Burnham Quarry

The economic significance of the proposed new Quarry at Burnham in Canterbury

NZIER report to Winstone Aggregates Ltd

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Key points

This report examines the economic effects of aggregates (rock, sand, gravel) production at the proposed Burnham Quarry against the key economic considerations in the Resource Management Act, in section 5's references to economic well-being, and section 7(b)'s references to efficient use of resources.

The economic contribution of an industry is often viewed in terms of its impact on the measured economy, GDP, exports and employment. On that basis quarrying makes a positive contribution to the Canterbury economy, but not a large one.

Aggregates are relatively cheap to obtain, as long as there are sources close to areas of demand. Aggregates have a low value but are bulky and heavy to transport, so transport costs rise rapidly if such material has to be carried to an area from afar. Quarrying is a regionally significant industry not because of the high value of its output or the incomes and employment it supports, but because of its underpinning role in development and maintenance of infrastructure. Without continuing access to aggregate sources within economic cartage distance to demand, infrastructure costs would rise, and its affordability would decrease, impacting all the region's industries that use and rely on infrastructure.

Quarrying makes an economic contribution by avoiding costs that would arise if quarried materials were less available, affecting the cost and timeliness of new infrastructure:

- Congestion of infrastructure of fixed capacity, such as roads, pipelines, interchanges
- Delay in the alleviation of costs and risks borne by the community, such as protections against natural hazards like flooding and repairs of landslips
- Delay in treating environmental degradation, which increases the cost of remediation and reduces the well-being for communities waiting for the remedial work.

In pre-COVID 2019 Canterbury accounted for around 29% of New Zealand's total production tonnage of rock and aggregate (26% by value), compared to around 12.5% of the nation's gross domestic product. Canterbury is one of the largest producers of rock and aggregate in New Zealand, supplying infrastructure projects that support the Christchurch earthquake rebuild and wider regional development.

Although located in a rural area, Burnham Quarry is well placed to serve demands in Christchurch metropolitan area. It would not be the only rock and aggregate quarry in the city's hinterland, as there are around 20 quarries still consented and potentially operating in the local market. That may raise objection that the area is well served by quarries already and does not need to endure the disruption and potential for adverse effects that a new quarry would bring to the area.

That, however, is a static view of quarries' place in the community and overlooks the significance of aggregates and rock as foundational materials for maintaining current infrastructure of roads and pipelines, houses and buildings. All these structures have a finite design life and need to be repaired or replaced periodically, due to weathering, wear and tear in use, or technological developments that render current infrastructure no longer fit for purpose. There is a continuing need to replenish supplies of aggregate and rock as existing quarries are worked, and the most readily accessible and versatile material is removed from existing sources, leaving less versatile material with higher extraction cost from existing sites.

Quarries on the Canterbury Plains are unusually shallow compared to other regions because the groundwater is found relatively close to the surface. This increases the need to expand horizontally into new quarries, as there are limited options for digging deeper.

Demand for new sources of quarry material is likely to increase in the future, partly in response to population growth, fuelling new building for residential and work purposes. Demand may also increase because of the impacts of climate change, which is expected to bring more frequent and extreme weather events, more damaging storms and floods necessitating more frequent repair and replacement of roads, stormwater systems and other infrastructure; also more pre-emptive mitigation measures, such as stop-banks to reduce flood risk and water storage to limit disruption resulting from droughts and dry periods.

International agreements on curbing climate change aimed at reducing net emissions of greenhouse gases to the atmosphere are also likely to increase the cost of transport that relies on fossil fuelled propulsion, encouraging a change in urban density and new public transport systems to reduce the emissions associated with daily travel patterns. All these things suggest an increasing demand for quarry products as the foundation for new infrastructure and building patterns.

The adequacy of current quarries to meet such growth in demand is difficult to determine, as annual production and remaining resource are shrouded in commercial confidentiality. However, estimates of the annual production and remaining stocks of the 20 or so quarries identified in Christchurch's hinterland suggest there could be sufficient resource available to meet somewhere between 14 and 20 years of further production at current annual demand levels. New Zealand's Emissions Reduction Plan is aiming to achieve Zero Net Carbon by 2050, with other milestone targets to hit at intermediate years like 2035. Reaching such targets requires a continuous stream of new quarries becoming successively available in future years to ramp up supply as other quarries wind down.

