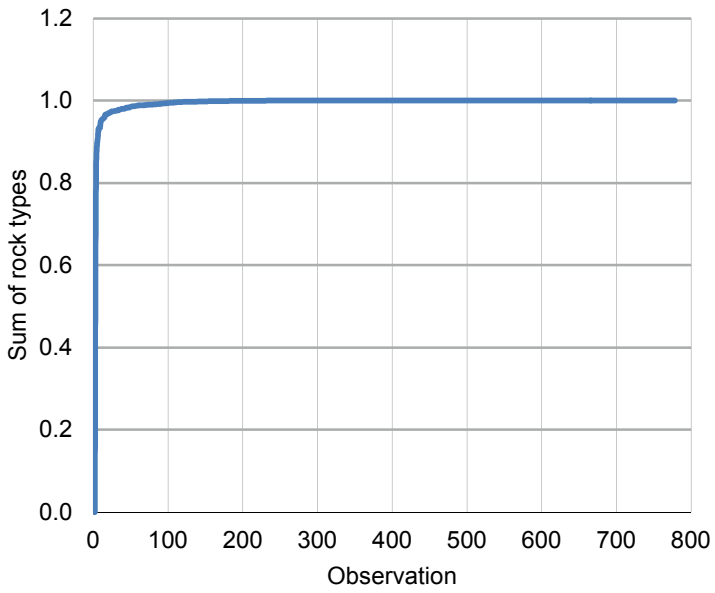


Exhibit 4.7:
Sum of the three rock types for the ESA level data [Source: Network Strategies]

A difference of one or two metres could be ascribed to rounding, however in many cases – 112, or 14.4% of all ESAs – the difference is more than 500 metres, which is far more than just a rounding issue. The worst case – excluding the two ESAs for which there is no information on road lengths by rock type – is the ESA [✂…]**CNZCI** where the difference is over 10km, or 39% of the total road length for that ESA.

The source of the ESA road lengths by rock type is noted in the spreadsheet as an 'Analysys Mason analysis of ESAs and rock database'. There is an obvious discrepancy between this information and the total road length by ESA – two sets of data that should be entirely consistent.

As these road lengths are all inputs, we cannot determine which may be the correct value.

Road type

A similar problem also occurs with road type, namely there is a mismatch between the input total road length by ESA and the input ESA road lengths by road type. The sum of the road lengths by road type should equal the total road length, but for many ESAs this is

not the case. Unlike the situation with rock types, in some instances the sum across the road types is greater than the total, while in others it is less than the total – there does not appear to be a consistent bias.

The differences are considerably less than in the case of rock types – in 82 ESAs the difference is greater than five metres, and only seven ESAs have a discrepancy of more than 100 metres – yet there is no logical reason why there should be any difference at all between the two sets of data, other than at most one or two metres due to rounding.

Clutter type

There are five clutter types used in the analysis, and again we also see discrepancies between the input total road length by ESA and the input ESA road lengths by clutter type. Again there should be no differences, other than at most one or two metres due to rounding. These differences are much smaller than for the case of rock types, however as for road types there is no logical reason why the two sets of data should differ.

4.4.2 Aggregated projects within the ESA

The input data for the statistical model is the UFB and RBI project data aggregated by ESA. Note that it does not represent the whole ESA, only that part of the ESA that was covered by the UFB and RBI projects included in the statistical analysis. This aggregated project data is used to estimate the parameters for the statistical model, and that statistical model is then applied to inputs relevant to the whole ESA (rather than part of the ESA).

While the input data to the R application omits the values for clutter type 'other', road type 'other' and rock type 'soft' – as it assumes that the sum across each characteristic must equal one – we have extracted the relevant values from Analysys Mason's spreadsheet model, and checked to see if this assumption holds.

We find that – similar to the ESA level data – the proportions for rock types and road types do not sum to one in many instances. The data for clutter type is better – the sum across clutter types is within 0.005% of one, which could be due to rounding.

Of the 376 observations in this input data, nearly half (175 observations) have the sum of road types being less than one (Exhibit 4.8). Indeed, 49 observations (13%) have the sum of road types being less than 0.9, with the lowest value across all observations being 0.38.

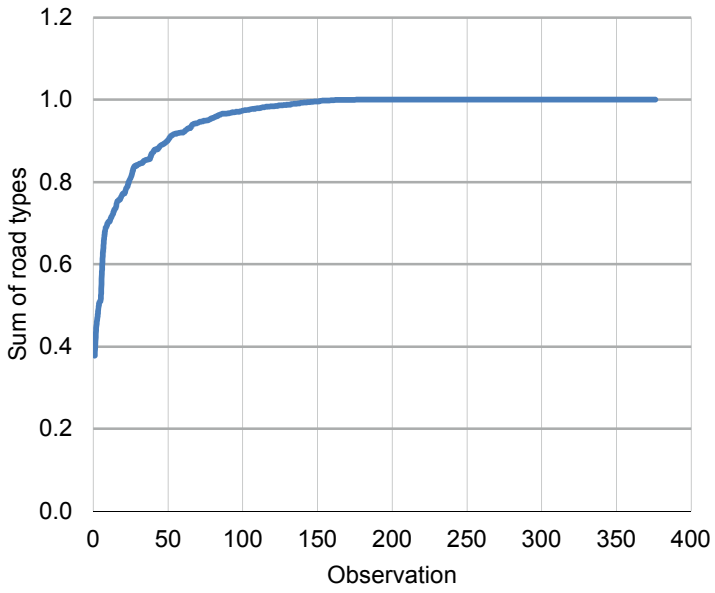


Exhibit 4.8:
Sum of the three road types for the input data to the statistical model [Source: Network Strategies]

The data issues are worse for rock types – in 240 of the observations (64%) the sum of the rock types is less than one, with 55 observations (15%) being less than 0.9. The lowest value is 0.21. Furthermore, the sum of rock types is greater than one for a number of observations, with the highest value being 1.07 (Exhibit 4.9).

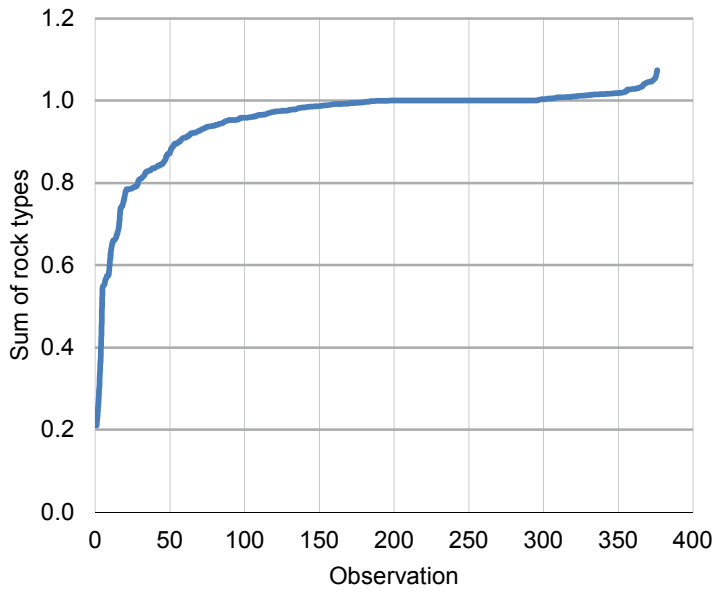


Exhibit 4.9:
Sum of the three road types for the input data to the statistical model [Source: Network Strategies]

Furthermore, there are some instances where the value for one of the proportions is greater than one. Examples within the input data to the statistical model include:

- rock type urban: [✂…….. …… ……]**CNZCI**
- rock type soft: [✂…….. ……..]**CNZCI**
- rock type hard: [✂……]**CNZCI**.

Clearly, there are major issues with the input data. These are so severe that the estimation of the parameter values for the statistical model is fundamentally flawed due to the repeated violation of a key assumption of the model – namely, that the sums of the proportions must be one, so that the coefficients of the model variables for the clutter type 'other', road type 'other' and rock type 'soft' can be set to zero. As Analysys Mason clearly states, the model relies on this relationship:

> For the purposes of our analysis, we have assumed that A, F and J must be zero (i.e. their corresponding variables P_{other}, Q_O and R_{Soft} are excluded). We note that this is reasonable

since they are all complementary to the remaining variables (e.g. $Q_O = 1 - Q_2 - Q_H$) and therefore will be negatively correlated to them.[50]

Due to this assumed relationship, the statistical analysis assumes that the values for the clutter type 'other', road type 'other' and rock type 'soft' are obtained by subtracting the other proportions from one – this value would therefore often differ from the value calculated from the project data.

The severity of the problem is such that it is likely to have a radical effect on the estimated model parameters – this effect is potentially far greater than a minor adjustment to the input data. Any results from Analysys Mason's analysis will therefore be misleading and therefore its model should not be used.

4.5 Model applied to ESAs with missing parameter input values

When calculating the estimated trenching cost for each ESA, it is essential that appropriate values of the input parameters are available for each of these ESAs. Thus the proportions across each of the clutter types, road types and rock types must sum to one. If data on any of these characteristics is missing, applying the model will give incorrect results.

There are some ESAs however where data for the input parameters is missing. For example, the ESA [✂…]**CNZCI** has no associated information in regards to rock types. By default the spreadsheet model sets each of the four rock type proportions to zero, but still applies the statistical model. The result given by the model for this ESA is therefore totally erroneous due to the absence of any information regarding rock type.

In a second example, the ESA [✂…]**CNZCI** has no information for road types – the spreadsheet model sets each of the three road type proportions to zero, but still applies the statistical model even though data on road type is missing. The result for this ESA is therefore incorrect.

50 Analysys Mason (2015), *Annex A: Statistical estimation of trenching costs based on Chorus recent UFB and RBI trenching experience*, section A.3.2.

4.6 Summary

Analysys Mason views its statistical analysis of trenching to be incontrovertible proof that the trenching costs produced by the Commission's model are too low.

> We strongly recommend that the Commission take proper account of this significant body of real-world, New Zealand telecoms-specific information. In particular, the data from the UFB digging projects can offer the Commission significantly improved data as to how trench costs build up in urban areas, including costs such as arborist activities, consents and traffic management.[51]

However due to flaws in the input data used to estimate the parameter values, we find that Analysys Mason's statistical analysis is unsound. The key issues are:

- for many ESAs the proportions of clutter types, road types and rock types do not sum to one, thus violating a key assumption of the model and rendering the statistical model, as well as any estimates made by this model, invalid
- the use of actual UFB and RBI project costs for the sample of 125 ESAs in which there is actual data for at least three projects does not consider whether the characteristics of the project areas are suitable for extrapolation to the whole ESA, resulting in misleading results for a number of ESAs
- while cost data for UFB projects is restricted to that from years three and four of the rollout, the RBI project data includes costs from years one to five, and thus does not reflect efficiency gains achieved in the later years of the rollout
- the mark-up for RBI overheads differs from that for UFB overheads with no justification
- RBI project costs have a mark-up for contractor overheads even when there appears to be no involvement by third party contractors
- there is no explanation of what activities are covered by overheads or 'other' costs, and thus it is not possible to assess whether these costs are reasonable
- the statistical model is erroneously applied to ESAs for which values of the input parameters are not available.

