Before the Independent Commissioners

In the matter of	the Resource Management Act 1991
And	
In the matter of	the Proposed Canterbury Land and Water Regional Plan

Statement of Evidence of Richard Spencer English

Dated: 4 February 2013

Lane Neave
LAWYERS
137 Victoria Street
PO Box 13149
Christchurch
Solicitor Acting: David Caldwell/Jane Walsh
Phone: 03 379 3720
Fax: 03 379 8370
Email: david.caldwell@laneneave.co.nz/jane.walsh@laneneave.co.nz

Introduction

1. My full name is Richard Spencer English.

2. I hold a Bachelor of Science (Hons, Civil Engineering) degree from Birmingham University, England. I am a Member of the Institution of Professional Engineers New Zealand and a Member of the Institution of Civil Engineers (London).

3. I am the Principal of Twelfth Knight Consulting, Christchurch. I have over 40 years of general civil engineering experience in both the United Kingdom and New Zealand. I have worked for central and local government, contractors and consultants and more latterly as a sole practitioner consultant.

4. Over the last 20 years, I have been involved in the quarrying and roading industries and in the management and reuse of construction and demolition materials in the Canterbury area. I previously managed Halswell Quarry, and was responsible for the initial phases of its restoration process. In my capacity as General Manager for CanRoad Construction Ltd – the forerunner of City Care Ltd – I managed a variety of projects and processes where aggregates were a major component of the company's day to day activities including roading construction and surfacing contracts, an asphalt plant and a roading materials testing facility.

5. As a result of my industry experience I am keenly aware of the importance of aggregates to not only the construction industry but also to society as a whole.

6. Of specific relevance to my evidence; over the last ten years I have been responsible for the compilation of reports on local aggregate resources encompassing demand forecasting and a variety of resource management issues for a number of clients including Environment Canterbury, Christchurch City and Selwyn District Councils and the Urban Development Strategy Implementation Management Group (UDSIMG). With respect to demand forecasting in particular, I have developed new methodologies that enable forecasting to be undertaken down to sub-regional levels.

7. My evidence in relation to water is not presented as an expert in water quantity. Rather it addresses the need for water, use of water, and the value of water to the industry. I have had both a direct and indirect involvement with the local aquifers for over twenty five years and have approximately ten years of local water supply experience including responsibility for the development and maintenance of local water supply well fields.

8. I have been responsible for a study of the impacts of irrigation abstractions on water supplies in the north west of Christchurch city and the subsequent introduction of a system of upstream trigger wells. I have been involved in studies relating to both actual and potential contamination of local aquifers and the potential impacts of aquifer mounding on local aggregate resources consequent on the Central Plains Water Enhancement scheme. Over the last eight years I have conducted a personal investigation into the inter-relationships between the hydrology of the Waimakariri River and the Avon River and its tributaries.

9. Throughout my career I have always been mindful of the benefits associated with the efficient use of resources and as such I have been involved in the recycling of construction and demolition materials in particular. I was the main researcher for, developer and author of the Christchurch Cleanfill Bylaw, which although primarily directed towards resource recovery, has significantly reduced the potential for groundwater contamination from quarry based cleanfilling activities within the Christchurch area.

10. Whilst I have been asked to present this evidence primarily on behalf of Fulton Hogan Ltd, and others in the aggregates industry, my views are completely independent. They are based entirely on my experience in, and my association with, the aggregate industry over many years.

Code of Conduct for Expert Witnesses

11. I confirm that I have read and am familiar with the Environment Court Consolidated Practice Note (2011) – "Expert Witness Code of Conduct". I agree to comply with that Code. Other than where I have stated that I am relying on the evidence of another person, I confirm that my evidence is within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions I might express.

Scope of Evidence

12. My evidence provides a background description of the uses and demands for aggregates, the resources required to satisfy these demands and comments on the more major constraints that impact on access to these resources. In particular my evidence covers:

    (a) The economic importance of aggregates, their uses and the general sources of these materials.

(b) Both the historical and future demand for aggregates in Canterbury.

(c) The resources potentially available locally to supply these demands.

(d) The major factors that impact on the ability to economically access these materials both in the short, medium and longer terms.

Evidence Summary

13. Aggregates are a vital, if under recognised component of everyday life. Without them there would be none of the infrastructure on which modern society relies.

14. The Canterbury aggregate industry produces in the order of 5 to 6 million tonnes of materials per year with a total annual gate value of approximately $40-$50 million.

15. High quality materials in Canterbury have been historically and are currently readily available close to the main sources of demand. This has resulted in aggregate prices in Canterbury being significantly cheaper than in many other areas of New Zealand. These factors have in turn provided an equally significant economic benefit and advantage to the Region.

16. The demand for aggregates can fluctuate markedly over the short to medium term however in the longer term there is a clear correlation between demand and a combination of population growth and economic activity.

17. Whilst a study of Canterbury per se has not been completed, a study of the combined areas of Christchurch City, Selwyn and Waimakariri Districts in 2009 concluded that annual demand within that area would increase over twofold by 2041[(4)].

18. The study area generates approximately two thirds of the total Canterbury demand. It is likely therefore that, given similar circumstances, the increase in demand within Canterbury as a whole will be of the same order.

19. The recent Darfield and Christchurch earthquakes have not had a marked impact on overall longer term total demand although they have created and will continue to increase annual demand in the short term.

20. It is likely that the presently available resources will be exhausted in the short to medium term.

21. The size of resource required to satisfy demands in the medium to longer term will be substantial.

22. Transportation is often the single most important factor in determining the delivered price of aggregates – it is not unusual for freight costs from a quarry to market to exceed the gate sale price of the product. Transportation costs are therefore a crucial element in determining the level of economic benefits accruing to the Region as a whole. Hence it is critical that new quarries are located as close as is possible to their main sources of demand. (For example in the case of Christchurch, immediately to the west of the urban area.)

23. The aggregate resources required are physically available but access to them may be constrained by their remoteness from demand and a lack of appropriate importance being placed on them by the existing planning framework and / or by the imposition of plan rules that do not equitably balance economic and environmental outcomes.

24. Of particular concern is the ability to access the relatively small quantities of water required to enable production of aggregates to continue. It is vital that access to water is maintained to ensure that new quarries may be developed to replace existing resources as they are exhausted. A system of water allocations "reserved" for quarrying purposes may be required throughout Canterbury in order that future demands for aggregates are economically met to the benefit of the Region as a whole.

25. In my opinion efforts should be made to ensure that these potential constraints are reduced as far as is feasible in order that the Region may continue to enjoy its existing economic advantages with respect to aggregates.

Aggregate[1] Useage and Sources

26. A strong economy and a high quality of life are literally built on a foundation of aggregates. Aggregates touch our lives everyday, from the home to the workplace. We drive, stand and walk on aggregates yet their importance to society is almost universally under estimated.

27. Without aggregates we would not have roads, railways, airports, schools, hospitals and other public buildings, clean water supplies, electrical power and a myriad of every day items such as glass and crockery.