From an economics perspective the critical question in considering consents for the Burnham Quarry is not does Canterbury need another quarry, but rather, would the quarry result in adverse effects on the environment sufficient to outweigh the benefits of enlarging the network of quarries supplying the region? More specifically, would the new quarry cause adverse environmental effects that cannot be avoided, mitigated or remedied or otherwise made less than significant by applying conditions at a cost that does not undermine the economic viability of the quarry? Given the Burnham site's rural location, few close neighbours and lack of restrictive overlays and designations, it is unlikely that consenting the Burnham Quarry will have significant adverse economic effects.

It is sometimes argued that adding another quarry to the mix serving a market of a given size will lower the market returns and utilisation of all suppliers. Such arguments imply there is an economic adverse effect of a new quarry, but such implication is inconsistent with the RMA and its section 7(b) interest in efficiency of resource use and development. There are benefits for competition and supply security in widening the range of quarries, and arguments about the sufficiency of existing quarries risks conferring market power on existing quarries and may violate the RMA's s104(3) requirement that consent authorities are not to have regard to trade competition.

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1 Introduction

Winstone Aggregates is applying for consent for a new aggregate quarry in Burnham in Selwyn District. It would occupy a triangular site bordered by Grange Road and Aylesbury Road. The site covers 362 hectares and is currently used as farmland for dairying, located in a rural zone, with few close neighbours, no designations and no restrictive overlays. The site is sufficiently large that quarry operations can be confined to relatively small footprint of around 40 hectares at any one time, leaving room for mitigation planting and continuing farming on the remainder of the site.

The resource size is estimated to be 26 to 36 banked cubic metres (BCM) of aggregate Annual extraction will vary to match market demand but will average in the vicinity of 500,000 tonnes per year. Up to 15 people will be employed by a quarry operation of this scale.

This report focuses on the broader context of the economic consequences of aggregate production for the Canterbury regional economy. It is structured as follows:

- The role of economic analysis under the Resource Management Act;
- Aggregates production in the Canterbury region;
- The changes that the new quarry will bring to the environment, with effects on wellbeing; and
- Implications of the changes for efficient use and development of resources.

2 How to assess economic contribution

The purpose of the Resource Management Act (Act) is to promote the sustainable management of natural and physical resources (section 5(1)). Section 5(2) of the Act defines sustainable management as using resources in a way that enables people and communities to provide for their well-being and their health and safety, while sustaining the potential of those resources to meet reasonably foreseeable future needs and avoiding, remedying or mitigating any adverse effects of activities on the environment. Section 5(2)(a) explicitly excludes minerals from the sustaining potential requirement, in recognition that such a requirement would preclude any use of finite or exhaustible non-renewable resources and limit their contribution towards community well-being. However, sustainable management still applies to the environmental effects of utilising mineral resources which need to be avoided, remedied or mitigated.

In numerous decisions the Environment Court has recognised various economic threads woven into the Resource Management Act (RMA). The relevance of economics to decisions under the Act is most obvious in references to enabling economic well-being in section 5 and to efficiency in section 7(b) and some other parts of the Act.[1] In particular, section 32's requirement to assess costs and benefits of changes in plans and regulations. The Resource

[1] See, for example, in Marlborough Ridge Ltd v Marlborough District Council [1998] NZRMA 73, where the Court noted that all aspects of efficiency are "economic" by definition, because economics is about the use of resources.

Management Amendment Act (2013) reinforced this relevance with its s32(2)(a) requirement for cost benefit assessments to consider how opportunities for economic growth and employment are affected.

Despite the idea persisting in the public at large that "economic" means "commercial" or "financial", economics is not confined to matters covered by financial transactions or the simple enumeration of costs, jobs and effects on incomes. The defining characteristic of economics is its insights into choices made under conditions of scarcity: how limited resources are used in the satisfaction of potentially unlimited human wants.

Economics encapsulates “well-being” in the notion of economic welfare, which is related to people’s consumption possibilities, both of marketed goods and services and of other less tangible non-market effects, such as the contributions to quality of life derived from the natural environment. “Efficiency” is about obtaining greatest value from use or non-use of available resources, where value in principle covers both market and non-market effects. Economic value is expressed in people’s willingness to pay for things, which is easy to see for market goods where money is exchanged to purchase them. In practice non-market effects, such as the quality of air, water, landscape or biodiversity, are difficult to quantify or bring into the economic calculus. They often arise out of shared resources which people pay for indirectly, through the taxes and rates paid to government agencies that provide public goods, or through restraint on private activity, either voluntary or imposed by regulation. There is value in improvements in environmental conditions, but they are also not costless, often entailing expenditures or opportunity costs – income forgone – by some for the benefit of the wider community.