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51 Analysys Mason (2015*), UCLL and UBA FPP further draft determination submission*, 11 August 2015, page 12.

The nature of these problems is such that any results from the statistical analysis should be ignored. These results therefore cannot be used to assess how the Commission's trenching costs compare with Chorus' real-life costs, unless the underlying data issues are addressed.

5 Aerial infrastructure

Chorus comments on the proportion of aerial deployment and assumed costs (pole rental, access and consenting costs) used in the Commission's model and provides recommended values[52]. In this Section we review Chorus' proposed values which fall into three main categories:

- extent of aerial deployment (Section 5.1)
- pole costs (Section 5.2)
- other costs (Section 5.3).

Finally we have summarised the main points and our recommendations in Section 5.4.

5.1 Extent of aerial deployment

Chorus asks the Commission:

> …to reduce the extent of aerial deployment in the Commission's model to reflect real world evidence (both of Chorus UFB/RBI deployment and statements from Vector) that a greater proportion of available electricity distribution poles cannot be economically used for telecommunications network deployment.[53]

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52 Chorus (2015), *Submission for Chorus in response to Draft Pricing Review Determinations for Chorus' Unbundled Copper Local Loop and Unbundled Bitstream Access Services (2 July 2015)*, August 2015, pages 48 to 52.

53 *Ibid*, page 13.

The Commission bases its 47% estimate of the proportion of network that may be aerially deployed on the extent of existing EDB aerial deployment, less 2%.

Chorus has previously stated that only 2% of its network is aerially deployed while it has a 20% aerial UFB target. We could find no previous mention by Chorus of the RBI-related evidence to which Chorus alludes in the above quotation.

> Rather than using the 2% aerial that exists today in Chorus' network, the Analysys Mason modelling used an estimate of 20% which is the real world "target" for UFB[54].

In response Network Strategies noted that Chorus' UFB aerial target is irrelevant for an HEO deploying a nationwide network as the Chorus target reflects predominantly urban areas. Furthermore, the Chorus target was less than half of Vector's planned proportion of UFB aerial deployment in Auckland which was 45%. As we previously stated:

> We understand, for example, from Vector that, had it been successful in its UFB bid, it planned to deliver UFB to approximately 45% of premises in Auckland using aerial fibre network.[55]

Given that the Vector deployment would have covered largely urban areas, this implies that an efficient floor value using 'real world evidence' for the Commission's estimate is 45%, not Chorus' 'target' of 20%.

In its latest submission, Chorus appears to have misunderstood the Commission's approach to aerial deployment. Chorus has confused the Commission's methodology for defining areas in which the HEO would deploy aerially with the extent of existing (as is) pole use.

These are the key points in the Commission's analysis:

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54 Chorus (2015), *Submission in response to the Commerce Commission's Draft Pricing Review Determinations for Chorus' UBA and UCLL services (2 December 2014)*, February 2015, paragraph 32.

55 Network Strategies (2015), *Review of issues from UCLL and UBA submissions, Cross submission for the UCLL and UBA Draft Determination*, 20 March 2015, Section 5.3.

- existing EDB infrastructure provides guidance as to where the HEO would deploy aerially (approx 49% of distribution cables)
- experience from Northpower and UFF suggests that undergrounding is 'very rare' in areas where there is existing aerial infrastructure
- to allow for these 'very rare' instances the Commission has reduced the aerial percentage by 2% so that a small number of areas previously served by aerial structure are replaced with underground
- the HEO leases pole space from EDBs
- the HEO incurs costs for replacing 10% of electricity poles as it is assumed that those poles are not currently capable of carrying distribution poles[56].

Chorus claims that the Commission 'significantly under-estimates the number of customers which cannot be served via aerial distribution where EDB poles are available'.

> … our experience from seeking to access EDB poles for the UFB deployment is that a significant proportion of existing poles cannot be economically used for aerial fibre distribution even if replaced due to aerial service congestion, electricity network requirements, poor pole location, progressive undergrounding initiatives, or various other factors[57].

Although Chorus concludes that the Commission's 2% deduction is insufficient, in fact its argument is relevant only to the Commission's assumption that 10% of poles would be replaced.

While Vector did indeed refer to using 65% of its poles in 2011 for its proposed UFB deployment, this was in the context of potential re-use with no additional investment – for example, no requirement for strengthening to accommodate fibre. Chorus appears to have (wrongly) interpreted this Vector statistic as reflecting the need for replacement of 35% of poles to accommodate aerial plant.

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56 Commerce Commission (2015), *Further draft pricing review determination for Chorus' unbundled copper local loop services*, 2 July 2015, paragraph 1160.2.

57 Chorus (2015), *Submission in response to the Commerce Commission's Draft Pricing Review Determinations for Chorus' UBA and UCLL services (2 December 2014)*, February 2015, paragraph 117.

In fact evidence provided previously by Chorus indicates that the Commission's 10% assumption in this regard is appropriate. Specifically Chorus stated:

> **[✂**……
> ……...
> ……...
> ……**] CI**[58]

The example provided by Chorus suggests that **[✂…]CNZCI** of poles may need replacement.

Another useful benchmark has been provided by Chorus' consultants, Analysys Mason, in recent advice to the Finnish regulator that in bottom-up LRIC models typically almost 100% of poles would be assumed to be reusable:

> The reusable proportions are likely to vary from asset to asset. For example, the proportion of existing poles that are likely to be available for re-use could be close to 100% (albeit some might need refurbishment)[59].

5.2 Pole costs

Chorus claims that the Commission has not included realistic costs of aerial deployment that would be incurred by the HEO. In particular Chorus states that the Commission should use a weighted average of access charges rather than the least expensive: [60]

> In addition, the Commission materially understates the cost of securing access at $25 per pole, **[CI: ✂……..]**.
> It is not realistic or appropriate given the TSLRIC exercise to extrapolate the lowest cost

58 Chorus (2015), *Submission in response to the Commerce Commission's draft pricing review determinations for Chorus' UBA and UCLL services (2 December 2014)*, February 2015. See page 136.

59 Analysys Mason (2015), *Survey of the suitability of a bottom-up LRIC+ model for Finland*, 30 April 2015. Page 61.

60 Chorus (2015), *Submission in response to the Commerce Commission's Draft Pricing Review Determinations for Chorus' UBA and UCLL services (2 July 2015)*, August 2015, paragraph 391.

> data point in one region and assume that it can be achieved nationally. Different lines companies charge different rates in the various regions around the country and Chorus' estimate of a national weighted average for pole rental is **[CI:** ✂…….**]**. The result is that the Commission's model underestimates the true costs of obtaining pole access by around **[CI:** ✂…**]**.

Chorus' statement implies that it does not appreciate that the Commission's model must encompass efficient costs and hence the Commission is correct to use the most economical cost rather than Chorus' estimate of its own costs. In fact Chorus' estimate is incorrect as it is based on inconsistent and biased calculations. Firstly, the average has been weighted using customer numbers rather than pole numbers which has overestimated the costs. Chorus has justified this by claiming that HEO's use might be different to Chorus' use:[61]

> We have used customers served as a proxy for the number of poles an HEO would rent for aerial distribution in each area. This is more appropriate than using Chorus actual poles rented in each area, as Chorus' actual poles rented will vary from the HEO's use of poles in the Commission's model due to a number of factors, including optimisation and excluding non-TSO areas as well as post-2001 subdivisions.

Chorus' argument supports our point – the HEO is an efficient optimised operator who will not necessarily use the infrastructure as Chorus does and pay costs which are comparable to Chorus' costs. It is extremely important to note that the HEO is not Chorus; it is an efficient operator deploying nationwide network to provide services. Consequently the Commission should only consider efficient costs.

Secondly, Chorus' weighted average has been calculated using a selection of areas and EDBs, rather than nationwide values. Chorus has not provided any justification for its choice of EDBs and limiting its calculations to four EDBs. In fact Chorus provided [✂……..]**CNZCI** to the Commission but decided to ignore its costs in this calculation because [✂…… ……]**CNZCI**. This reflects the inconsistency and bias in Chorus' calculation which

61 Chorus (2015), *Submission in response to the Commerce Commission's Draft Pricing Review Determinations for Chorus' UBA and UCLL services (2 July 2015)*, August 2015, paragraph 125.

has overestimated the costs. Hence the value provided by Chorus is misleading and cannot be used in the TSLRIC model.

Thirdly, it seems there are discrepancies in pole lease costs that have been provided by Chorus. The Commission clearly states that the costs used for the model – distribution and lead-in cables and lead-in cables only – were provided by Chorus: [62]

> We note that Chorus provided pole lease costs showing it pays [✂……]CNZCI for distribution and lead-in cables and [✂……]CNZCI for lead-in cables only. Ultrafast Fibre pays [✂……]UFFCI for access for approved telecommunications equipment.

However Chorus is claiming that the distribution and lead-in cable costs provided to the Commission are in fact distribution costs only: [63]

> The above methodology for pole rental only applies for access to poles used for aerial distribution network. There are different rates to access poles for service lead-ins.

Our investigation reveals that the Commission is correct as Chorus had provided different costs to the Commission earlier and is now changing the values to increase the cost significantly:[64]

> The terms negotiated by Chorus include an annual fee per pole of between:
>
> [CI(B3): ✂…….] per pole for service leads only, which is CPI adjusted; and
>
> [CI(B3): ✂…….] per pole for service leads and distribution, which is CPI adjusted.

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62 Commerce Commission (2015), *Further draft pricing review determination for Chorus' unbundled copper local loop services*, 2 July 2015, paragraph 1160.1.2.

63 Chorus (2015), *Submission in response to the Commerce Commission's Draft Pricing Review Determinations for Chorus' UBA and UCLL services (2 July 2015)*, August 2015, paragraph 390.

64 Chorus (2014), *Submission in response to the Commerce Commission's Consultation paper outlining its proposed view on the regulatory framework and modelling approach for UBA and UCLL services (9 July 2014)*, 6 August 2014, paragraph 419.

Furthermore it seems the Commission has also considered Chorus' pole lease agreement with [✂……[65]]**CNZCI,** which states the lease cost as [✂……]**CNZCI,** to estimate the range for distribution and lead-in cables. Hence Chorus is either confused or attempting to mislead the Commission.

