Tabled @ Hearing 11/11/2015
RAVENSDOWN

BEFORE THE CANTERBURY REGIONAL COUNCIL

IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of the Proposed Canterbury Air Regional Plan (PCARP)

SUMMARY OF EVIDENCE OF PETER WILLIAM HAY

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Fertiliser Manufacture in New Zealand

1 Fertiliser is a vital input to the farming and New Zealand economy. According to the Canterbury Development Corporation, primary production contributes $1.5 billion to the national GDP, and $4.5 billion in primary products are exported from Christchurch annually (Canterbury Development Corporation summary report 'Christchurch & Rural Sectors Relationship Analysis', N Brunsdon April 2014).

2 The supply of the nutrients phosphate and sulphur are essential to the achievement of this agricultural productivity and superphosphate is the preferred source of these nutrients.

3 Ravensdown is a 100% farmer owned co-operative which manufactures, imports and distributes fertiliser products and other farm inputs throughout New Zealand. Ravensdown was established in 1977 through the merger of Dominion Fertiliser and Kempthorne Prosser. Since 1977 annual sales have grown from 100,000 tonnes to a peak of 1.6 million tonnes in 2003, with current sales around 1.2 million tonnes. Over that time the co-operative has grown to become the leading supplier of farm nutrients with just under half of the New Zealand fertiliser market, employing approximately 675 staff.

4 Within the Canterbury region, Ravensdown owns and operates a major fertiliser manufacturing plant in Hornby, two lime quarries, eight bulk fertiliser stores and is involved with ten bulk consignment stores. Each year we import approximately 380,000 tonnes of mineral fertilisers into Canterbury, through the ports of Lyttelton and Timaru.

The Hornby Works

5 The Hornby Works is located at 312 Main South Road, Hornby. The Hornby Works occupies approximately 14 hectares and sits within the Hornby industrial area. The site is situated between State Highway 1 and the Main South rail trunk line to the west of Christchurch.

6 The construction of the Hornby Works commenced in 1919 and from 1922 has been manufacturing fertiliser and sulphuric acid. The current site was chosen because of its close proximity to a port, access to labour and its rural location. At the time of establishment there were only five homes in the immediate area.

7 The primary activities carried out at the Hornby Works are the import of raw materials and the manufacture, storage and sale of fertilisers. The industrial processes are the manufacture of sulphuric acid and superphosphate. The plant includes a Simon Carves Sulphuric acid plant and ancillary equipment, Bradley pulveriser rock phosphate grinding mills, a Broadfield single superphosphate plant and associated equipment, three fertiliser screening and despatch systems, associated buildings to house the equipment and bulk storage stores.

8 The site employs 51 staff with an annual operating budget of approximately $9 million, of which over $4 million is paid to staff in salaries and wages. In excess of $2 million is paid to local contractors (fitters, electricians, carpenters etc.) and service providers with up to 15 contractors employed on site for sustained periods. A contribution of approximately $1 million goes to the purchase of locally supplied operational and engineering parts and consumables.

9 In addition to the operating budget the Hornby Works has a significant capital expenditure programme as it redevelops the site post the September 2010 earthquakes and the continuing investment in site improvements. In the last five years over $30 million has been invested into the Hornby site alone, with a further $25 million forecast over the next five years.

10 The Hornby Works annually supplies in excess of 280,000 tonnes of manufactured and imported fertilisers to the Upper and Central South Island regions at an approximate value of $190 million. Currently the site produces between 98,000-195,000 tonnes of superphosphate and between 35-80,000 tonnes of sulphuric acid per year.

11 The Hornby Works operates under an Air Discharge Permit to discharge contaminants to air that was granted in February 2010 and expires in February 2030. The process to obtain this consent started in 2006 and involved significant technical assessments and consultation with key stakeholders. It was a thorough and robust process demonstrating that the discharges from the site with the appropriate mitigation are at acceptable levels.

12 Ravensdown has invested significantly in the Hornby Works. The effective replacement value of a plant of similar size and capacity to Hornby would be in the vicinity of $130 million for the manufacturing

plants and raw material storage areas. The additional product storage and despatch facilities that would also be required would cost a further $30 - 50 million.