The RMA can be viewed as a process for assessing and controlling effects that are not managed in markets, such as “externalities” caused when people’s actions create effects that fall uninvited and uncompensated on third parties. Externalities include non-market effects, so their economic value is not readily apparent. In principle it is possible to use various non-market valuation methods to infer economic value for externalities, based on people’s willingness to pay for reduction in adverse externalities, or willingness to accept compensation for enduring them. Such methods are complex and produce results that can be contentious and open to challenge. A simpler alternative to implementing such methods is to use a value already estimated for an analogous situation, in a process known as value transfer, but this depends on finding a closely analogous situation. In practice, in RMA hearings it is often easier to not place economic value on non-market externalities and rely on other subject-matter experts’ assessments of the scale of their significance.

It is common in RMA contexts to present an economic impact analysis of a proposed application that shows how the expenditures on an activity impact on such economic variables as production, value added and employment. Such impacts include both the direct effect of spending in the locality by the project, and the indirect effect of expenditure that flows from the affected sectors and stimulates other sectors in the local economy. This is useful but does not cover the full economic consequences of proposed projects and plan changes.

An alternative analysis frame is that of cost benefit analysis which compares the effects of a proposal against a counter-factual in which it does not proceed and identifies the costs and benefits of one option against the other. Such cost benefit analysis looks at the present value of effects of the proposal over time, which is appropriate for considering the availability and use of an exhaustible finite resource such as rock (that is close to the location where it will be used). It also, in principle, allows non-market effects in the analysis if they can be valued consistently with market values, although in practice this is possible for only a few such effects.

The economic impacts of any activity are generally greatest in the construction or establishment phase of a new development. Opening a new quarry would inject more expenditure into the local economy and provide a short- term stimulus for suppliers in the establishment phase, but such establishment costs could raise the cost of aggregates compared to those supplied from existing quarries. So, an impact analysis would be a misleading indicator of economic benefit. Similarly, an activity can have economic significance far greater than its economic impact would suggest where it harnesses a natural resource which would otherwise be untapped. Economic value arises not just from the observed transactions in the economy but also from avoiding the need to use more costly alternatives in sustaining economic activities.

3 Existing environment of the proposed Burnham Quarry

The proposed Burnham Quarry occupies a physical environment with potential for effects that are assessed by non-economic subject-matter experts. But it also occupies a place in an economic environment affected by and affecting the surrounding economy.

Aggregate is a fundamental but often overlooked input into the infrastructure on which the economy runs, as well as in numerous building products. Aggregate is used in large quantities for roads and concrete, with lesser quantities used for fill, drainage material and harbour and river protection (riprap). It is obtained either by excavating material and crushing it to desired sizes, or by extracting gravel and sand from riverbed, lacustrine or coastal deposits. Burnham Quarry will extract aggregate from old riverbed deposits.

Although aggregates are abundant in the Earth's crust, their cost of extraction and value in use varies widely. The cost of producing aggregates varies with the amount of over-burden that must be removed to access the useable rock material. The value of aggregate extracted depends on the quality of the quarried material and its versatility in use for a variety of products. There is uncertainty about the extent and quality of aggregate available from a given resource until it is extracted, and assessments of a given resource may change over time.

3.1 Aggregate is heavy and costly to transport

The high weight of aggregate makes it expensive to transport relative to the cost of extraction, so markets for aggregate tend to be localised. An industry rule of thumb is that the price of aggregates doubles with every 30 kilometres transported[2]. If the price at the quarry gate were $15 per tonne (roughly the price of aggregate for roading use), transporting material 30 kilometres at a cost of $0.50/tonne-kilometres travelled would double the cost of the product as it would incur another $15 per tonne. Higher value aggregate products can bear the cost of transport better than lower value ones: - transport costs would eliminate the profit margin on lower value fill materials and unprocessed

[2] Aggregate and Quarry Association refer https://issuu.com/contrafed/docs/q_m 1612_issuu_rev/47

aggregate products. Closure of quarries and relocation by even a few kilometres can make an appreciable difference to the cost of material for its users.