Finally the pole lease agreements supplied by Chorus to the Commission previously show lower costs than those used by Chorus – [✂…… ……..……]**CNZCI**. Again Chorus' calculations are incorrect as they do not match the evidence provided. In fact such discrepancies reinforce our advice to the Commission to disregard Chorus' estimates as they are inappropriate for an HEO.

Chorus has also claimed that the Commission should include additional costs for surveying, assessments and replacements[66]. It seems that Chorus does not realise that the Commission's model already includes cost for pole replacement:

> Having considered Chorus' information, in our view the hypothetical efficient operator would also incur the cost of replacing 10% of electricity poles as those poles are not currently capable of carrying distribution cables.[67]

Hence Chorus' suggested approach will in fact lead to double counting of pole replacement costs.

5.3 Other costs

In addition to components for pole costs, Chorus has provided extensive analysis on costs for obtaining consents as well as monitoring and complying with consents.[68] The

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65 Chorus and [✂……]CNZCI (2013), *Reciprocal agreement for the coexisting of electricity and telecommunications network on poles*,16 December 2013, page 37.

66 Chorus (2015), *Submission in response to the Commerce Commission's Draft Pricing Review Determinations for Chorus' UBA and UCLL services (2 July 2015)*, August 2015, paragraph 391.

67 Commerce Commission (2015), *Further draft pricing review determination for Chorus' unbundled copper local loop services*, 2 July 2015, paragraph 1160.1.2.

Commission should be very wary of relying on actual costs incurred by service companies from the early stages of the UFB deployment, since these are unlikely to reflect efficient costs. Reliance on these costs would lead to an overestimate of efficient costs.

In any event, we have already noted in our report that Chorus' values are not forward-looking: [69]

> We believe that the Commission should adopt a forward-looking approach that reflects the changing requirements for consents and reduced costs. The recent document released by Ministry for the Environment proposes amendments in National Environmental Standards for Telecommunication Facilities (NESTF) to speed up the availability of the new and better communications technologies.

The relevant NESTF amendments proposed by the Ministry for the Environment will reduce the required consents:[70]

> It is proposed that the NESTF be extended to include aerial and underground deployment of telecommunications cables deployed within the road reserve (subject to conditions). It is also proposed that this include the lead-in of these cables (ie, the cable that connects the communal distribution cable to private premises).
>
> If this proposal is adopted, then in those districts that currently require resource consent for the aerial or underground deployment of telecommunications cables, network operators would no longer be required to obtain such consent if they met the conditions. In other districts where these activities are already classified as permitted, the activities would be subject to the conditions in the NESTF rather than the conditions in the district plan.

The Ministry for the Environment also outlines the proposed cost benefits of the amendments to NESTF:[71]

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68 Chorus (2015), *Submission in response to the Commerce Commission's Draft Pricing Review Determinations for Chorus' UBA and UCLL services (2 July 2015)*, August 2015, paragraph 393-413.

69 Network Strategies Limited (2015), *Revised draft determination for the UCLL and UBA price review*, 13 August 2015, Section 5.1.

70 Ministry for the Environment (2015), *Proposed Amendments to the National Environmental Standards for Telecommunication Facilities: Discussion Document*, March 2015, page 6.

> …the telecommunications industry will be able to save costs spent on reviewing district plans and plan changes, applying for resource consents, attending hearings and complying with consent conditions.

Hence the costs of consents and compliance which have been incurred in the past are highly unlikely to be applicable and cannot be assumed for the HEO in the Commission's TSLRIC model.

5.4 Summary

The Commission's task is to ensure that the HEO deploys its nationwide network efficiently. As we have previously noted[72], evidence from LFCs indicates that aerial deployment is used wherever possible since aerial reticulation is more cost-effective than undergrounding. In the case of NorthPower 60% aerial deployment has been achieved. Clearly economies accrue through the avoidance of trenching costs, and further savings occur with the faster deployment time of aerial reticulation.

We recommend that the Commission:

- disregards Chorus' comments on the extent of aerial deployment and continues to rely on EDB and other LFC information as to the extent of aerial deployment that would be possible for an HEO
- does not use the pole lease costs and data provided by Chorus because they are misleading, biased and inaccurate
- considers data for pole lease costs from other LFCs as the basis for efficient costs for an HEO deploying a nationwide network
- adopts a forward-looking approach in respect to the consent costs that would apply to the efficient HEO

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71 Ministry for the Environment (2015), *Proposed Amendments to the National Environmental Standards for Telecommunication Facilities Preliminary evaluation under section 32 of the Resource Management Act 1991*, March 2015, page 31.

72 Network Strategies (2015), *Commerce Commission Draft Determination for UCLL and UBA*, 20 February 2015. See Section 5.1.

- reviews its calculations for percentages of aerial deployment and lead-ins to correct the errors explained in our previous report:[73]
  - the percentage of aerial lead-ins based on EDB data has dropped from 49.5% (in the previous draft December determination[74]) to 47% (in the revised draft determination[75])
  - the percentage of aerial deployment based on EDB data has been reduced from 51% (the draft December determination[76]) to 49% (in the revised draft determination[77]).

73 Network Strategies Limited (2015), *Revised draft determination for the UCLL and UBA price review*, 13 August 2015, Sections 5.1 and 5.2.

74 Commerce Commission (2014), *Draft pricing review determination for Chorus' unbundled copper local loop services*, 2 December 2014, Table 8, page 137.

75 Commerce Commission (2015), *Further draft pricing review determination for Chorus' unbundled copper local loop services*, 2 July 2015, Table 10, page 213.

76 Commerce Commission (2014), *Draft pricing review determination for Chorus' unbundled copper local loop services*, 2 December 2014, paragraph 611.

77 Commerce Commission (2015), *Further draft pricing review determination for Chorus' unbundled copper local loop services*, 2 July 2015, paragraph 1134.

6 Price trends

In its report for Chorus[78], CEG suggests the use of 'bespoke' indices for determining a price trend for trenching rather than NZIER's preferred option of the Statistics New Zealand Producers Price Index (PPI) for outputs of the heavy and civil engineering construction sector, or the Capital Goods Price Index (CGPI) series used by Beca.

We discuss CEG's tailored indices for trenching (Section 6.1), the use of forecasts as well as historical data (Section 6.2), and the weightings of the various series within the indices (Section 6.3).

6.1 Bespoke price indices

CEG notes that the options suggested by both NZIER and Beca are not ideal for use as a price trend for trenching:

- the PPI for the heavy and civil engineering construction sector includes a large range of activities not related to trenching for the telecommunications sector
- the CGPI only includes capital expenditure, not operational expenditure such as labour costs which form a large part of trenching costs.

Indeed, we had similar criticisms of these shortcomings.[79]

78 CEG (2015), *Response to the further draft determination*, August 2015, section 5.

79 Network Strategies Limited (2015), *Revised draft determination for the UCLL and UBA price review*, 13 August 2015, Section 6.3.

CEG has constructed five different bespoke indices, each of which is a weighted average of various CGPI and labour cost index (LCI) series for historical data and forecasts:

- **Option a:** constructed from Statistics New Zealand data on average annual growth in the series underlying Chorus' field service agreements, weighted according to the field service agreement weights. CGPI All Groups and Labour All Groups are used as the predictive series.

- **Option b:** constructed from Statistics New Zealand data on average annual growth in Beca's preferred CGPI series (Earthmoving and Site Works, Electrical Works and Pipelines) and LCI Construction, weighted equally. CGPI Civil Construction and LCI Construction are used as the predictive series.

- **Option c:** constructed from Statistics New Zealand data on average annual growth in Beca's preferred CGPI series (Earthmoving and Site Works, Electrical Works and Pipelines), with Beca's suggested weightings of 50%, 25% and 25% respectively. CGPI Civil Construction is used as the predictive series.

- **Option d:** Statistics New Zealand data and NZIER forecasts of average annual growth in CGPI Civil Construction and LCI Construction, weighted 50/50 (version 1) and 75/25 (version 2) respectively.

The time period used by CEG to develop a price trend estimate varies according to the index. Options b and d span the period from Q3 1994 to Q1 2020; Option a is from Q1 1996 to Q1 2020 and Option c from Q1 1990 to Q1 2020. Hence each index is comprised of a mix of historical and forecast data.

With the exception of Option d which uses NZIER forecasts, the forecasts of the nominated series were developed by CEG.

6.2 Mix of historical and forecast data

We believe that the main problem with CEG's bespoke indices is the incorporation of a mix of historical and forecast data.

In our opinion, CEG's use of both historical data and forecasts is unnecessary, and indeed it is questionable whether the end result would even be an appropriate reflection of the long-term trend for the index. The TSLRIC methodology requires that the costs be forward-looking – this does not mean, as CEG appears to believe, that long-term price trends be used.

Forecasts are forward-looking, as required by the TSLRIC methodology, although they may consider past data. By developing a price trend that is a mix of forward-looking and historical information, CEG is violating this requirement – essentially CEG is adjusting the forward-looking information to reflect what has happened in the past.

For all indices, except for Option d, the series used for forecasts differs from that of the actual historical data as presumably forecasts were not available for the series used for the historical data. This introduces a discontinuity to the indices.

6.3 Weightings

With the exception of Option a, there is no firm evidence to support the weights used by CEG. While the weights for Option a are based on Chorus' field service agreements, they may not reflect those for the HEO.

We had previously noted that for the December draft determination TERA had assumed that the trend for trenching costs was 90% labour/wages and 10% for CPI[80], which are very different to the weights used by CEG in its Option d (although the series used by TERA and CEG do differ).

Sensitivity analysis

As shown by the differences in the two versions of Option d, the results can be sensitive to the weightings selected.

80 In CI_ComCom-Price trends v5.xlsx, sheet Analysis, row 89.

6.4 Other comments

CEG provides no details on how it constructed its LCI series. In 2009 the NZSIOC classification system – based on the Australian and New Zealand Standard Industrial Classification (ANZSIC06) – was introduced. LCI data for the Construction sector (which CEG claims to use) does not appear to be available prior to 2009, most likely due to the change in classification system.

CEG's Option c suffers from the same problem as Beca's original proposed use of the CGPI – it only covers capital costs with no consideration of trends in operational costs, in particular for labour.

6.5 Summary

We do not consider the price indices constructed by CEG to be appropriate for use as price trends:

- the key TSLRIC requirement that costs are forward-looking is violated by CEG's use of a mix of historical data and forecasts
- the weightings used are not supported by evidence that suggests they reflect the mix of costs of an efficient operator

Finally it is unclear how CEG constructed its historical data series, given changes in classifications used by Statistics New Zealand.

7 WACC

Chorus and CEG[81] have devoted substantial attention to critiques of the Commission's proposed Weighted Average Cost of Capital (WACC) parameters. As many of the arguments have been raised previously our main focus in this section is reviewing new information.