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[1] For the purposes of this evidence, unless otherwise noted, the definition of "aggregates" includes all coarse and fine materials, (i.e. gravels, sands, silts and clays) sourced from both alluvial and river deposits.
"Rock" sourced materials produced solely for rip-rap, agricultural and / or industrial purposes are not included.

28. Without aggregates we would neither be able to maintain our existing vital infrastructural facilities nor would the built environment be able to expand enabling economic growth both regionally and nationally.

29. I have listed below some of the more common uses for aggregates in Canterbury:

    (a) Road, footpath, car park and driveway construction foundation materials.

    (b) Asphalt and chip seal surfacing materials.

    (c) Foundation materials for a wide variety of buildings.

    (d) Concrete – for industrial, commercial, public and residential building construction, bridges, tunnels, port structures and dams.

    (e) Clay and concrete pipe and culvert manufacture.

    (f) Bedding and trench restoration materials for piping and cabling.

    (g) Railway ballast.

    (h) Airport runway foundation and surfacing materials.

    (i) Water purification and sewerage treatment.

    (j) General filling, embankments and retaining wall construction.

    (k) Field and other drainage systems.

    (l) Bricks, tiles and paving manufacture.

30. Aggregates are sourced from either bed rock or gravel deposits, the latter of which may be found on land, in rivers or in a marine environment. (Marine deposits are presently not utilised in Canterbury.)

31. Aggregate production derived from 'rock' quarries, which are located on Banks Peninsula and in the Canterbury foothills, is relatively small. I have therefore omitted their consideration from my evidence – although provision should be made for them within planning documents as these quarries generally supply specialist industrial and engineering products, such as river bank protection boulders, that cannot be sourced from alluvial deposits.

32. The extent of the land based aggregate resource on the Canterbury Plains is such that suitable material for aggregate production may in theory be quarried almost anywhere. I will describe examples of the distribution of the most suitable deposits in greater detail later in my evidence.

33. The method of land based aggregate extraction generally consists of layer mining utilising excavators or front end loaders (i.e. without the use of explosives) to a point above or, in some past cases, to the level of the ground water depending on the physical and planning constraints at the time the quarry was established. Because of the relatively high water table on the Canterbury Plains close to the coast, and in particular close to Christchurch city, the excavations tend to be shallow and more latterly, extensive in area.

34. In the case of river sourced aggregates, haul roads, and on occasions river training works, are required to enable access to the river gravels Aggregate extraction from the river's fairway utilises excavators and front end loaders.

35. It should be noted that the extraction of gravel from rivers frequently performs an important role in flood hazard management thereby alleviating what would otherwise be a substantial cost to the community.

36. The ready availability of aggregate resources has historically resulted in a large number of small quarries being scattered across the Region in order to minimise transport distances and hence costs. More recent practice in the Christchurch City Council area, where the bulk of the Region's demand for aggregates originates and the largest quarries are located, has been to set large, but lesser numbers of areas aside which are zoned for "Quarry" purposes. With one specific localised exception, quarry zones do not exist elsewhere in Canterbury.

37. Quarry zones originated locally in the mid 1980's with the purpose, from a planning standpoint, of regularising the then existing quarries that had historically become established in a somewhat uncoordinated and generally unregulated fashion. (i.e. the zones were not designated primarily as areas that had been identified as containing suitable resources. Rather they were constructed around existing quarry operations.) Approximately one third of the original resource remains within the combined quarry zones.

Regional Aggregate Economics

38. Canterbury is effectively self sufficient with respect to aggregates, there being little or no export from or import of aggregates into the area, and hence production equates to demand.

39. The 'gate value' of aggregates produced in the Region (i.e. the value of the aggregates as they leave the quarry) is approximately $40 to $50 million per year. (Nationally the equivalent figure stands at approximately $400 million per annum.)

40. The aggregates industry is highly competitive and operates on tight margins which, although positive for the consumer, creates situations where the economic viability of a potential quarry site is easily eroded to the point where it is not economically feasible to access the resource no matter its quality or volume.

41. Transportation is often the single most important factor in determining the delivered price of aggregates – it is not unusual for freight costs from a quarry to market to exceed the gate sale price of the product. Transportation costs are therefore a crucial element in determining not only a quarry's viability but also the level of economic benefits accruing to the Region as a whole. Hence it is critical that quarries are located as close as is possible to their main sources of demand.

42. The historic, ready availability of high quality materials close to the main sources of demand (e.g. the quarries located to the immediate west of the Christchurch urban area) has resulted in delivered aggregate prices in Canterbury being significantly cheaper than in many other areas of New Zealand. This provides an economic advantage for the Region which will continue to be realised provided the overall planning environment is conducive to the provision of access to the most suitable resources.

43. In order to illustrate the importance of the need for supplies to be close to demand it is useful to consider the situation in both Auckland and Christchurch.

44. The Auckland region already has to import some of its requirements from the Northland and Waikato regions (i.e. over distances of 100km) – even the possibility of importing materials from as far a field as the South Island has been mooted such is the size of the predicted shortage in Auckland.

45. In comparison, the average transportation distance in the Christchurch area, which dominates the Region's demand for aggregates, is of the order of 15km. Given that the industry's "rule of thumb" is that the delivered price for aggregates doubles for every

30km the material is transported it is easy to envisage the economic advantage to the Region of both its self sufficiency and the general proximity of supply to demand.

46. To further illustrate the economics of 'distance' it is worth considering the local situation where presently, as noted above, all materials are sourced from land based quarries and rivers within a 15 km radius of the City's centre. If, as a result of planning constraints, new quarries need to be developed at say a 30 km radius from the City, which is at least a possibility under present circumstances, then the additional cost to Christchurch alone over the next 30 years - a horizon specified by local territorial planning documents - would be at least $500 million even without allowance for the additional infrastructural and environmental costs that would be incurred.

47. It is clear that even relatively small increases in transportation distances can have dramatic economic impacts. Although significant quantities of suitable materials may theoretically be available in Canterbury their location may therefore result in only a small proportion of these resources ever being economically viable for the Region's use.

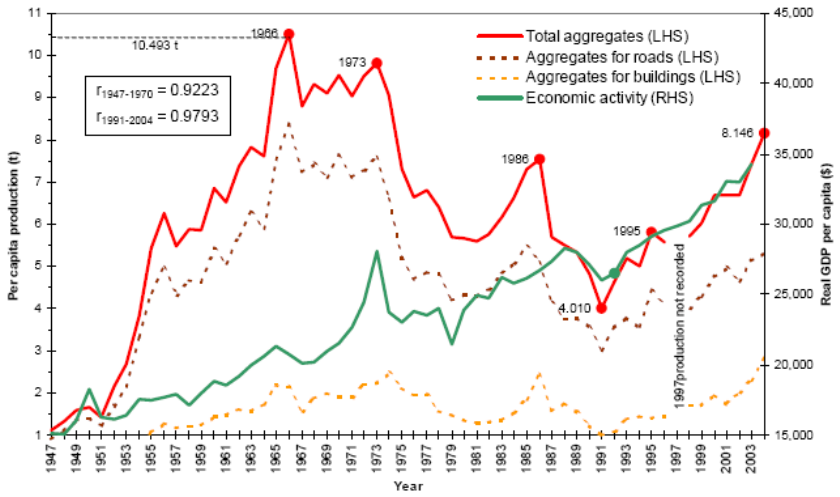
48. If steps are not taken to ensure that long term access to suitable resources close to areas generating major demands is possible (e.g. the urban areas of Christchurch) then transport costs - and hence the overall costs of aggregates incorporated into projects - could rise significantly to the detriment of the Region's economy.