Aggregate sources are exhausted over time and need to be more or less continuously replaced. Rock may not be scarce but, readily accessible resources of high-quality rock are not common, both because of natural variation in the underlying rocks and because of restrictions on land use and quarrying activities imposed with the intention of reducing effects of extraction on neighbouring communities. So, when considering consenting or planning for extractive activities the broad economic question is about the relative scarcities of what is being sought (extracted minerals) and the potential environmental effects associated with extracting that material. Where the aggregate is locally scarce, and extraction would adversely affect something which is relatively abundant, then it can be economically worthwhile and efficient to incur higher cost and environmental impact to obtain the benefit of the extracted aggregate.

In economic terms it is efficient to restrict quarrying, by limiting extraction or imposing costly measures on residual discharges to air or water, only to the point where the marginal cost of additional restriction is equal to the marginal benefit obtained from it. Big changes in a short period of time can be disruptive of quarry operations and necessitate costly changes to the pattern of aggregate supply, whereas gradual adjustment with successive smaller changes over time will have less costly effects.

3.2 Demand for aggregate moves with population and economic growth

A long term (forty year)[3] study of demand for aggregate concluded that aggregate consumption is closely correlated with population and income growth. The relationship allows for technical factors that have lowered the demand for aggregate such as change in building practices[4] and specification of better performing materials[5] for roading. Roading and construction activities are the principal uses of aggregate in New Zealand. Cyclical fluctuations in these activities, as for instance from upswings and downswings in building activity, or the demands for aggregate created by specific roading projects, can cause peaks and troughs in quarrying activity.

Aggregate is produced to meet demand, so production figures are useful indicators of consumption of aggregate. The long-term demand for aggregate broadly moves in line with population which provides the employment base for local economic activity. Growth in population necessitates expansion of residential housing supply and in the streets and three waters infrastructure that directly serve it, and in the commercial spaces and institutional structures (such as medical centres, schools) that serve that population growth.

To illustrate the scale of aggregates' contribution to the built environment, over 4,000 tonnes of aggregate are used in the construction of one kilometre of standard highway pavement, while the building of a new six lane motorway can consume in excess of 20,000 tonnes for the same distance. Underground piped services along new streets may use up to 8,100 tonnes per kilometre of street. Up to 250 tonnes of aggregate can be used in the

3 O'Brien J 'Planning for Growth? The Determinants of Aggregates Demand in New Zealand', IPENZ engineering TreNz 2006-003, 2006

4 Reduction in safety and load factors required for reinforced concrete, greater use of pre-stressed concrete factors and achievement of higher concrete strengths using additives noticeably affected demand for aggregate in the 1970s.

5 Upgraded specifications for basecourse in roading have reduced the ratio of aggregate used in roading to that for building from about 6:1 in the 1950's to 2:1 in the mid-2000s

construction of a single new house, although those of wooden frame and cladding construction could use substantially less[6].

3.3 Canterbury has higher than national average demand for aggregate

Based on aggregate production data from New Zealand Petroleum and Minerals and Statistics New Zealand population data, in pre-COVID 2019, Canterbury accounted for 29% by volume of New Zealand's production of aggregates, or 26% by value. That share dropped dramatically in the COVID-affected years of 2020 and 2021. The value share is larger than Canterbury's share of total economic production (12.5% of national GDP in 2019[7]), which implies that Canterbury uses more aggregate relative to its economic production than New Zealand at large.

Table 1 shows recent production tonnages and values of rock, sand and gravel, in Canterbury and all New Zealand. Note that there has been a reduction during the pandemic-affected years (2020 and 2021), and that production has been proportionately larger in Canterbury than in New Zealand at large. In Canterbury's case, demand for aggregate products was already slackening pre-pandemic with completion of large rebuild projects following the Christchurch and Kaikoura earthquakes.

Table 1 Production of aggregates in Canterbury and New Zealand

Annual production volume and value by rock type in Canterbury region and totals for New Zealand

	Volume (million tonnes)			Value ($ million)		
Year ending March	**2019**	**2020**	**2021**	**2019**	**2020**	**2021**
Rock for reclamation and protection	0.058	0.037	0.080	1.528	0.524	1.894
Rock, sand and gravel for building	1.288	0.724	0.178	25.236	11.090	2.414
Rock, sand and gravel for roading	5.016	2.633	2.486	61.261	34.706	17.258
Rock, sand, gravel and clay for fill	0.774	0.392	0.000	6.033	4.761	0.000
Sand for industry	0.098	0.048	0.000	2.987	1.382	0.000
Total Aggregates (rock, sand, gravel)	7.233	3.833	2.745	97.044	52.464	21.566
Other (Stone, lime, clay etc)	0.366	0.454	0.713	6.098	8.939	11.668
Total Canterbury Quarrying	**7.599**	**4.287**	**3.458**	**103.143**	**61.403**	**33.235**
Total New Zealand Aggregates	25.046	28.170	26.057	378.148	484.576	469.059
Total New Zealand Quarrying	**39.898**	**34.093**	**29.515**	**655.095**	**611.483**	**502.294**