7.1 Risk free rate and TAMRP

Chorus and CEG claim that the Commission's approach to estimating the risk free rate and the tax adjusted market risk premium (TAMRP) does not capture interdependencies between the two parameters. In particular CEG argues that the cost of equity has been underestimated since the risk free rate reflects current (relatively low) values while the TAMRP gives weight to historical average estimates.

CEG has previously argued that it is incorrect to use a short-term estimate of the risk free rate with a long term TAMRP estimate[82]. In response to this the Commission stated in its further draft determination that CEG's position is inconsistent with empirical evidence, citing a study by Dimson, Marsh and Staunton[83]. This study investigates whether contemporary conditions imply higher market risk premiums.

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81 CEG (2015), *Response to the further draft determination*, August 2015.

82 CEG (2015), *Issues from submissions UCLL and UBA*, March 2015, paragraphs 69 to 74.

83 Dimson, Marsh and Staunton (2013), *The low-return world*, Credit Suisse Global Investment Returns Yearbook 2013.

> The equity premium can be viewed as an expected reward per unit of risk. It should not, therefore, be constant over time, but instead should vary with risk levels and investors' risk aversion. Today, risks abound relating to the Eurozone, world growth, and political and geopolitical concerns. Many argue that this high level of uncertainty should command a high risk premium. It is hard to find either historical or current market support for this view. First, the empirical evidence over 113 years indicates that, when markets are turbulent, volatility tends to revert rapidly to the mean, so that we should expect any period of extreme volatility to be relatively brief, elevating the expected equity premium only over the short run. Second, at the time of writing, volatility is in any case below the long-run average. [84]

It is notable that subsequently CEG did not respond to the Commission's statement that its position is inconsistent with these empirical findings, nor does it comment at all on the evidence provided in the Commission's cited study.

CEG's position relies on the accuracy of its claim that current 'exceptional market circumstances' entail 'heightened risk premiums'. This may be intuitively plausible, as acknowledged by Dimson, Marsh and Staunton[85]:

> After sharp market declines, equity investors are poorer and more risk averse. At such times, markets are also typically more volatile and highly leveraged. Investors should therefore demand a higher risk premium (which will drive markets even lower) in order to ensure that stocks are then priced to give a higher future expected return.

Nevertheless following an examination of the empirical evidence Dimson, Marsh and Staunton demonstrate that in fact this is not observed in practice:

> But, if risk aversion is accentuated by market declines, it is hard to argue that it should currently be high. Over 2012, the world equity index gave a return of 16%, while, over the last four years, the world index has risen by 65%. Current levels of risk or risk aversion do not therefore justify an equity premium above the long-term estimate of 3%–3½% (relative

84 *Ibid*, page 12.

85 *Ibid*.

> to bills). Those who argue to the contrary may well have forgotten that equity markets almost always face a wall of uncertainty. We do not live in uniquely uncertain times.[86]

Thus, we may conclude from this study that current market conditions do not reflect a fundamental change in investment behaviour that must be accommodated within the Commission's existing WACC methodology.

This finding appears to contradict results from an International Monetary Fund (IMF) study[87] cited by CEG as evidence that, although government bond rates have been falling in recent years, the cost of equity has actually increased. However, a more detailed review of relevant research than that presented by CEG reveals that the empirical evidence remains mixed and inconclusive[88]. Furthermore in order to draw meaningful conclusions for regulatory WACC estimation, as noted by Gibbard[89], it is important to ensure that data is evaluated over appropriate time horizons and that proper econometric analysis is conducted. In particular it is important to guard against data mining which may be unintentional or intentional.

CEG conducts its own analysis of New Zealand government bonds using the IMF approach, as well as an updated analysis of the impact of the Greek debt crisis. The latter analysis is informed by a graph (Figure 17) of yields on Greek, New Zealand, Australian and United Kingdom ten year Government bonds over the time-period September 2014 to July 2015. CEG claims there is a clear 'overall negative correlation between Greek and New Zealand debt' during 2015 (that is, for a period of less than one year) and concludes from this that 'there is no reason to believe heightened fears of global shock to financial markets would lead to lower cost of equity in New Zealand'[90]. CEG's correlation estimate

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86 *Ibid*, pages 12 to 13.

87 International Monetary Fund (2014), *International Monetary Fund World Economic Outlook: April 2014*, April 2014. See Chapter 3, Perspectives on real interest rates.

88 For a useful survey of empirical research see Gibbard (2013), *Estimating the Market Risk Premium in Regulatory Decisions: Conditional versus Unconditional Estimates*, Working Paper no. 9, ACCC / AER working paper series, September 2013.

89 *Ibid*, section 4.3.

90 CEG (2015), *Response to the further draft determination*, August 2015, paragraph 51.

of -0.22 between Greek and New Zealand debt is characterised as a weak negative correlation[91] in that the value of one changes only slightly in response to changes in the other (noting also that correlation does not imply causation).

We find casual inspection of a snapshot of a small selection of bond yields over a very short time horizon insufficient evidence to support CEG's conclusion.

International regulatory precedent

CEG suggests that the Commission's approach is out of step with international regulatory practice by presenting a series of examples from Australia, the United States, the United Kingdom and continental Europe.

In fact the Commission's approach is consistent with the ACCC's recent draft determination for fixed access services[92], as acknowledged by CEG. We note that the ACCC does not favour the Dividend Growth Model (DGM) method for estimating the Market Risk Premium (MRP), which is CEG's preferred approach. CEG uses this approach to demonstrate 'the clear inverse relationship between the risk free rate and the TAMRP'[93]. The ACCC characterises DGM estimates as 'highly contentious and could not be estimated with precision for Australian markets' and lists a number of limitations[94] of this method.

CEG interprets the recent decision of the Economic Regulation Authority (ERA) of Western Australia as establishing:

91 Assuming that the estimate is Pearson's correlation coefficient.

92 Australian Competition and Consumer Commission (2015), *Public inquiry into final access determinations for fixed line services – primary price terms Draft Decision*, March 2015, see Section 5.3.1.2

93 CEG (2015), *Response to the further draft determination*, August 2015, paragraph 21.

94 Australian Competition and Consumer Commission (2015), *Public inquiry into final access determinations for fixed line services – primary price terms Draft Decision*, March 2015, see pages 86 to 87.

> … that the MRP is non-stationary, and that the long-term historical average estimate can be a poor predictor of the MRP in future regulatory periods – especially in a context where the risk free rate differs from historical average market levels.[95]

CEG appears to have misinterpreted the ERA's reasoning since its statements in relation to setting a lower bound for the MRP estimate clearly illustrate that it is not endorsing the position that the MRP is non-stationary or stationary:

> For this Final Decision, the Authority [ERA] accounts for the Ibbotson approach in its process for establishing the lower bound of a range for the forward looking MRP.
>
> The use of the Ibbotson approach to inform the lower bound of the MRP bound does not mean the Authority ascribes to the view that the MRP in Australia is stationary. The Authority remains of the view that evidence on mean reversion of the MRP in Australia is inconclusive as outlined in the Guidelines which conducted empirical tests on the Australian data.
>
> The Authority also notes that any empirical testing may be subject to shortcomings such as those relating to the data itself, its span or in the methods applied. Empirical evidence may provide information that assists in understanding economic and financial relationships, but should be grounded in theory. For this reason the Authority considers it reasonable that investors may give credence to historical averages of the MRP in forming their views for the future.[96]

In other words, the ERA does not have a definite position one way or the other and is hedging its bets by ensuring that the MRP estimated range incorporates different methodologies and underlying assumptions. To do this it must use a range that is flexible over time due to the properties of the DGM method which, unlike the ACCC, it is minded to consider.

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95 CEG (2015), *Response to the further draft determination*, August 2015, paragraph 72.

96 Economic Regulatory Authority (2015), *Final decision on proposed revisions to the access arrangement for the Mid-West and South-West Gas Distribution systems*, 30 June 2015, paragraphs 1179 to 1181.

The focus of the other Australian regulatory examples cited by CEG[97] tends mainly to be on the selection of a point estimate for the MRP within a range, with the upper end of the range defined by estimates using a DGM approach, rather than providing unequivocal support for CEG's recommendations that the Commission change its approach (which already includes consideration of estimates using the DGM approach).

In its analysis of the regulated US electricity and natural gas businesses, CEG finds that:

> …the allowed cost of equity for energy businesses has been relatively stable at around 10.5% over the last 15 years, despite volatility in the government bond rates (proxied by ten year Treasury bond rates.[98]

CEG refers to Figure 6 to support its conclusions, however we find this graph very ambiguous. It is unclear, for example, exactly what the unlabelled secondary y-axis denotes. However it does appear clearly that in the first half of this 15 year period the cost of equity is below 10.5% and in the second half it is above 10.5%. This is more indicative of a slight declining trend over the past 15 years, than CEG's assertion of stability.

In the United Kingdom Ofgem has not changed its approach of using long term rather than spot/market data for the risk-free rate. In this regard we find CEG's language misleading when it states that 'Ofgem's decision involved an increase of between 1.3% and 1.6% relative to this value [the market level of Index Linked Gilts]'[99]. This assertion could be interpreted as Ofgem raising the rate from the spot rate but this is not the case at all. Note that the Ofgem proceeding is dated 2011 and is setting prices for an eight-year period.

CEG also presents a survey of allowed risk free rates and prevailing risk free rates in continental Europe. CEG provides no explanation as to how the prevailing risk free rates were estimated. These are not reported in any of the documents cited by CEG. We have provided examples below.

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97 CEG (2015), *Response to the further draft determination*, August 2015, paragraphs 73 to 78.

98 *Ibid*, paragraph 82.

99 *Ibid*, paragraph 85.

Denmark

The regulator previously used a shorter period for estimating the risk-free rate. Calculation of the rate will be undertaken as close as possible to the date of determination. Note that the document cited by CEG does not include a value for either the allowed risk-free rate or the prevailing risk-free rate.

Ireland

To some degree, CEG misrepresents the situation with regard to the Irish estimate for the risk-free rate. In fact, this point estimate of 2.30% was selected from an estimated range – 1.75% to 2.50%. While CEG claims that the regulator considered ten-year government bonds from several European countries, actually only ten-year German sovereign bonds were used as the proxy for the Irish risk-free rate, not Irish government bonds, due to the higher yields of the latter in comparison with those of other Eurozone countries, as well as their volatility. Europe Economics states (with a number of references) that:

> Finance professional [*sic*] tend to use the 10-year German bond as the benchmark risk-free asset for the Eurozone as a whole. This practice is, to varying degrees, endorsed also by a number of academic studies.[100]

Norway

We do not understand how CEG determined the prevailing risk-free rate (1.19%). This is not in the cited expert's report – indeed this report gives the government ten-year bond rate as 2.8% at the end of the period under consideration (December 2002 to October 2013).