The Demand for Aggregates

49. The demand for aggregates within New Zealand is dominated by construction and maintenance activities in the roading and building sectors, with the former being the significantly larger of the two. The approximate split nationally is 65% roading, 25% building and 10% filling. The average demand per head of population varies between rural areas, where building activity is low but road construction and maintenance expenditure may be relatively high on a per head basis, and urban areas where demands generated by roading and building activities are more evenly split.

50. Short to medium term demand is often subject to wide fluctuations. The following graph, taken from the report by O' Brien[2], illustrates the changes in national production, on a tonnes per head basis, over the period 1947 to 2004.

[2] & [3] The reasons for these fluctuations are discussed in depth in the paper by J. O'Brien – "Planning for Growth. The Determinants of Aggregates Demand in New Zealand 2006" and the Environment Canterbury "Regional Gravel Management Report" – Report No.R06/1 January 2006.

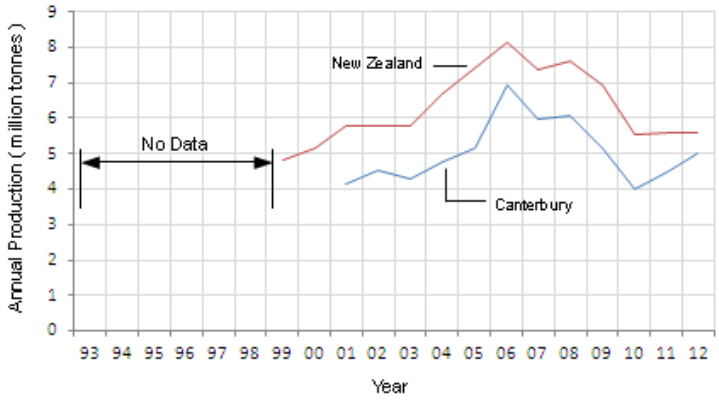


Graph 1: Annual Aggregate Production (tonnes per head) and Real GDP per head ($)

51. Yearly demand is influenced by a range of factors the most dominant of which are population changes, economic activity and government and local authority budgetary priorities[3].

52. For example, the high growth rates in production in the period from the 1950s through to the 1970s illustrates the impacts of the major post war road construction and infrastructural projects. Once this influence is removed it can be seen that the underlying growth in demand per head generally correlates well with growth in economic activity measured in real GDP per head.

53. The following graph illustrates the growth in production / demand in Canterbury over the last ten years.



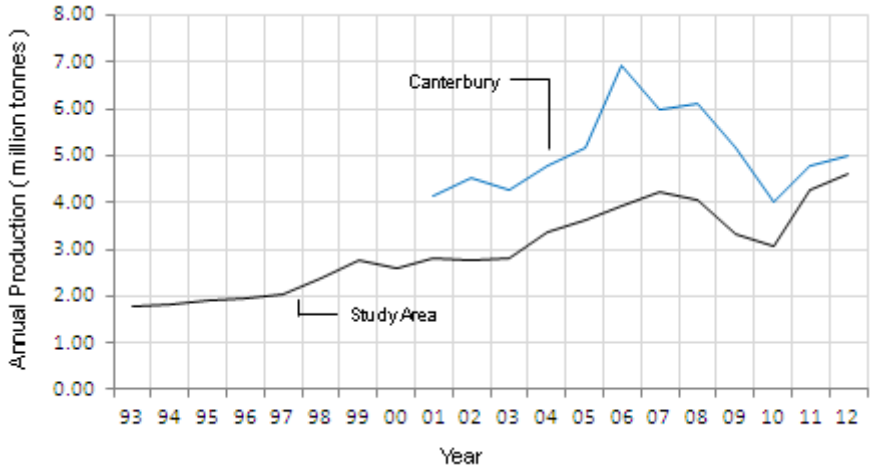
(Note: New Zealand data scaled by factor of 5 for comparison purposes. Base data source: NZ Ministry of Economic Development - Annual Mining Production Statistics(3))

Graph 2: Annual Aggregate Production (tonnes) for New Zealand and Canterbury[3]

54. For context it is worth noting that if the total annual aggregate production from the Canterbury area were transported to Christchurch it would fill the entire Cathedral Square to a depth of more than 100m every year. Aggregate consumption in Canterbury is approximately equivalent to 10 tonnes (or one truck load) per person per year.

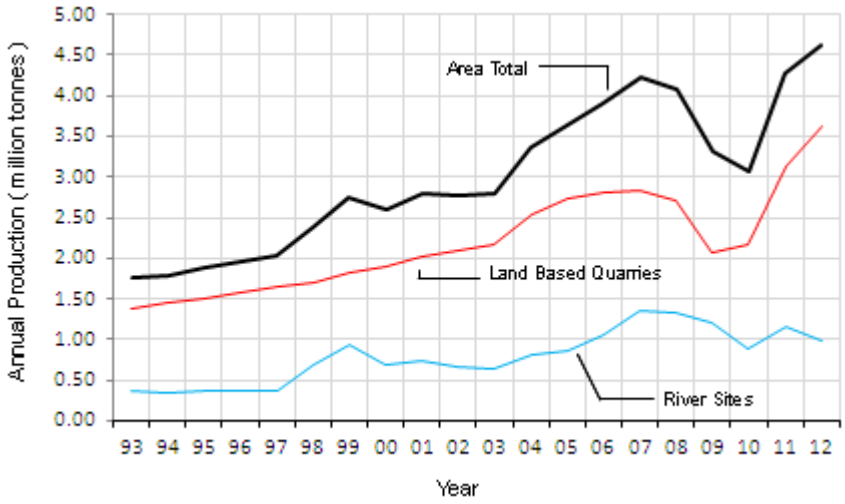
55. To my knowledge an in depth study of the demands and the resources available to fulfill them has not been undertaken for Canterbury as a whole. However a study undertaken for the Urban Development Strategy Implementation Management Group (UDSIMG) in 2009[4] serves to illustrate the broad issues common to both Canterbury and the UDSIMG "study" area.

56. Statistics for the combined areas of Christchurch City (CCC), Selwyn District (SDC) and Waimakariri District (WDC) Councils extend back to 1992. These demands are illustrated below.