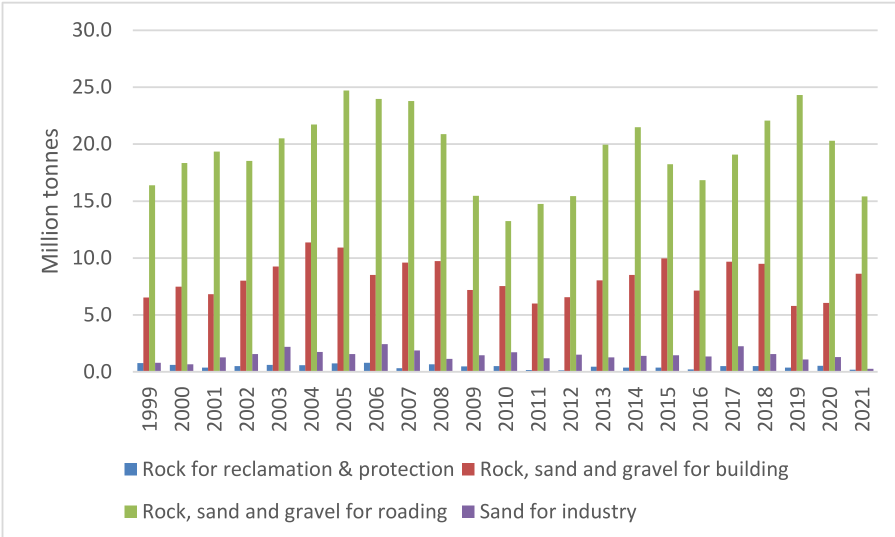
Source: New Zealand Petroleum & Minerals: 2021 Mineral Production Statistics

Apart from the pandemic, over the longer- term aggregate production varies over time with economic circumstances and demand. Figure 1 shows pronounced dips in aggregate production following the slump in demand caused by the Global Financial Crisis after 2008, and rising production boosted by earthquake rebuild after 2011 and again after 2016.

[6] From "Providing solid foundations for New Zealand", Aggregate and Quarry Association of New Zealand, www.aqa.org.nz

[7] Based on Statistics New Zealand, Regional Gross Domestic Product tables

Figure 1 Production of aggregates (rock, sand, gravel) in New Zealand, 1993-2021



Source: NZ Petroleum & Minerals aggregate production 1993-2021 Available at: https://www.nzpam.govt.nz/assets/Uploads/our-industry/statistics/aggregate-production-1993-2021.xlsx

3.4 Strong growth is forecast for Canterbury

Statistics New Zealand's population growth projections by territorial local authority suggest that Christchurch, Waimakariri and Selwyn districts face relatively high growth between 2023 and 2033, and beyond to 2043. The combined areas of Christchurch, Waimakariri and Selwyn are forecast to face an average annual growth rate of 1.38% between 2023 and 2033, and 1.15% between 2023 and 2043. Those rates of growth are the second highest in the South Island behind only the combined Queenstown Lakes and Central Otago districts (although the volume of additional people is considerably higher around Christchurch).

North Island centres like Auckland, Hamilton and Tauranga/Western Bay of Plenty face slightly higher growth rates, but because of the high cost of transporting rock they are effectively separate markets from those in the South Island. There is significant growth in population and housing expected in Christchurch and its hinterland, and that requires sufficient aggregate sources within easy reach to stop material transport costs from materially affecting the affordability of housing in the region.

Development of new quarry resources close to cities can be constrained by spread of residential areas and the "reverse sensitivity" of new residents to the effects of quarrying activity, the difficulty of finding green-field sites suitable for quarrying and limitations on quarry operations associated with heavy truck movements on local roads. Finding alternative sources of material to quarries that are constrained by operating restrictions to reduce adverse neighbourhood effects associated with discharges to air and water, removal and deposition of over-burden, extraction operations and transport of product, will involve higher costs. This is due to both longer transport routes from more distant sources and because of consent processes and the establishment costs of developing new quarries.