Sweden

Again, there is no explanation of how CEG determined the prevailing risk-free rate, given as 2.40% – the cited document states that the rate for ten-year government bonds increased from 1.69% on 3 May to 2.49% on 1 October then fell to 2.31% by 3 December 2013.[101]

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100 Europe Economics (2013), *Cost of Capital for Mobile, Fixed Line and Broadcasting Price Controls*, April 2014, page 20.

101 PTS (2013), *PTS konsultationssvar på samråd om uppdaterad kalkylränta för det fasta nätet*, 16 December 2013, page 6.

CEG's updated analysis

CEG notes that the Commission's TAMRP estimate was based on the median of five different methodologies as at April 2014. CEG recommends that the estimate be updated using the latest available data, and presents its own estimates for this including an adjustment. We agree that the Commission should use the latest available data and as such should update its estimate, given that over one year has passed since the previous estimation. However it would be unreasonable for the Commission to include any further changes to its approach – as proposed by CEG – without further consultation.

Implications of the IMs

The Commission in the context of its work on the Input Methodologies (IMs) has previously considered whether the risk-free rate should be estimated by reference to average historical interest rates or current interest rates. As such it is clear that the Commission is well aware of different practices in this regard across jurisdictions. However, the Commission has determined that current interest rates are most appropriate in the context of our legislation.

> The use of current rates will lead to estimated costs of equity and debt which more closely reflect changes in expectations in the financial markets. That is, they are more up-to-date estimates of interest rates and therefore the cost of capital. In a price setting context, using current rates means changes in expectations in the financial markets will be signalled more rapidly to suppliers, and to consumers.
>
> The Commission considers that the use of current rates better achieves the Part 4 Purpose (of promoting the long-term benefit of consumers such that suppliers have, among other things, incentives to invest) and the potential dynamic efficiency benefits of investment, than the use of historic rates.[102]

[102] Commerce Commission (2010), *Input Methodologies (Electricity Distribution and Gas Pipeline Services) Reasons Paper*, December 2010. See paragraphs H4.12 – H4.13.

7.2 Asset beta and leverage

CEG claims that the Commission's asset beta is biased downwards as a result of the Commission's assumption that a zero debt beta is appropriate for all firms in Oxera's benchmark sample. Accordingly CEG presents its own estimates to correct for the claimed bias, resulting in an increase in the average monthly five year asset beta from 0.45 to 0.485.

We are puzzled as to why CEG now considers that the Commission's approach – previously well debated and finalised in the context of the Input Methodologies – of using an average leverage of the revised comparator sample is insufficient to justify the assumption of a zero debt beta. Indeed CEG itself previously assumed a zero debt beta when it presented its own benchmarking survey of comparator countries for this proceeding[103].

Chorus continues to argue for the use of a longer historical period for assessment of the asset beta. However it appears that Chorus has not presented any new material in support of its argument.

7.3 Summary

CEG claims that its analysis consistently demonstrates that the Commission's cost of equity methodology is inappropriate, and as such recommends that the Commission either:

- adjusts the risk free rate estimate to reflect historical average rates, or
- increases the TAMRP by placing greater weight on prevailing estimates.

Chorus devotes considerable effort to illustrating the practical impact of the Commission's current approach to estimating the risk free rate in support of its arguments for the use of a long-term average. Nevertheless Chorus also indicates that it approves of either of the two options provided by CEG.

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103 CEG (2014), *Response to Commerce Commission UCLL/UBA WACC consultation paper*, March 2014, See Section 2.3.2.

Our review of the material provided by CEG has found that there is no credible evidence that the Commission's approach is out of step with international regulatory practice. While it is certainly true that some other regulators adopt different practices in respect to the estimation of the risk free rate and the TAMRP there is no evidence of widespread changes in practices due to prevailing market conditions. Furthermore, these practices are governed by each country's legislative and regulatory context. As such, the Commission's approach is entirely consistent with the New Zealand context and should not be amended in the light of short-term considerations.

Finally, Chorus attempts to demonstrate that the Commission's assumptions are unrealistic. It claims to have developed 'an integrated set of financial statements based on the assumptions contained within the Commission's July draft determination' which demonstrates that 'the HEO isn't financeable on the basis the Commission has assumed'[104]. Chorus indicates that there is a mismatch between the Commission's assumed BBB+ credit rating and the leverage and financial metrics derived from their hypothetical financial statements. However Chorus has not provided copies of these statements, and so it is impossible to assess the merits of its arguments.

We agree that consistency between the assumed asset beta, leverage and credit rating is important. To this end we have made a number of recommendations in our August report that would strengthen the Commission's estimates[105].

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104 Chorus (2015), *Submission in response to the Commerce Commission's Draft Pricing Review Determinations for Chorus' UBA and UCLL services (2 July 2015)*. August 2015. Paragraph 185.

105 Network Strategies (2015), *Revised draft determination for the UCLL and UBA price review*, 13 August 2015, see Section 8.

8 Uplift

On behalf of the Commission Oxera examined whether an uplift to the WACC might deliver end-user benefits that would exceed the direct costs of the uplift.[106] Its analysis is based on the framework previously developed to assist with the Commission's decision on WACC for the regulation of pricing for electricity and gas pipelines, under Part 4 of the Commerce Act.

The Oxera analysis relies on an assumption that a WACC uplift for UCLL and UBA services will have an impact on the timing of major innovations in telecoms. As we previously identified[107], there is no attempt to demonstrate any causal impact – Oxera admits that other factors are likely to affect the pace and scale of new investment.

Both Sapere[108] and CEG have suggested adjustments to Oxera's modelling of a potential uplift to the WACC.

8.1 Sapere on the WACC uplift

Sapere claims that the Commission should include an allowance in the WACC for parameter error, and that:

> In particular, there is no recognition that by adding a margin:

106 Oxera (2015), *Is a WACC uplift appropriate for UCLL and UBA?*, June 2015.

107 Network Strategies (2015), *Revised draft determination for the UCLL and UBA price review*, 13 August 2015, Section 9.3.

108 Sapere (2015), *Economic Comment on UCLL and UBA Pricing Issues*, 11 August 2015, section 5.

- Chorus obtains additional incentive to invest in the copper network to maintain reliability and to provide augmentation and upgrades, particularly in the areas where 25% of the population is not covered by UFB; and
- there will be an increase in the UCLL/UBA price which will result in increased migration to UFB with attendant positive externalities.[109]

The presentation of results by both Sapere and Oxera is very confusing. A key problem in both reports is the labelling of the potential net benefits relating to a 'two-year delay' and a 'five-year delay'[110] – in fact this should be two-year and five-year accelerations (referring to the introduction of new technology) respectively.

Sapere's claim that Oxera's 'Figures 6.1 and 6.2 purport to show the annual, not probability weighted benefits of accelerated adoption but in fact the benefits shown are probability weighted'. Our reading of Oxera suggests no such claim – these figures refer to annual benefits (not probability weighted), but in our view these are simply labels to assist the reader in providing an explicit reference to specific values of estimated benefits (referred to elsewhere in the text) which may be within an estimated range. We agree that the figures show probability weighted benefits. Oxera does not provide any tables for the probability weighted benefits.

An annualised net benefit can be calculated from estimates provided by Oxera as follows:

- annualised benefit with acceleration
- *less* annualised direct cost of a WACC uplift for UCLL and UBA
- *less* annualised direct cost of a WACC uplift for the new technology.

A probability-weighted annualised net benefit is essentially a weighted average of the annualised net benefit, with the relevant probabilities also provided by Oxera:

- annualised net benefit assuming the benefit due to uplift is realised, multiplied by the probability that the benefit is realised

109 *Ibid*, paragraph 139

110 See Table 6.1 in Oxera (2015), *Is a WACC uplift appropriate for UCLL and UBA?*, June 2015 and Table 1 in Sapere (2015), *Economic Comment on UCLL and UBA Pricing Issues*, 11 August 2015.

- annualised net benefit assuming no benefit is realised (that is, only the direct cost), multiplied by one minus the probability the benefit is realised.

In its Table 1, Sapere assumes that the annualised direct costs of uplift for the new technology are the same as for the existing technology. As Oxera notes:

> If we assume that the asset base of the new service/technology is the same as the existing UCLL/UBA asset base, the direct costs would effectively be double the costs shown in [Oxera report] Table 3.3.
>
> In practice, an assumption of doubling of the asset base is likely to overstate the costs. The total annual investment in telecoms in New Zealand has fluctuated between NZ$1bn and NZ$1.5bn, and only a proportion of this has been investment by Chorus or other providers of infrastructure and retail services. This implies that, first, building up an asset base of more than NZ$7bn would take quite a long time, and, second, a new technology of this size would be likely to displace some of the existing asset base – i.e. consumers are unlikely to be paying for both the existing and the new asset base in full.[111]

Subsequently, in its Table 2, Sapere assumed that the annualised direct costs of uplift for the new technology are half that of the existing technology, and then in Table 3 it presents results as for Table 1 but on a total welfare basis (which only takes into account the deadweight loss).

In essence, Sapere's analysis simply is an alternative presentation of the Oxera results – it does not address the substance or the underlying assumptions of the Oxera model, nor does it explore Sapere's suggestion of an allowance for parameter error. Our previous criticisms of the Oxera uplift model therefore equally well apply to Sapere's analysis.

> In summary the key assumptions on which Oxera bases its NPV estimates of early technology introduction benefits, at best, have a large associated margin of error. However the fundamental issues with the analysis lie in:

111 Oxera (2015), *Is a WACC uplift appropriate for UCLL and UBA?*, June 2015, page 19.

- the absence of evidence of a causal relationship between a WACC uplift and the acceleration of investment in disruptive technologies
- a failure to demonstrate that New Zealand service providers are technology laggards
- the lack of clarity concerning the next disruptive technology that will have services subject to regulation and is likely to offer benefits on a similar scale as the introduction of high-speed broadband.[112]

8.2 CEG on estimating benefits of acceleration

CEG criticises Oxera's modelling of early technology innovation benefits as a result of WACC uplift, claiming:

- Oxera over-estimates the costs through its assumption that the asset base of the new technology would be the same size as the existing technology
- benefits are weighted by probabilities and costs are not (probability assumed to be 100%)
- Oxera's estimate of indirect costs of an uplift is high due to the constant elasticity assumption (CEG states that elasticity should decline)
- Oxera's assumption of 100% passthrough would only occur in a perfectly competitive retail market (CEG implies that a lower passthrough should be explored)
- a non-linear functional form, such as the Prelec function, should be used instead of a straight line for the relationship between the WACC uplift and the probability of acceleration
- as the uplift on WACC increases, the probability of under-investment will decrease and the probability of acceleration will increase.