Graph 3: Annual Aggregate Production (tonnes) for Canterbury & CCC/SDC/WDC areas.

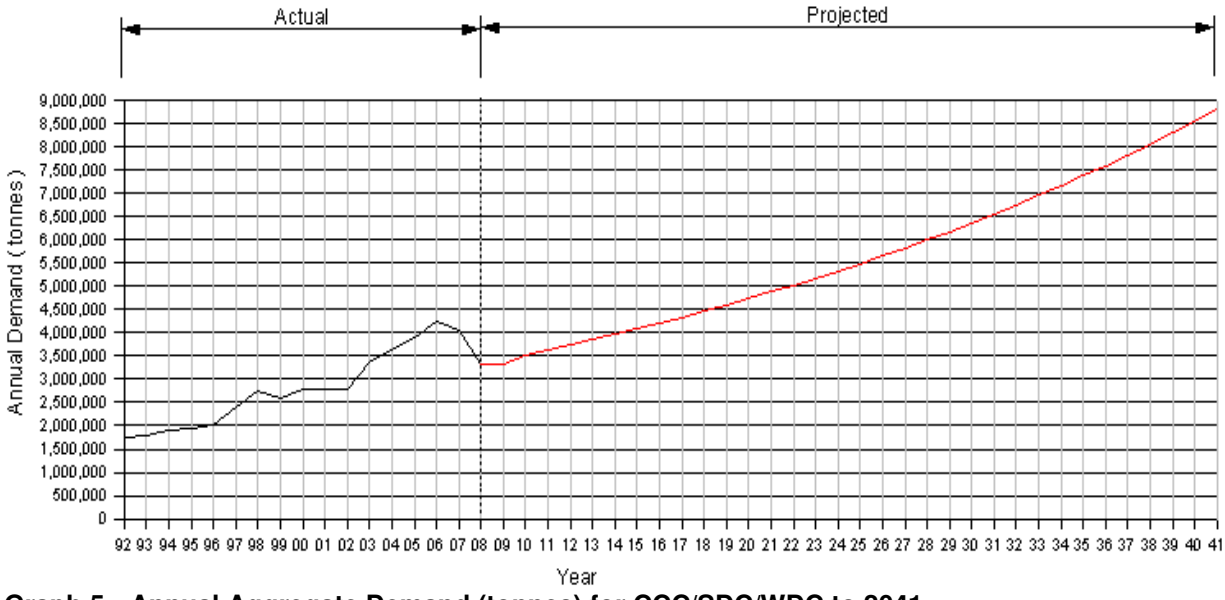
57. A comparison between land based production and river sourced material for the study area shows that the proportion of the total being sourced from the rivers has increased over the same timescale (i.e. from approximately 20% of the total in 1992 to approximately 25% in 2011 – peaking at over 35% in 2008).



Graph 4: Annual CCC/SDC/WDC area Land based, River Sourced and Total Aggregate Production (million tonnes per annum)

58. Although river based production has generally been increasing, I would suggest that this is more a reflection of the increasing pressures facing existing consented land based resources rather than its desirability from a quarrying stand point. Issues with respect to material gradings, diminishing supplies of historic deposits, unreliable annual replenishment rates, access, transportation, flooding, protection of environmentally sensitive areas and vandalism all serve to reduce the economic desirability of river based extraction.

59. Forecasts were made in 2009 (i.e. pre-earthquakes) of possible future increases in demand for the CCC/SDC/WDC area through to 2041[4]. This forecast is illustrated below:



Graph 5: Annual Aggregate Demand (tonnes) for CCC/SDC/WDC to 2041

60. It should be noted that this projection does not purport to represent demand on an individual annual basis but rather represents both the predicted general trend and the overall total quantities of aggregates required over the timescale of the forecast.

61. The following table details the projected demands, existing resources and the additional resources required to satisfy these demands in the area studied.

Area	Existing Resource* (tonnes)	Total Demand (tonnes)	Additional Reserves Required* (tonnes)
		2009 - 2041	2009 - 2041
Combined CCC/SDC/WDC	75,000,000 + 700,000 p.a. from rivers.	200,000,000	100,000,000

(All figures rounded)

Table 1: Consented Resources, Demands and Additional Resource Requirements at 2009

62. Existing resources include estimates of the quantities available from the area's rivers both on a one off basis to remove those areas presently above minimum design bed levels plus those materials carried down the rivers on an annual basis. Generally river extraction is keeping pace with gravel deposition rates in the areas where extraction is allowed, so, apart from some limited areas of previous aggradation, there is little opportunity to expand river extraction in the future.

63. The UDSIMG report estimated that the then presently zoned and consented resources would be exhausted by approximately 2024.

64. As noted earlier in my evidence, the UDSIMG study area generates approximately two thirds of the total Canterbury demand. It is likely therefore that, given similar circumstances, the increase in demand for the wider Canterbury area will be equally substantial.

65. It should be noted that subsequent to the UDSIMG report being compiled and the "exhaustion" date estimate being made:

(a) One new quarry has become operational in the area and one is about to begin operation, although both are relatively small.

(b) One medium sized new quarry, located in the McLeans Island area of Christchurch city, is expected to begin production in 2013 (neither this quarry nor the two mentioned above are within the existing CCC quarry zones).

(c) One large quarry in the vicinity of Burnham has applied directly to the Environment Court for resource consent. (An interim decision has recently been released.)

(d) The Darfield and Christchurch earthquakes have occurred.

66. A "broad brush" study of the combined effect of these changes was undertaken in mid 2012 the details of which I will discuss later. However in the context of this hearing the actual exhaustion date is not critical, rather it is the ability to access further resources not only immediately after the exhaustion of presently consented reserves but also in the long term.

Efficiency of Use

67. There is a possibility that a component of local aggregate demand is driven by the relative cheapness of materials in the area. (Statistical data suggests that the aggregate per head consumption rate is greater than would generally be expected.) Given that transport is a major component of aggregate pricing, and that it is likely that new extraction sites will be further from demand than is presently the case, it is almost inevitable that aggregate prices will rise at a rate greater than general inflation.

68. It is not known how price sensitive the market may be to these increases but it is possible that it may drive an increase in efficiency of use. For example newer construction methodologies, which utilise fewer aggregate resources, but which are presently not, or are only marginally cost competitive with traditional methods, may become viable in the face of rising aggregate prices.

69. Increases in both public and industry awareness of environmental and sustainability issues in general may also drive efforts to increase the efficiency of aggregate usage. The longer term UDSIMG projections have included a small allowance for these possibilities eventuating.

Earthquake Generated Demands

70. A series of large earthquakes centred in the mid Canterbury area, beginning in September 2010, have significantly impacted on the local economy and built environment.

71. A portion of the demand postulated in the pre-earthquake UDSIMG forecast will be delayed depending on both the short and medium term impacts on the earlier assumed population growth rates for the area and on local authority budgets for previously

planned infrastructure works. It is anticipated that these effects may to an extent counter and / or impact on the timing of the additional, originally un-forecasted demands consequent on the earthquakes.