4 Effect on community well-being and efficient use of resources

The Burnham Quarry is planned to utilise an estimated resource that could sustained for over 60 years and with operations that employ up to 15 people each year. However, employment is only one indicator of its contribution to well-being, and not necessarily the main one.

Economic well-being can be defined in various ways, but there are three key interrelated components - income, consumption and wealth. Income is pivotal, as it can support current consumption, such as food, clothing, education, housing or leisure activities, or it can be saved to support consumption in the future[8]. More expansive definitions of well-being include people having sustainable income and assets so they can prosper or having the capabilities and skills to make the most of what's available to them. Such definitions put people at the centre of policy and move away from an attitude of "grow first, redistribute and clean up later"[9]. To illustrate the contribution of quarrying to the Canterbury region and its well-being, the following sections estimate the economic impacts it has at present, and discuss the implications of changes to those impacts[10].

4.1 Quarrying's contribution to the regional economy is positive but modest

The starting point is MBIE's Mineral Production statistics, which show that Canterbury produced 7.6 million tonnes of non-metallic minerals with a value of $103 million in 2019, but this fell through the pandemic years to 3.46 million tonnes worth $33.2 million in 2021. The unit value per tonne in 2021 is about 70 percent of what it was in 2019. This regional information on output volume and revenue is understated by the withholding of some information by some quarry operators to avoid identification of individual production figures.

Most of the production of rock, sand and gravel is for roading (61%), followed by stone for building (17%) and material for fill (9%). Most of it will also take place in the vicinity of Christchurch's urban area, as that is where most demand is concentrated.

In 2021 Canterbury's rock quarries produced total output worth $33.2 million, but in pre-COVID 2019 the corresponding figure was $103.1 million. Taking that as the region's gross output value of quarrying in a "normal year" and applying a ratio of gross output to value added for the metal ore and non-metallic mineral sector from Statistics New Zealand's input output tables, the contribution of quarrying to GDP in the region would be about $43.1 million in 2019, 0.11% of regional GDP. Within that GDP, compensation for employees accounted for around $16.5 million. Dividing this income figure by the average earnings in non-metallic mineral mining of around $70,000 per year, suggests the employment associated with this production would be around 235 Full Time Equivalent (FTE) jobs across the region. The corresponding figures for post-COVID 2021 are $13.9 million GDP, $5.3 million employee compensation and about 76 FTE jobs.

8 Available at; https://www.abs.gov.au/ausstats/abs@.nsf/Lookup/by%20Subject/4160.0.55.001~Jun%202015~Main%20Features~Economic%20wellbeing~10015

9 Available at: https://www.oecd.org/about/secretary-general/the-economy-of-well-being-iceland-september-2019.htm

10 This is an exercise particularly difficult at present, due to changes in presentation of MBIE's Regional Mineral Production Statistics, which do not disclose volumes produced of a range of non-metallic minerals (which were available in previous years), and also by delays in release of 2018 Census material which would provide more detail on employment.

These estimates are necessarily approximate due to data limitations. While neither the share of GDP nor the employment estimates seem particularly substantial against the regional totals, quarrying does create value and employment from an otherwise unused natural resource. To put this in perspective, very few business operations account for a large proportion of value added in any modern, diversified urban economy. The main significance of quarrying is not in its contribution to the measured economy, but in supplying material inputs to other businesses and infrastructure that support all economic activity. Quarries create value from a local natural resource servicing a market for aggregates in building and construction, roading and other public infrastructure that is most cost effectively supplied from local sources because of transport costs.

Direct spending by a quarry, like other businesses, will have an indirect flow-on or "economic multiplier" effect to the extent that it stimulates added business for suppliers of inputs to quarrying, and from added spending by those who receive income from it. In a 2008 study of the national quarrying activity, NZIER estimated multipliers on input supply of 1.9 for value added and 2.63 for employment, and the multipliers for combined effect on input supply and added consumer expenditure of 3.00 and 5.14 in value added and employment respectively.

While presented to show the interconnections of a business with other parts of an economy, data limitations make economic multipliers less reliable for local economies and they are inherently prone to overstate effects of potential changes in economic activity: the larger a new project, the more likely it is to place demands on locally constrained inputs like labour, which increases the price of inputs for all businesses that use them. That reduces profitability and output for some existing businesses that offset the new project's addition to output. Data issues aside, all regional or local multipliers will be lower than those at national level, as a regional economy is smaller and more reliant on importing from other regions than the national economy, so additional spending experiences more "leakage" out of the region. In the case of quarries, multipliers also understate the importance of the material supply to the economy: if restriction of quarrying increases the cost of aggregate supply and reduces the amount of investment in infrastructure such as roads or flood defences, the impediments this creates for local economic well-being, such as increased traffic congestion, wear and tear on vehicles or periodic losses from flood damage, are not the sort that show up in a multiplier based on inter-industry transactions.