CEG subsequently adjusts Oxera's model to allow for a selection of these claims, finding that the optimal uplift would be between the 65th and 75th percentile (depending upon the discount rate used).

A key issue with any type of modelling is the determination of appropriate inputs – for example, it is difficult to source elasticity data on broadband services. Adjusting or

112 Network Strategies (2015), *Revised draft determination for the UCLL and UBA price review*, 13 August 2015, Section 9.3.

relaxing various assumptions implies that suitable alternatives are available. If not, the modelling exercise can only be a theoretical exercise, useful at best to establish sensitivities of the results to the assumptions (assuming the underlying relationships of the model are valid).

Nonetheless despite CEG's increased sophistication with regard to the assumptions relating to the Oxera framework, as in the case of Sapere, CEG has not addressed the underlying flaws of the Oxera model, and thus its findings are subject to the same criticisms.

Costs

CEG, Sapere and indeed Oxera itself all note that Oxera's assumption that the direct costs of the new technology will be equal to that of the old technology is a very conservative assumption. CEG then compares three cost curves, corresponding to situations where the costs of the new technology replace 100%, 50% and 0% of those of the existing technology. Note that this assumes that the costs of the new technology are still the same as those of the existing technology – the total cost of both technologies varies between the total cost of the new technology and twice the cost of the new technology.

With regard to the costs, we believe that CEG makes a valid point – if Oxera's analysis is to be considered, then the costs should be probability weighted as are the benefits.

Oxera's estimation of indirect costs relies on an assumption of constant elasticities – CEG suggests that elasticities should decline. This suggestion is reasonable, however in practice it is extremely difficult to source elasticity data for broadband services. Given the lack of suitable data, making arbitrary assumptions for the behaviour of declining elasticities is likely to introduce additional uncertainty into the analysis and thus the results would be subject to a greater level of error. In a high level analysis such as Oxera's it is therefore preferable to apply the more conservative option of constant elasticity.

CEG also suggests that passthrough assumptions lower than 100% be explored, as 100% passthrough would only occur in a perfectly competitive market. Oxera's assumption of 100% is, again, conservative and is thus more suitable for this high level analysis than applying a lower – and much more uncertain – passthrough assumption.

Benefits

CEG suggests an alternative non-linear functional form for the relationship between the WACC uplift and the probability of investment being accelerated. Oxera notes that its own linear assumption may not be valid:

> In reality, the acceleration probability is unlikely to increase linearly as the size of the WACC uplift is increased. Rather, it seems more likely that the increase in the incentive to bring investment forward is bigger for modest values of the uplift than implied by the linear projection.[113]

The selection of the functional form – and indeed the type of analysis – is based on a number of assumptions made by CEG with little or no evidence to support those assumptions. While CEG makes reference to the work on the prospect theory of Kahneman and Tversky[114] it should be noted that this is a model that aims to describe human behaviour, in particular how humans make a decision under uncertainty – it does **not** model how to make the optimal decision. In other words, it does not model the decision-making of an economically efficient operator. Thus the use of prospect theory in this instance may be inappropriate.

CEG claims that:

> The probability weighting function with the strongest empirical support appears to be that of Prelec (1998).

In a literature search, we have found that the results of empirical studies have been 'ambiguous' in relation to the optimal choice of a probability weighting function. This was noted by Cavagnaro, Pitt, Gonzalez and Myung[115] who found that there was no clear best candidate and indeed their own empirical results exhibited considerable heterogeneity – for

113 Oxera (2015), *Is a WACC uplift appropriate for UCLL and UBA?*, June 2015, page 37.

114 Kahneman, D. and Tversky, A.(1979), "Prospect theory: An Analysis of Decision Under Risk", *Econometrica* 47(2), March 1979, pages 263-291.

115 Cavagnaro, D.R., Pitt,M.A., Gonzalez, R. and Myung, J.I. (2013), "Discriminating Among Probability Weighting Functions Using Adaptive Design Optimization", *Journal of Risk and Uncertainty*, volume 47 issue 3, December 2013, pp255-289.

some decision makers a two-parameter Prelec function provided the best explanation of behaviour, while for others another functional form – Linear in Log Odds – was superior. In particular, the Prelec function was found to be better for decision makers that drastically overweighted small probabilities. Furthermore the results suggested that some underlying assumptions inherent in the Prelec function were unlikely to explain the probability weighting behaviour of some decision makers.

Thus CEG's selection of the Prelec function is based purely on an (incorrectly) assumed level of popularity – not an assessment of whether it is fit for purpose. Furthermore CEG has not attempted to estimate the parameters of the Prelec function – it simply assigns notional values ($\alpha = 0.5$ and $\beta = 1$). Note that the values of these parameters control the shape of the Prelec function and thus the resultant probability weights. CEG's weights must be considered at best hypothetical values that are not supported by any evidence. The results of CEG's analysis therefore represent purely an academic exercise and cannot be considered by the Commission in its decision-making.

Even if we accept CEG's approach and use of the Prelec function, the fact remains that the underlying flaws within Oxera's analysis have not been addressed, and thus CEG's analysis does not add any value to assist the Commission.

CEG also adapts Oxera's framework by assuming that as the WACC uplift increases, the probability of under-investment will decrease and the probability of acceleration will increase. CEG provides no evidence to support this assumption. We would suggest that assumptions relating to under-investment and the relationship between the WACC uplift and probabilities of under-investment and acceleration should be more properly explored within a sensitivity analysis.

8.3 Summary

Neither Sapere nor CEG address the fundamental flaws of Oxera's analysis that we previously identified[116], namely:

116 Network Strategies Limited (2015), *Revised draft determination for the UCLL and UBA price review*, 13 August 2015, section 9.

- the absence of evidence of a causal relationship between a WACC uplift and the acceleration of investment in disruptive technologies
- a failure to demonstrate that New Zealand service providers are technology laggards
- the lack of clarity concerning the next disruptive technology that will have services subject to regulation and is likely to offer benefits on a similar scale as the introduction of high-speed broadband.

Sapere's analysis is essentially an alternative presentation of the Oxera analysis, plus an exploration of the impact of the use of a total welfare standard. No additional insight is provided.

CEG suggests modifications to a number of the assumptions in the Oxera model, generally with little evidentiary support, and thus cannot be considered in the Commission's decision making. Furthermore CEG's results remain questionable due to the complete lack of any effort to address the above flaws in the underlying Oxera model. As in the case of the Oxera results, we find that CEG's result 'does not contradict the continued use of a midpoint WACC for UCLL/UBA'[117].

117 Oxera (2015), *Is a WACC uplift appropriate for UCLL and UBA?*, June 2015, section 6.

9 Backdating

Chorus, supported by Sapere[118], submits that the final price from the FPP process should apply for the entire period since the introduction of the IPP price. The main argument offered in support of this position is that the FPP offers 'assurance' to investors that TSLRIC pricing will be applied should the IPP result be unsatisfactory. According to Sapere this assurance function cannot be credible unless FPP results are backdated to the date at which the IPP price applied.

It should be noted that these arguments imply that the IPP price is inefficient. In fact, as a benchmark of TSLRIC-based prices that were viewed as efficient at that point in time the IPP price must be efficient. Indeed, as we have previously noted, it is unreasonable to expect that an efficient TSLRIC price estimated today would be the same as an efficient price estimated at some previous point in time.[119]

Sapere also accuses the Commission of acting in a 'time inconsistent' or opportunistic manner, on the basis that the Commission has adopted choices with undue regard to Chorus' investment circumstances.

In this Section we investigate Sapere's 'assurance function' (Section 9.1), time consistency issues (Section 9.2), and the appropriate welfare standard for this proceeding (Section 9.3).

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118 Sapere (2015), *Economic Comment on UCLL and UBA Pricing Issues*, 11 August 2015.

119 Network Strategies Limited (2015), *Revised draft determination for the UCLL and UBA price review*, 13 August 2015, Section 11.1.

9.1 Assurance for investors

Sapere characterises the 'economic rationale' for the FPP method as providing 'the assurance that prices can and will be set using TSLRIC, should any affected party be sufficiently dissatisfied with the result of the IPP to call for the FPP'[120]. Sapere claims that unless the FPP price is applied from the date at which the IPP price was implemented then the 'assurance function' will not be complete since:

> …it will leave investors unsure as to the extent to which they are in practice able to rely on the FPP if the IPP is found to be inadequate. Such erosion of investment incentives will have efficiency implications that are contrary to the long-term benefit of end-users.[121]

We have not previously encountered the so-called 'assurance function' in telecommunications (or indeed other sectors), unless Sapere regards it as related to 'revenue assurance' which is a term that is applied in the telecommunications sector. Since this term typically describes issues in billing and revenue collection[122] we doubt that this is the context that Sapere intended. However it is not entirely clear as Sapere has provided no references at all in relation to its 'assurance function'. It is possible that Sapere simply associates assurance with risk management activities.

The rationale for New Zealand's IPP in the access pricing regime was clearly explained by its architects in 2000 as providing a means of resolving an access dispute quickly. Specifically, the purpose of the IPP was stated to be:

> … to ensure that an appropriate pricing principle can be applied in the first instance for disputes to be resolved expeditiously. The initial determination would ideally get

120 *Ibid*, paragraph 102.

121 *Ibid*, paragraph 105.

122 This is defined by the TM Forum: "Revenue Assurance is the use of data quality and process improvement methods to improve profits, revenues and cash flow without influencing demand. A set of techniques and methodologies is used to identify and repair revenue leakages as well as to detect and prevent errors resulting in unbilled or uncollected revenues. … It is mostly used in the telecommunication area."
See http://mitiq.mit.edu/iciq/PDF/DATA%20QUALITY%20ASPECTS%20OF%20REVENUE%20ASSURANCE.pdf.

> sufficiently close to the 'efficient' price so that both parties accept the determination and decide not to progress to the (longer and more costly) pricing review determination.[123]

It is clearly stated that the intention of the IPP is to serve as a proxy for the FPP[124]. There is no mention of the need for an assurance function, despite the acknowledgement that TSLRIC cost models are time-consuming and complex to implement[125]. The opportunity to apply for a pricing review is guaranteed by legislation, hence affected parties may be assured that an FPP price is available should the IPP price be regarded as unsatisfactory.

Sapere notes that the investor's view of the probability of the FPP price being lower or higher than the IPP price may be different from the regulator's view.

> We note this timing requirement is not addressed, from an assurance perspective, by the regulator assuming that the supplier of the regulated service will view as symmetric the probability of an IPP being above or below the FPP. The supplier (or potential investor) may have a very different view of these probabilities, and it is the views of the investor that drives investment incentives, not the assumptions of the regulator.[126]

To test Sapere's claim concerning the regulated price expectations of the potential supplier or investor we reviewed the advice provided to investors in 2011 by the former Telecom New Zealand. In regard to the regulatory regime the advice did not convey any certainty about the direction of price changes.