72. The demand generated by reconstruction of the commercial and industrial sector will depend on not only the numbers and sizes of buildings ultimately reconstructed but also on the mix of construction materials utilised. (e.g. There may be a greater use of structural steel rather than concrete.) The timing of this activity is uncertain but the majority will possibly occur over a ten year time frame.

73. The Canterbury Earthquake Recovering Authority (CERA) assumed, as at March 2012, that approximately 12,500 houses would need to be rebuilt or would require substantial repairs. In addition CERA assumed that all replacement "red zone" houses would be built on new sub-divisions constructed post the earthquakes. This is possibly a conservative estimate as it makes no allowance for those sections that already existed prior to the earthquakes or for those families who may choose to move out of the region permanently. The majority of this demand is anticipated to occur over the next four or five years.

74. Under the circumstances it is difficult to forecast a precise figure for the impact of the earthquakes on demand, however an investigation and report [(5)] completed for the Christchurch Quarry Owners Group (CQOG) in August 2012 estimated the total, unadjusted, earthquake generated demand from all sectors to be of the order of 8.5 million tonnes**.**

75. However a proportion of this demand, as noted above, at least in the short to medium term, is not "additional" but rather a "substitution". The effective demand from a resource standpoint was therefore considered to be of the order of an additional 5 million tonnes**.** The total study area demand to 2026 with due allowance for the impacts of the earthquakes is now estimated to be 90 million tonnes (c.f. UDSIMG's pre-earthquake 2012 to 2026 estimated equivalent of 85 million tonnes.)

76. Although the estimated earthquake generated demand is large in absolute number terms, it is equivalent to less than two years of local pre-earthquake aggregate production. It is likely therefore that this demand will not have a marked impact in the context of the longer term projections. (i.e. The 5 million tonnes is small in comparison to the pre-earthquake forecast overall total demand between 2009 and 2041 of 200 million tonnes.) The earthquakes may however bring forward some demand, whilst suppressing others.

77. The following Table summarises the revised forecasted demands, includes allowance for the changes in consented resources that have occurred post the publication of the UDSIMG report and notes the additional resources that will be required to be consented to fulfil demands to 2026 and 2041 in the UDSIMG study area alone. It is estimated that the presently consented resources will be exhausted by approximately 2025.

	Consented Resource (tonnes)	Total Demand (tonnes)*		Additional Resources Required (tonnes)	
		2012 - 2026	2012 - 2041	2012 - 2026	2012 - 2041
TOTALS	80,000,000 + 700,000 pa	90,000,000 (85,000,000)	200,000,000 (200,000,000)	5,000,000 (say)	100,000,000

*All figures rounded. Figures in brackets taken from 2009 UDSIMG report data for equivalent period.

Table 2: Existing Consented Resources, Demands and Additional Resource Requirements

Resources Available to Fulfil Demand in UDSIMG Study Area

78. The central Canterbury Plains consists mainly of glacial outwash gravels derived from the Waimakariri and Rakaia Rivers. In general fluvial gravels are well sorted and therefore provide the best potential source for high quality aggregates, whilst glacial gravels are less so and contain more silt and clay.

79. In previous recent interglacial periods the rivers probably ran in very similar locations to their present positions. Incision of the major rivers during these periods effectively precluded lateral reworking or deposition of gravels over large areas west and south of Banks Peninsula (i.e. reworking/cleaning of gravels is likely to have occurred only in or immediately adjacent to the existing rivers).

80. The greywacke parent rock, which constitutes the bulk of the source of the shingle materials in the central Canterbury Plains area, is of a high quality. However, as noted, given the geological history of the area, deposits may be intermixed with varying quantities of unsuitable clays and/or silts. The increasing content of these latter materials is also generally accompanied by increasing natural moisture contents, both factors which slow crushing and screening rates and hence increase costs. In some cases it is not possible to produce aggregates of sufficient quality to readily meet customer specifications. Experience has suggested that these

problems appear to increase with increasing depth and accordingly most pits have historically only been excavated to relatively shallow depths.

81. It should also be noted that deposits in some areas may have a natural grading that is not conducive to the manufacture of certain types of aggregates.

82. At approximately 6000 years ago sea levels were 1-2m higher than present and a cover of fine grained sands, silts and peats accumulated over most of the near coastal area now occupied by the urban areas of Christchurch, Kaiapoi, and the areas further south bordering Lake Ellesmere.

83. In most places this fine material has covered the older pre-glacial river sediments, but the Waimakariri and other rivers have flooded periodically so there are some narrow local corridors of gravel that inter-finger with the fine coastal sediment. Most of the early gravel pits in Christchurch were located in these narrow fingers of gravel.

84. A study[4] covering the central Canterbury Plains area undertaken for the UDSIMG defined two categories of areas where suitable deposits were most likely to be found given a constraint of a minimum of 6m depth to groundwater.*

85. These areas are illustrated on the following map of central Canterbury.

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*The specified 6m minimum results from combination of two factors:
- Excavation depths to a maximum of less than 5m are considered to be generally uneconomic.
- Excavation within less than 1m of groundwater fails to meet local best practice requirements.