4.2 But quarrying has a wider economic significance for its region

Quarrying has a minor contribution to the regional GDP but that is not the full measure of quarrying's economic significance. The main significance of quarrying is in providing materials and affecting their price for use in infrastructure which supports the value adding activities of all other sectors in the local regional economy, including building and construction, infrastructure and utility suppliers, transport operation, property managers and operations of owner-occupied housing. Put another way, the aggregates and quarrying industry is significant for Canterbury despite its relatively modest contribution to measured GDP and jobs, because of its underpinning role in infrastructure costs. Without quarrying facilities in the region in easy transport distance from the sources of demand, costs would increase, and affordability decrease, for all activities that rely on aggregate-based infrastructure such as roads, stop-banks, water storage, treatment plant and house building. By widening aggregate supply, the proposed Burnham Quarry would help avoid infrastructure disruptions that have a negative effect on community well-being.

5 The efficiency of extending quarry resources and providing for new development

Quarrying provides a capability to meet infrastructure needs that is most effectively met by local resources. That local sourcing also provides a source of resilience against the effect of disruptions to normal supply of materials. The economic value of such resilience is difficult to estimate but there is a strategic value in having that capability. The costs of business disruption caused by such events as floods or earthquakes is not so readily valued as property damage and other tangible losses but can be substantial.

Evidence presented to previous consenting hearings suggested aggregate demand around Christchurch from 2014 to 2041 was around 180 million tonnes and identified existing sites with potential supply of 140 million tonnes, leaving a shortfall of 40 million tonnes to be met by new quarries[11]. This is a logical, planning-based approach to providing for supply security over a foreseeable future[12]. However, it may give the impression that once sufficient supply is secured there is no need for further quarries until current sources are depleted, so having headroom capacity can be valuable in recovering from disruption more quickly.

However, as an economist, the last inference about “sufficiency” of quarries is an unnecessary restriction on quarry development. This is because the market for aggregate, as for other goods, is generally most efficient if there are many sellers in competition with each other. Competition sharpens the sellers’ incentive to offer competitive low prices, which leaves consumers better off and enhances their well-being. The alternative of restricting the number of suppliers is less efficient because it can confer market power on suppliers, allowing them to increase their prices, and because with less supply there is more likelihood of spikes in demand not being able to be met without restricting demand by raising prices or by resorting to obtaining aggregates from further away, which also raises costs to consumers.

Aside from ensuring there is sufficient physical supply of material becoming available to meet future needs, there is also economic benefit in widening the choice of quarry sources in the district. These network benefits are apparent when a larger range of suppliers in a market gives greater range in the variety of product supplied, and hence a greater likelihood of customers finding what they want when they want it, instead of incurring costs from delayed availability or seeking delivery from further away. A larger network of active quarries improves the choice, reliability and timeliness of supply, as well as exerting the pressure on each quarry to search for efficiencies to improve its competitive position.

That Winstone Aggregates is seeking consent for a new quarry is evidence that the company thinks it can provide a positive return on investment. The company sees opportunity to continue supplying aggregate in the Christchurch area and is seeking consent to have the option of developing it at a time that seems most advantageous in the future. The company incurs the investment cost, bears all the risk around the future value obtained from the quarry and is best placed to decide on how much and when to make the

11 See Statement of Evidence of Mr Richard Spencer English on behalf of Christchurch City Council, 16 October 2015, before the Christchurch Replacement District Plan Independent Hearings Panel.

12 The evidence in these figures imply an annual average demand over the period of around 7 million tonnes, similar to the 2019 production but below that of 2018 (see Annex).

investment. As long as. RMA processes show the quarry can be operated without significant adverse effects in the bio-physical environment, there is no economic reason to object to a private entity making investments in new quarrying capacity. If there was a demonstrable shortfall in available supply to meet likely demand, to the extent that aggregated prices were being pushed up, there would be an adverse effect to economic conditions in the status quo which could be alleviated by consenting new quarries. But even in the absence of demonstrable shortage of supply, there is no reason to expect a new quarry would create significant adverse effects on the economic environment, as the new quarry increases competition and diversity in supply.