> The level of the UCLL and SLU prices is not certain. Regulation may either raise or lower copper prices. Lower UCLL prices may negatively impact on the financial performance of New Chorus and also potentially result in lower uptake of fibre. Higher prices may negatively impact on the financial performance of New Telecom, while New Telecom could also be adversely affected if the Commerce Commission's review of UCLL pricing results in a steeper fall in the de-averaged urban UCLL price than in the averaged UCLL

123 Fletcher, H. (2000), *Ministerial Inquiry into Telecommunications, Final Report*, 27 September 2000. Page 47.

124 *Ibid,* page 68.

125 *Ibid.*

126 Sapere (2015), *Economic Comment on UCLL and UBA Pricing Issues*, 11 August 2015, paragraph 104.

> price. Depending on the process used by the Commerce Commission, a pricing review using a total service long run incremental cost (TSLRIC) methodology could be available following the re-setting of prices.[127]

We interpret the final sentence in the above quotation as implying that, should the IPP price be unacceptable then an application for an FPP may be considered. In other words, the only assurance Chorus gives to the investor is the possibility of a different (higher or lower) price (from the initial price) following a review process. This does not support Sapere's view of the world in which apparently investors have homogeneous expectations that the regulator would not anticipate, and in order to guarantee future investment in the sector regulatory assurances are required to mitigate investment risk.

9.2 Is the Commission time inconsistent?

Sapere claims that the Commission is guilty of time inconsistency in its approach to price setting for UCLL and UBA services, and this regulatory opportunism will stain the Commission's future reputation to the detriment of the long-term benefit of end-users. Specifically Sapere argues that the Commission has changed its policies in response to Chorus' 'point in the investment cycle'. The policies identified by Sapere relate to the WACC and backdating. For example:

> In relation to estimating WACC, the Commission also identifies the stage of the investment cycle at which Chorus finds itself as one of the reasons to change from the approach it has used for many years of selecting a WACC above its midpoint estimate.[128]

Sapere suggests that, had Chorus been in an early stage of its UCLL / UBA investment, then the Commission would have applied an uplift to WACC. Thus Sapere concludes that the Commission is acting time inconsistently and this will affect investment incentives over the long-term.

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127 Telecom New Zealand (2011), *Share in two journeys*, 13 September 2011. Page 79.

128 Sapere (2015), *Economic Comment on UCLL and UBA Pricing Issues*, 11 August 2015, paragraph 92.

Sapere is incorrect in stating that the Commission has adopted a WACC above a midpoint estimate for many years. In fact during the first decade of this century for all of the Commission's Telecommunications Service Obligation (TSO) Determinations it adopted a mid-point estimate of the WACC[129]. Thus the Commission would be acting time inconsistently if it now changed its approach of using a mid-point to use other than a mid-point WACC estimate in regulating telecommunications services.

We presume that Sapere's statement concerning the Commission's policy on WACC uplift relates to regulation of other industries, and the outcome of the Commission's Input Methodologies workstream. If this is the case then Sapere should have explained why it believes cross-industry consistency is important, given that the Commission **is** being time consistent with respect to telecommunications regulation.

Sapere claims that 'the implications of governmental or regulatory time inconsistency are well established in the economic literature' and refers the reader to a 'seminal article' by Levy and Spiller from 1994[130]. This article considers 'potential for administrative expropriation or manipulation' by examining the interaction of political institutions and regulatory processes in the telecommunications sectors of Argentina, Chile, Jamaica, the Philippines and the United Kingdom.

The authors note:

> Our analysis may be especially relevant for the design of regulatory policy in developing, newly industrializing, and previously socialist countries, where lack of economic development may be related to a generalized lack of administrative restraints.[131]

Three mechanisms are identified for administrative restraint:

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129 For example, see Table 4 in Commerce Commission (2005), *Determination for TSO Instrument for Local Residential Service for period between 1 July 2002 and 30 June 2003*, 24 March 2005; see Table 3 in Commerce Commission (2007), *Final Determination for TSO Instrument for Local Residential Service for period between 1 July 2003 and 30 June 2004*, 23 March 2007; see Table 3 in Commerce Commission (2008), *Final Determination for TSO Instrument for Local Residential Telephone Service for period between 1 July 2004 and 30 June 2005*, 10 September 2008.

130 Levy and Spiller (1994), *The Institutional Foundations of Regulatory Commitment: A comparative analysis of telecommunications regulation*, Journal of Law, Economics, & Organization, Vol. 10, No. 2, October 1994.

131 *Ibid*, page 203.

- substantive restraints on regulatory discretion – either process regulation or specific rules
- restraints on changing the regulatory system – legislative or licensing
- judiciary institutions for enforcing substantive restraints and restraints on system changes.

The authors conclude that 'private utilities were aggressive investors'[132] whenever these three restraining mechanisms were in place.

It is difficult to see any implications of the Levy and Spiller paper relevant for the present context. In New Zealand we have had all three restraints operating for many years. In fact, arguably there are more restraints in New Zealand on regulatory discretion than in many other developed countries. For example, the Telecommunications Act in New Zealand includes legislated pricing principles, while in Australia the Australian Competition and Consumer Commission (ACCC) has the powers to draft the pricing principles that will apply to regulated services.

We also examined Sapere's other references but again found little (if any) relevance to the current New Zealand telecommunications context. Note that a number of Sapere's references relate to the implementation of monetary policy over time, which is the original context for the examination of time consistency issues. Below we briefly review the references that specifically address utilities:

- Spiller (2011)
- Ergas (2009)
- Levine, Stern and Trillas (2005).

Spiller (2011)

Spiller (2011)[133] discusses the implications of government opportunism and suggests that the solution lies in sound regulatory structures:

132 *Ibid*, page 239.

> Such institutional arrangements are nothing but the design of a regulatory framework. They will have to stipulate price setting and conflict resolution procedures (arbitration or judicial), investment policies, quality controls and so on and so forth, that are both credible, in the sense that the Government will not be able to by-pass them easily, and at the same time substantially limit the government discretionary interpretation of the same. In other words, regulatory procedures, if credible, must restrain the government from opportunistically expropriating the utilities' sunk investments. This, however, does not mean that the utility has to receive assurances of a rate of return nature, or that it has to receive exclusive licenses. In some countries, however, such assurances may be the only way to limit the government's discretionary powers.[134]

It is notable that the two examples of political expropriation provided by Spiller are from developing countries – Argentina and Bolivia.

Ergas (2009)

Sapere cites an Ergas (2009)[135] case study as evidence that regulatory opportunism 'can plausibly result in substantial welfare costs over time'[136]. The study considers whether full cost recovery is achieved using the tilted annuity approach to depreciation in TSLRIC modelling, as adopted by the ACCC in its regulated access pricing decisions from 1999 to 2007. Ergas identifies as problematical the periodic model updates that occurred when access disputes arose. With these updated determinations, model parameters were changed with the result, Ergas claims, of continued deferral of cost recovery. However, it is important to note that the ACCC did not change its method of estimating depreciation over this period. The issue that concerns Ergas relates more generally to the implementation of TSLRIC methodologies rather than the regulator opportunistically changing its approach over time.

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133 Spiller (2011), *Transaction cost regulation*, National Bureau of Economic Research Working Paper 16735, January 2011.

134 *Ibid*, section III.I.

135 Ergas, H. (2009), 'Time consistency and regulatory price setting: an Australian case study', *Review of Network Economics* 8 (2), June 2009.

136 Sapere (2015), *Economic Comment on UCLL and UBA Pricing Issues*, 11 August 2015, paragraph 86.

In another article Ergas proposes a prescriptive rules-based approach to regulation in Australia to constrain regulatory discretion[137]. Sapere also indicates that the introduction of 'policy rules that remove discretion' can address issues of time inconsistency[138].

As an aside we note that CEG endorses Sapere's arguments concerning time consistency[139]. However this would appear to contradict some of CEG's previous arguments, particularly in relation to its arguments that the Commission should change its approach to estimating key WACC parameters due to time-related circumstances[140].

Levine, Stern and Trillas (2005)

Sapere provides a quotation from Levine, Stern and Trillas (2005)[141] which purportedly cautions against time inconsistent behaviour. The original passage (incorrectly transcribed by Sapere) reads:

> Of course, infrastructure regulators – in developing as well as developed countries – need to balance their role in supporting investment with their role of protecting consumers against monopolistic exploitation. Capture is a threat in all environments. However, in many countries, the risks to ensuring that the majority of citizens fail to [*sic*] have access to such services more often that [*sic*] not comes from overprotection of current consumers relative to future consumers and investors.[142]

The wording of the final sentence of the passage is confusing, to the extent that we believe that it does not reflect what the authors were attempting to say. If we consider the full

137 Ergas (2009), 'Error and Design: Economics in (and some Economics of) the Australian Competition Tribunal', *Agenda*, Volume 16, Number 3, 2009.

138 Sapere (2015), *Economic Comment on UCLL and UBA Pricing Issues*, 11 August 2015, paragraph 83.

139 CEG (2015), *Response to the further draft determination*, August 2015. Section 6.

140 *Ibid*, see, for example, Section 2.2.5.

141 Levine, P., J. Stern and F. Trillas (2005), 'Utility price regulation and time inconsistency: comparisons and monetary policy', *Oxford Economic Papers* 57 (3), July 2005.

142 *Ibid*, page 471.

context of the paper then the authors' concern is ensuring that the majority of citizens in developing countries have access (not fail to have access) to telecommunications services.

> The focus of this emerging literature on developing country private investment in telecoms and similar industries is appropriate and corresponds to the concerns of this paper. There is no question that these countries have considerable unsatisfied demand and that they face major difficulties in inducing sufficient investment to meet the capacity needs – at least at an acceptable cost of capital. Hence, the role of the regulator is crucial in providing the credibility that will support the necessary investment flows.[143]

The conclusion of the study is that time-inconsistency issues may be addressed through a rules-based approach to regulation or delegation to an independent conservative agency with discretionary powers defined in primary legislation. Unlike Ergas, Levine, Stern and Trillas prefer the latter, provided there are appropriate safeguards in place.

> In public utilities regulation in OECD countries, it is common that the government establishes the policy to be followed. Primary legislation, among other provisions, usually prescribes that the regulator has to guarantee the financial viability of regulated firms. Then the regulator acts in a discretionary fashion to set a previously defined set of instruments using all available current information.
>
> In this sense, regulators such as the British utility regulators are goal-dependent, required to behave with a specific objective function, and therefore constitute an example of our 'as if' Rogoff-delegation.[144]

Conclusion

The logical outcome of Sapere's arguments is a recommendation to remove all discretion from the regulator. However Sapere has failed to prove that this is necessary in the New

143 *Ibid*, page 469.