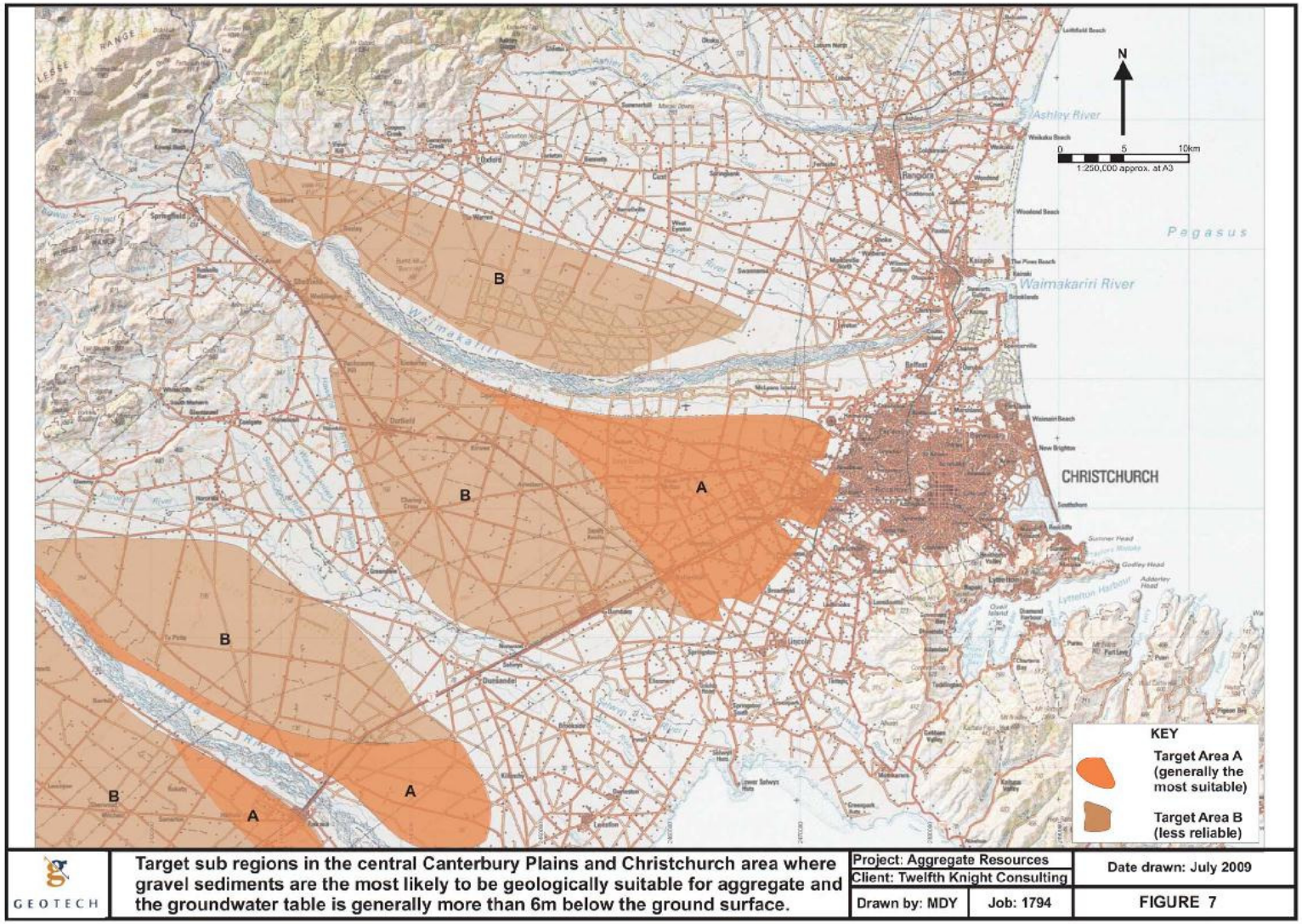

Figure1: Potential land based aggregate resource areas in the central Canterbury Plains

86. Area Type A contains the post glacial fan sediments of the Waimakariri River near Christchurch and the Rakaia River near SH1, that are elevated more than 6m above the maximum recorded groundwater levels. These areas encompass those most likely to contain reserves of good to high quality, well sorted aggregates.

87. Area B defines glacial era sediment that is elevated more than 6m above the maximum recorded groundwater level. Aggregates from this area will more often contain a higher silt and/or clay content and the overburden is likely to be generally thicker. However experience to date suggests that there are also likely to be some occasional areas of good quality aggregate comparable to the best material from Area A.

88. It should be noted that the areas identified are only general in nature. Given the inherent variability of the deposits, specific site investigations would be required to confirm the actual quality and quantity of materials at any particular location. It should also be noted that it is possible that there could be pockets of suitable materials outside those designated Type A or B, provided the requirements for minimum depths to groundwater can be satisfied.

89. Whilst some reserves of suitable bed rock materials have been identified on Banks Peninsula, extraction costs (e.g. drilling and blasting) render them generally uneconomic at the current time for other than low volume, specialist products.

90. The underlying quality of the river based resource is generally very good, however materials extracted from the rivers are often deficient in silts and boulders which consequently have to be imported from land based sources. Materials may also on occasions be contaminated with organic matter such as branches, which have to be removed, often by hand, before the material becomes suitable for use.

91. Quantities of materials available on a sustainable basis from all but the largest of Canterbury's rivers are small. Materials from the larger rivers are coming under increasing pressure as land based quarries seek to preserve/augment their existing resources by drawing materials from the rivers. In the medium term, when existing aggradation resources currently found above minimum bed design levels are exhausted, the percentage contribution of materials from the rivers to Canterbury's total production will

decrease markedly. This will add further pressure to develop land based resources.

92. It should be noted that when the Central Plains Water Enhancement Scheme proceeds, groundwater levels may rise. These postulated increases have the potential to impact significantly on locations for new pits to the east of approximately SH1 south of Christchurch and to a lesser but potentially economically important extent in the Christchurch – West Melton area where materials are often of a higher quality. (Refer to Appendices for a figure indicating the location of existing consented quarries, pits and river extraction sites in central Canterbury).

Resources Available in Wider Canterbury

93. The areas indicated in Figure 1 as Type A or B were derived only for those areas generally within the boundaries of the Christchurch City and Selwyn and Waimakariri District Councils. Similar studies of aggregate quality for the remainder of Canterbury have not been undertaken. It is likely however that the deposition patterns, and hence aggregate quality, described above are repeated in the vicinity of each of the major rivers within the Region.

Recycled Materials

94. Pre – earthquakes. the volume of locally recycled materials was probably of the order of 2 to 5% of overall production. Anticipated volumes of potentially, ultimately recyclable materials are of the order of 10% of production. (Recycling rates for aggregates in the United Kingdom have now reached approximately 25% of total production.)

95. The quantities of earthquake related “rubble” materials presently in storage and suitable for recycling into aggregate products is estimated to be of the order of 0.2 million tonnes. It is difficult to know if these materials will eventually become available however their long term impact on reducing overall demand for virgin aggregates will be limited. They have therefore, conservatively, been disregarded in terms of existing resource estimates.

Constraints on Accessing Resources

96. The interplay of the following major factors will influence the locations and sizes of the new quarries and river extraction sites that will be required if future demand is to be met:

    (a) Resource Quality.

    (b) Excavation Depths in Relation to Groundwater

    (c) Groundwater Availability for Resource Processing.

    (d) Distance from Demand.

    (e) Access.

    (f) Land Holdings and Proximity to Sensitive Land Uses.

    (g) Existing Land Use, Quality and Value.

    (h) Sites of Ecological , Historical and Landscape Significance

    (i) Local and Territorial Authority Planning Requirements.

    (j) Sustainable Yield from Rivers and River Design Bed Levels.

97. A recent ECan resource consent hearing decision[6] held that all these issues are capable of being managed through a carefully assessed resource consent process and the resultant specification of a suite of carefully prescribed consent conditions.

98. My following evidence discusses each of the first four access constraint topics, which are particularly pertinent to this hearing.

99. Resource Quality - As discussed in the previous section, resource quality of both the land and river sourced, base aggregates in the identified areas is generally good to excellent although some selective screening and inter-mixing of materials may be required.

100. It is economically important that the size of the resource is sufficient to enable long term production to occur – say 20 to 30 years – in order for the considerable quarry

establishment costs (e.g. resource consents and quarry infrastructure) to be amortised over a suitable time frame.

101. Excavation Depths in Relation to Groundwater – Management of land use activities over groundwater recharge zones is the key to effective groundwater protection. Both the quantity and quality of groundwater supplies rely, to varying extents, on the recharge water that filters down through the soil and underlying sediments.