Demand for rock and aggregate tends to be price inelastic (i.e. relatively unresponsive to price changes), so any additional cost of quarried material due to supply restraints requiring aggregate to be sourced from further afield would be mostly borne by local consumers rather than result in reduced consumption. As the largest consumers of aggregate within the region are Councils, these bodies will be the most affected by price increases and additional costs they face will ultimately be borne by their ratepayers. In other words, for what is essentially the same service – supply of aggregates to infrastructure – there would be additional cost to be met from ratepayers' disposable incomes, which would reduce their ability to spend on other activities in the region, to the detriment of well-being of both ratepayer consumers and other businesses that would benefit from additional spending that is forgone.

There is an economic value in providing for quarries to work out their resources to the point where they are no longer economically worthwhile to extract, as this defers the date at which new resources need to be brought into production and defers the present value cost of their development. In the longer term, costs will rise as new resources will need to be found and developed, but planning can foster efficient use and development of resources by not unnecessarily restricting access to, preventing development or expansion of, or accelerating depletion of, these quarries' existing resources.

There are no complete alternatives to ensuring that there are quarries which can produce sufficient quality aggregates within the Region. Crushed aggregate from demolition concrete can be re-cycled and used as an alternative to coarse aggregate for use in new concrete products or roading or drainage materials[13]. However, this typically needs to be blended with raw coarse aggregate, as it is difficult to know the properties of recovered material and a high percentage of recycled aggregate can negatively affect new concrete's strength. As with fresh aggregate, the high cost of cartage (both gathering material as well as distributing products) and need for a reliable source of recovered material at a consistent grade quality affect the economic feasibility of recycling aggregates[14]. It seems very unlikely that recycled aggregate could substitute for more than a fraction of the range of materials available from newly quarried material.

When existing quarries are restricted or closed, production at the remaining quarries may rise, resulting in increased environmental effects at these quarries as well as increased traffic movements around these sites. Consent conditions may restrict such adverse effects, but any residual adverse effect would add to the full societal cost of supply resulting from volumes produced in the region or volume made up from more distant sources. This is a

[13] CCANZ (2010) Recycled aggregates in new concrete; Technical Report TR 14, Cement and Concrete Association of New Zealand.

[14] Winstone has suggested that recycled aggregates are very expensive to produce and are of limited use in concrete. They can be used to make a low-grade basecourse, but this product is far more expensive than the excess low grade scalped material – a by- product of the production processes of other local greywacke quarries.

potential adverse externality from quarries closing down, the impacts of which will be lower if there are many alternative quarries across which to spread the load of extra production. This is another reason not to restrict new quarry proposals on the grounds there are enough already: the ecosystem of quarries is dynamic and can change rapidly from a situation of sufficiency to inadequacy in supply of material.

6 Summary and conclusions

In 2019 Canterbury accounted for around 29% of New Zealand's production tonnage of rock and aggregate, but this dropped to just 11 % in COVID-affected 2021. Quarrying contributed 0.1% to regional GDP in Canterbury, but quarrying has an economic significance far beyond its relatively modest economic impact, as it supplies material for the physical infrastructure on which the economy depends. It is a regionally significant industry because of its underpinning role in development and maintenance of infrastructure, and without continuing access to aggregate sources close to demand, infrastructure costs would rise, and its affordability would decrease, with impacts for all the region's industries that rely on that infrastructure, both directly (infrastructure providers) and indirectly (infrastructure users like transport operators).

Aggregate is a fundamental input into the infrastructure on which the economy runs, with few cost-effective substitutes for the range of uses of aggregate in roading, building and civil construction. It is expensive to transport relative to its cost of extraction and ensuring low-cost supply requires economically accessible resources close to the location of demand.

Availability of versatile high-quality aggregate faces increasing constraints as existing resources have been depleted and residential encroachment has increased restrictions on the use of new resources. While it is difficult to reliably estimate shortfall in available supply to meet likely demand, there is no economic reason to expect a new quarry operated without significant adverse effects in the bio-physical environment to have a net detrimental economic outcome.

Regional economic well-being and the efficient use of resources will be served by the addition of Burnham Quarry as this would add to the number and diversity of sources of quarried material in the region and help secure supply of rock and aggregate products into the future. The addition of another quarry also increases competition between suppliers and choice for consumers, with lower economic cost of supplies and environmental effect than sourcing aggregates at greater distance.