144 *Ibid*, pages 467 to 468.

Zealand context since all of the empirical evidence provided in its references is either irrelevant or inappropriate in relation to our political and regulatory institutions.

Sapere points to two examples which purportedly illustrate the time-inconsistent behaviour of the Commission. In fact we have demonstrated that the Commission is behaving completely consistently with its previous practice in respect to its mid-point WACC assumption in telecommunications regulation. Sapere suggests that with in the absence of backdating the Commission is applying different pricing methods[145]. Again Sapere is incorrect – both the IPP and the FPP are TSLRIC based. IPP benchmarks were selected on the basis of comparable countries that have developed TSLRIC cost models.

Finally, if Sapere is in fact accusing the Commerce Commission of lacking independence with its decisions unduly or improperly influenced by political agents or other forms of regulatory capture then it should provide specific details.

9.3 The appropriate welfare standard

Sapere contends that the Commission is wrong in its conclusion that Section 18's reference to the long-term benefit of end-users is a direction to consider consumer welfare. As we stated at the Commission's April conference our view is that a consumer welfare standard is more appropriate than a total welfare standard in the present context. Like the Commission we find that a consumer welfare approach is more consistent with the overriding Part 4 purpose statement than a total welfare approach.

In principle TSLRIC promotes opportunities to generate producer surplus by virtue of its efficiency standard which works in the interests of both end-users and service providers. Under TSLRIC producer surplus will be generated if access providers supply services efficiently, and continue to seek to innovate in service provision.

Furthermore, given that the FPP costing standard includes 'a reasonable allocation of forward-looking common costs', it is logical to expect that Chorus will achieve a reasonable return on its sunk copper assets.

145 Sapere (2015), *Economic Comment on UCLL and UBA Pricing Issues*, 11 August 2015, paragraph 113.

Sapere claims:

> To consider the incentives for investors to invest and the risks they face requires the Commission to include producer surplus as it is expected producer surplus that provides the incentive to invest and reward for risk. To be effective such considerations need to extend to the regulation of any services that substitute in whole or in part for "new telecommunications services that involve significant capital investment and that offer capabilities not available from established services" to avoid undermining such investments.[146]

This implies that Sapere does not believe that the Commission's proposed WACC would provide Chorus with a reasonable rate of return on regulated copper assets. The best way to test this claim is to examine the empirical evidence. As we have previously noted[147] Network Strategies reviewed an independent analysis of Chorus' return on copper investment in the early stages of the Commission's price review. Vector had estimated the return that the Commission would determine, should Chorus' copper network be operating under price control as per Part 4 of the Commerce Act. Network Strategies conducted a peer review of Vector's model which was based on the Commission's Information Disclosure Schedule 2 ROI methodology.

> Vector calculates the Commission's initial pricing determinations would allow Chorus to extract 19 - 23% return on investment (ROI) from its copper network between 2014 and 2019. While it is important to ensure regulated suppliers are able to earn a reasonable return on their investment the Commission does not permit other regulated suppliers to earn returns of this size. The Commission applied a WACC of 8.77% (2009) for the electricity distribution default price-quality path (DPP) and 7.44% (2012) for gas pipeline services. The Commission also applies a WACC of 7.01 - 8% (for disclosure year 2014) in relation to Airports for information disclosure purposes.[148]

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146 Sapere (2015), *Economic Comment on UCLL and UBA Pricing Issues*, 11 August 2015, paragraph 58.

147 Network Strategies (2015), *Review of issues from UCLL and UBA submissions, Cross submission for the UCLL and UBA Draft Determination*, 20 March 2015. See section 6.3.

148 Vector (2014), *Submission to the Commerce Commission on the Scoping and Issues Discussion Paper for UCLL TSLRIC*, 14 February 2014.

This analysis does not support Sapere's contention that Chorus is being inadequately rewarded for its copper investment, even at the IPP price.

9.4 Summary

Sapere recommends that the Commission reconsiders its draft decisions on backdating and WACC uplift on the basis that the Commission should:

- adopt a time-consistent approach and disregard Chorus' current stage in its investment cycle
- place more weight on expected producer surplus from regulated copper services
- provide effective assurance to investors that a TSLRIC price has been applied.

We have illustrated that Sapere's examples of the Commission's alleged time inconsistency are both incorrect while information highlighted by Sapere from the literature is inappropriate for the New Zealand context. In fact it is very difficult to reconcile Sapere's characterisation of the Commission as 'acting opportunistically' with the legislative framework within which the Commission operates. It is this legislative framework that also provides surety to investors that a system is in place that guarantees a TSLRIC price will be applied. No further assurance is required. The environment within which Chorus offers its regulated services also continues to provide a return on capital that is greater than most other regulated services in New Zealand. No additional regard to producer surplus is required. As such the Commission should in these proceedings continue to focus primarily on the promotion of consumer welfare, as required by Section 18.

10 Conclusions and recommendations

In its assessment of any further potential changes to its model the Commission must be guided by the characteristics of an efficient network that the HEO would deploy. As such Chorus' recommendations in respect to both FWA and aerial deployment are completely inappropriate for the HEO. At the same time Analysys Mason's arguments support Network Strategies' proposed approach for FWA implementation.

The reports by Chorus' consultants in relation to WACC, price trends and backdating provide no substantive evidence that the Commission should alter its proposed approach. Finally, the Analysys Mason trenching cost analysis is fundamentally flawed and therefore should be disregarded by the Commission.

FWA footprint does not correspond with efficient deployment

It is evident from Analysys Mason's map of FWA locations in the Commission's model that the selection of FWA customers based on distance from the exchange results in an unrealistic spread of FWA customers throughout the country. Moreover the map supports our earlier observation that this approach leads to inefficient deployment from a network planning perspective.

In its December draft the Commission admitted that in using the RBI footprint as the boundary for the FWA footprint it had taken 'a conservative approach to the extent of FWA in the modelled network'[149]. This was justified on the grounds that to do otherwise may lead to inconsistencies with observed network deployment in

149 Commerce Commission (2014), *Draft pricing review determination for Chorus' unbundled copper local loop service*, 2 December 2014. See paragraph 285.

New Zealand. In the July draft FWA customer numbers have been further reduced and scattered throughout the country, including within unbundled urban areas.

The Commission's model must satisfy TSLRIC principles and consequently FWA should be deployed in areas where it is feasible and economical to do so rather than restricting it by distance and underutilising its coverage and capacity. An HEO is most likely to deploy FWA for customers in Zones 3 and 4 areas where there is no current unbundling and future unbundling is unlikely. These are the areas in which FWA is currently being deployed in New Zealand. In its recent advice to the Finnish regulator Analysys Mason recommended that FWA be considered for areas in which the business case for unbundling is weak.

Analysys Mason's FWA modelling recommendations are inconsistent with TSLRIC efficiency principles

Analysys Mason's recommended increase in the number of base stations to serve FWA end-users should not be implemented in the Commission's model as this would deliver unrealistic costs for an HEO. In addition the analysis underlying Analysys Mason's recommendations are flawed with an incorrect approach to radioplanning and inappropriate assumptions for LTE in the 700MHz band. The inadequacy of the Analysys Mason analysis simply highlights the underlying issue in the Commission's modelling which is that it applies an incorrect approach to determine which customers are served by FWA.

The Commission must use the appropriate number of customers and areas to rectify the existing unrealistic and inefficient FWA deployment.

GIS analysis indicates that anomalies remain in the Commission's model

Based on GIS analysis we recommend that the Commission addresses:

- the inconsistency of the distribution of road sections served by FWA with the efficient deployment of this technology, and the violation of the Commission's principles in serving unbundled customers with FWA
- the incorrect mapping of buildings to road segments
- uneconomic technology choice for locations currently served with MAR technology.

Analysys Mason's statistical trenching cost analysis is unsound

The nature of the flaws that we identified with Analysys Mason's input data used to estimate parameter values is such that any results from the statistical analysis should be ignored. These results therefore cannot be used to assess how the Commission's trenching costs compare with Chorus' real-life costs, unless the underlying data issues are addressed.

The Commission should disregard Chorus' advice on aerial issues as it is inappropriate for an HEO's deployment

We have identified a number of problems with Chorus' data and analysis relating to aerial deployment, in addition to the issue of its irrelevance in the context of an HEO deploying a nationwide network. As such we recommend that the Commission:

- disregards Chorus' comments on the extent of aerial deployment and continues to rely on EDB and other LFC information as to the extent of aerial deployment that would be possible for an HEO
- does not use the pole lease costs and data provided by Chorus because they are misleading, biased and inaccurate
- considers data for pole lease costs from other LFCs as the basis for efficient costs for an HEO deploying a nationwide network
- adopts a forward-looking approach in respect to the consent costs that would apply to the efficient HEO

- reviews its calculations for percentages of aerial deployment and lead-ins to correct the errors explained in our previous report.

The Commission should not use CEG's price indices

CEG's price indices are inappropriate for use as price trends:

- the key TSLRIC requirement that costs are forward-looking is violated by CEG's use of a mix of historical data and forecasts
- the weightings used are not supported by evidence that suggests they reflect the mix of costs of an efficient operator
- it is unclear how CEG constructed its historical data series, given changes in classifications used by Statistics New Zealand.

The Commission should not change its overall approach to WACC in response to short-term considerations

Our review of the material provided by CEG has found that there is no credible evidence that the Commission's approach is out of step with international regulatory practice, while the approach is consistent with our local legislative context, existing practices and the Input Methodologies.

We agree that consistency between the assumed asset beta, leverage and credit rating is important. To this end we have made a number of recommendations in our August report that would strengthen the Commission's estimates.

Evidence in submissions does not contradict the continued use of a midpoint WACC

Neither Sapere nor CEG address the fundamental flaws of Oxera's analysis that we previously identified:

- the absence of evidence of a causal relationship between a WACC uplift and the acceleration of investment in disruptive technologies
- a failure to demonstrate that New Zealand service providers are technology laggards
- the lack of clarity concerning the next disruptive technology that will have services subject to regulation and is likely to offer

benefits on a similar scale as the introduction of high-speed broadband.

The majority view on backdating is appropriate for the context of these proceedings

Sapere's examples of the Commission's alleged time inconsistency are both incorrect while information highlighted by Sapere from the literature is inappropriate for the New Zealand context.

In fact it is very difficult to reconcile Sapere's characterisation of the Commission as 'acting opportunistically' with the legislative framework within which the Commission operates. It is this legislative framework that also provides surety to investors that a system is in place that guarantees a TSLRIC price will be applied. No further assurance is required. The environment within which Chorus offers its regulated services also continues to provide a return on capital that is greater than most other regulated services in New Zealand. No additional regard to producer surplus is required. As such the Commission should in these proceedings continue to focus primarily on the promotion of consumer welfare, as required by Section 18.