102. Groundwater contamination is theoretically possible from quarrying operations where the groundwater is unconfined or semi-confined. (i.e. where there is little or no impermeable layer, between the surface and the aquifer, that would otherwise prevent the ingress of contaminants into the groundwater.) In reality modern practice (which requires the siting of most operations with a potential for contamination to occur away from sensitive areas and/or the provision of hardstandings with suitable containment systems) significantly reduces this potential. In fact despite a number of searches of a worldwide nature, I have been unable to identify any recorded instances of groundwater contamination attributable to alluvial quarrying operations.

103. In relation to the Christchurch – West Melton area, Peter Callander, hydrologist and Director of Pattle Delamore and Partners Ltd, provided extensive evidence on this matter to the Canterbury Regional Council Natural Resources Regional Plan hearings into Variation 6 of Chapter 4, Water Quality, in April of 2010[7]. Mr Callander's conclusions, based on specific local evidence, was that the risk of groundwater contamination originating from quarrying activity was very low. However despite evidence of no contamination it is my opinion that this should not preclude other than operational best practice being continuously upheld at each quarry.

104. The disposal of inappropriate materials into quarries is an additional, and potentially the most significant source of groundwater contamination. Pre-planning for an appropriate end use of the quarry once production ceases is therefore essential. The conditions attached to the more recent resource consents have however significantly reduced the potential for contamination from this activity by more clearly defining what materials are considered to be acceptable as has the Christchurch Cleanfill Bylaw in the Christchurch City area.

105. It is worth noting that exhausted quarries sited in or close to urban areas have, in a number instances, been re-developed into popular local and in some cases even regionally significant parks. Locally Halswell Quarry is a good example of the former and Isaac Construction's proposals for an extensive native vegetation based, recreational park adjacent to the Waimakariri River is an example of the latter. Further a field, for example, Mt Smart Stadium in Auckland sits within a disused quarry.

106. Larger quarries in rural areas may be carefully contoured, re-top soiled, grassed and returned to light agricultural production. Smaller quarries / pits may be backfilled and then returned to agricultural use.

107. Appropriately managed quarries, rather than rendering land unusable once exhausted, can in fact be turned into assets with values at least equal to their pre-extraction state or, in some cases, to a use with an even greater value than pre-extraction.

108. The Use and Availability of Groundwater in Aggregate Processing – Water is primarily required for dust suppression and product washing.

109. Water used for washing purposes is generally recycled through a bunded pond to remove silt before being re-used or returned to the aquifer via infiltration through the overlying ground.

110. Quarries have the potential to create fugitive dust through on and off-site activities; the predominant generating activities being crushing and screening of aggregate, stockpiling and movement of machinery in, around and in the immediate vicinity of the site. Although unlikely to have direct health impacts, dust is potentially a 'nuisance' for neighbouring properties. Implementation of simple, best practice control methods, particularly by the use of sprayed water, are capable of reducing the potential problem to within acceptable limits.

111. Of these two uses for water (i.e. processing and dust suppression) effectively only that used for dust control measures is consumptive.

112. Quarries in Canterbury normally source water from the local aquifers. In some areas these aquifers are "fully or over allocated" which may restrict the volumes available for abstraction. However it should be recognised that the volumes of

water used relative to other uses are small particularly in relation to the production and the value of the vital infrastructural output it enables.

113. For example in Canterbury, the consumptive use of water, predominantly for dust suppression measures, has been estimated as approximately 50 litres per tonne [(8)] of processed aggregate which has a gate value of approximately $10 per tonne. In comparison, an average dairy farm in Canterbury uses approximately 250 litres [(9)] of irrigation water to produce 1 litre of milk with a gate value of approximately $0.50 (i.e.1,000 litres of water enables production of a product with a gate value of $200 in the case of quarrying or $2 in the case of dairying.)

114. As I have noted earlier, groundwater availability is already severely restricted in those areas of Canterbury which are considered by Environment Canterbury to be "fully or over allocated". Consents to take water in these areas for dust suppression, which is usually the only portion of water usage for aggregate production that may be considered to be consumptive, are difficult if not impossible to obtain. (This matter was extensively discussed in the recent consent hearing in the Environment Court in the case of *Road Metals Ltd* application to establish a new quarry near Burnham) (*Road Metals Company Ltd v Selwyn District Council and Canterbury Regional Council* [2012] NZEnvC214).

115. It is noted that under Rule 9.6.2 of the Proposed Canterbury Land and Water Regional Plan that "No additional water is to be allocated from the Christchurch West-Melton Groundwater Allocation Zone …." This is of particular concern as the pre-eminently suitable areas for new quarries to establish to meet forecast demand is within the Christchurch West-Melton Zone. The ramifications of being unable to access the relatively small quantities of water required for quarrying purposes would result in highly significant additional costs for the Region.

116. Distance from Demand – As noted earlier, transportation costs to an aggregates end use destination constitute a significant proportion of total aggregate costs. Accordingly the further quarries are from demand the greater the overall aggregate cost will be to the end user – as will be the environmental impacts associated with transportation.

117. From both overall regional economic advantage and industry competitive standpoints, distance from demand is liable to be one of the most important factors when deciding upon the locations of new sites.

118. For example should the average delivered distance within the region increase by as little as 1km the additional cost to the Canterbury economy would be at least $1million per year even at current production rates*

119. It can be seen that no matter how good the resource may be its distance from the demand may make it an uneconomic source of supply. It is vitally important therefore that access to resources close to the demands is maintained (i.e. not just access to resources per se).

120. This point is illustrated by the proposed establishment of a new quarry at Burnham which whilst containing a large resource is considered to be "*bordering on uneconomic*" (10) to supply demands generated in Christchurch city by the earthquakes "*given a haul distance of some 25kms.*" (10)

121. It is also not surprising therefore that it is industry practice, wherever possible, to co- ordinate the transport and disposal of materials in the co-located cleanfill sites/quarries with the purchase and delivery of aggregates.

Medium to Longer Term Planning Issues

122. Establishing a new quarry is a process that may often take from between three to four years from inception to operation, and reportedly in some cases up to 10 years where plan changes are required, Under the present planning framework, of the order of one to four years may be taken up by the consenting process. These timeframes may be compared with the average operating life of a larger quarry which may be of the order of 30 years (i.e. planning process timeframes are potentially significant in this context.) It is important therefore that planning and consenting issues are resolved as expeditiously as possible in order to minimise costs for all parties involved.

123. Both Environment Canterbury's proposed Canterbury Regional Policy Statement and the proposed Land and Water Regional Plan recognise quarrying as a vital component of the Region's strategy for infrastructural maintenance and development.

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*Derived from Canterrbury's annual 5 million tonnes production being transported 1 km at approximately $0.3 per km per tonne (i.e. an annual cost increase in excess of $1 million per year)

124. Aggregates can only be accessed from where they lie and hence there is no flexibility in moving extraction activities elsewhere. It is important therefore that regional and local planning frameworks are integrated to ensure that access is maintained in the long term to those resources that have natural advantages in the local context with respect to material quality, quantity and transport cost.

125. It is equally important that planning rules recognise the importance of aggregates to society as a whole and that they are therefore drafted so that there is an equitable balance achieved between economic and environmental outcomes.

126. Of particular concern is the ability to access water. Without water, despite implementation of best practice efficiency of use methodologies, it will not be possible to produce the aggregates that are required for the Region's future infrastructural maintenance and development.

127. Given that the Region has potentially reached the point where additional water is effectively no longer available in some areas and may be approaching a similar situation in others, consideration may need to be given to "reserving" allocations for quarrying purposes in much the same manner as that described in the Proposed Canterbury Land and Water Regional Plan for community water supplies.

128. With respect, in particular to the Plan's proposals for the prohibition on further takes from the Christchurch West-Melton Groundwater Zone, the recently published draft Zone Implementation Programme[11] does not, on my reading, contain reference to such a restriction, but rather notes the need for research to gain a better understanding of the Zone's hydrology.

Concluding Comments

129. As I noted at the opening of my evidence, "*Aggregates are a vital, if under recognised component of everyday life. Without them there would be none of the infrastructure on which modern society relies.*"

130. I have described the historical demand for aggregates and have demonstrated that the continuing demands for them will be substantial.

131. Canterbury is fortunate in possessing large reserves of generally high quality materials, a significant proportion of which have historically, and somewhat fortuitously, been able to be accessed close to the main sources of demand.

Ready and proximate access to these materials has provided the region with an economic advantage over those elsewhere in the country. However a growing population and competing land uses together with pressure on other resources such as water threaten the continuation of this advantage.

132. Physically it is likely that resources will be able to satisfy demand from within the Region in even the long term (i.e. for at least 100 years). However it is possible if steps are not taken to provide effective access to suitable materials, and associated resources, close to areas generating major demands (e.g. the urban areas of Christchurch) that the overall costs of aggregates incorporated into projects could rise significantly in the future to the detriment of the Region's economy.

133. In order therefore to preserve the Region's natural advantage it is important that aggregate production be given realistic and adequate recognition in the Region's planning hierarchy. The opportunity should not be lost to ensure that vital, economically important aggregate and associated resources are secured for the long term well being of the Region.

Richard English
Principal
Twelfth Knight Consulting

4 February 2013

APPENDICES

- Locations of aggregates pits, river extraction areas and bedrock quarries in central Canterbury.
- References

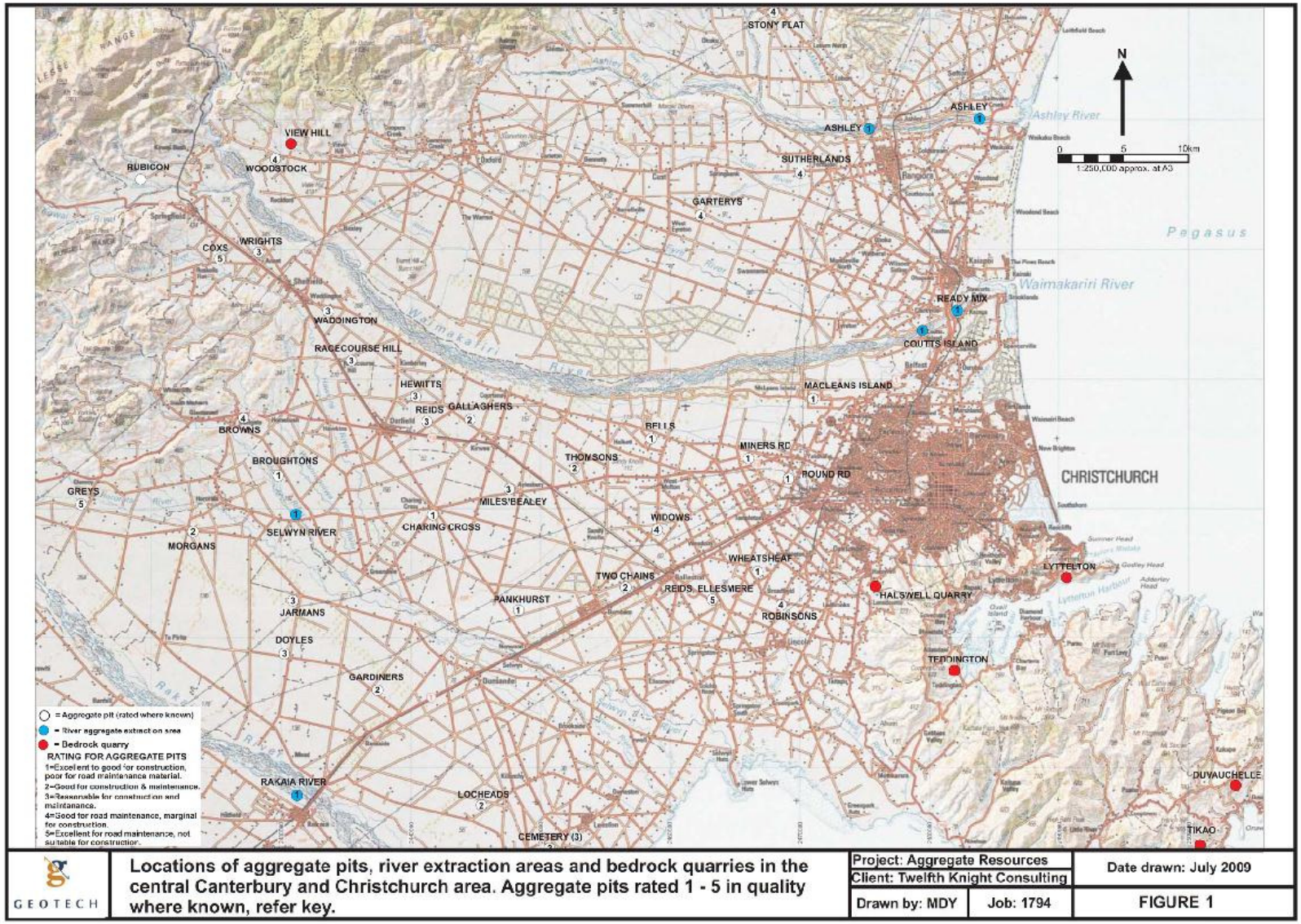

Figure 1A: Locations of aggregates pits, river extraction areas and bedrock quarries in central Canterbury.

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8. Figure, which is considered by the industry to be conservative, is derived from brief of evidence provided by Dr Helen Rutter, Aqualinc Research Limited and Mr Tim Curtis, URS New Zealand Ltd in the matter of Environment Court Hearing ENV 2011 – CHC – 078 - Road Metals Company Ltd: (http://ecan.govt.nz/publications/Consent%20Notifications/road-metals-evidence-helen-rutter.pdf) (http://ecan.govt.nz/publications/Consent%20Notifications/road-metals-evidence-andrew-curtis.pdf)

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