13 The main processes at the Hornby Works are the manufacture of sulphuric acid, grinding of phosphate rock and reacting with sulphuric acid (acidulation) to make single superphosphate. In my evidence I discuss these processes in some detail. My reason for doing so is to ensure the Commissioners understand the extent to which the various processes are carefully managed to achieve good environmental performance and to ensure Ravensdown remains fully compliant with its Air Discharge Permit.

Sulphuric Acid Plant

14 The sulphuric acid manufacturing process involves: the melting of solid sulphur to a liquid form; the combustion of sulphur to produce sulphur dioxide; catalysed oxidation of the sulphur dioxide to sulphur trioxide and absorption of the sulphur trioxide by sulphuric acid, plus the addition of water to control acid strength at 98.5%.

15 The first step in this process is the conveying and placement of solid sulphur into a melting vessel to produce molten sulphur. During this process and the storage of molten sulphur water is evaporated and a small amount of hydrogen sulphide is released from the sulphur. The hydrogen sulphide emissions are regularly measured and the results show that the filter achieves greater than 98% removal efficiency as required by Condition 26 of the Air Discharge Permit.

16 The filtered molten sulphur is pumped to the sulphur furnace for combustion within the acid plant. The sulphur, mixed with dry air, ignites resulting in a gas stream with typically 8.0 to 10.0% sulphur dioxide.

17 This gas is cooled in preparation for its oxidation to sulphur trioxide through a fire tube steam boiler. The resulting steam generation is used to produce electricity through a turbine and alternator.

18 The cooled gas enters a stainless steel converting tower which contains a series of four catalyst beds where sulphur dioxide is converted (oxidised) to sulphur trioxide. The sulphur trioxide gas is then absorbed by a solution of strong sulphuric acid within the absorption tower to produce sulphuric acid which is pumped to the production tanks. 99.99%

of sulphur trioxide is removed in this process. Acid mist carry-over in the gas stream is minimised using twenty-four sulphuric acid laden Brink filters in the top of the absorption tower.

19 The sulphur dioxide that is not converted, and traces of sulphur trioxide and sulphuric acid mist are discharged to air. This discharge is via a 67 metre high stack. A requirement of the Air Discharge Permit granted in 2010 was to raise the acid plant stack to at least 50 metres (from its previous height of 41 metres). However air modelling work completed by Golder Associates demonstrated that at 67 metres there was a significant reduction in ground level concentrations of sulphur dioxide so the new stack was increased to this height. Analysis of the sulphur dioxide data has shown the benefits of the increased stack height in reducing off-site ground level concentrations.

20 The primary method of controlling the discharge of sulphur dioxide, sulphur trioxide and acid mist to air is by accurate and tight control of process parameters. These parameters include continuous monitoring of gas stream temperatures, catalyst temperatures, absorbing acid strengths, liquid flows and temperatures, pump flows and power use and various pressures.

21 A computer monitors and records all the process parameters and alerts the operator to any deviations from optimal operating parameters. Critical interlocks are in place so that if equipment fails then automatic shutdown sequences will occur.

22 An 'in stack' sulphur dioxide monitor and airflow recorder continuously monitors the concentration and mass of the sulphur dioxide discharge.

23 The Hornby Works laboratory measures the concentration of sulphur dioxide and trace sulphur trioxide/acid mist at fortnightly intervals using validated externally approved methodology.

24 The computer monitoring and control systems present the operator with a significant amount of information to optimise plant conditions. Automatic controls provide assurance that key operational parameters are maintained so sulphur dioxide emissions are minimised and maintained within consent requirements.

Phosphate Rock Grinding Plant

25 Phosphate rock is received from Lyttelton and stored in bulk storage buildings. The rock is transferred from the feed hoppers into two air swept Bradley Pulveriser mills which grind the rock to a talcum powder consistency. The transfer conveyor drop points are all extracted and filtered to minimise fugitive dust within the building.

26 The filtered air stream from the mills is vented to air from two roof top vents.

27 The discharges associated with this process are:

(a) Fugitive dust from loading the rock into the blending hoppers. The rock storage, handling and grinding processes are enclosed within a building.

(b) Moist air is vented from the mill dust collectors to control humidity and fine dust from the mill air stream. The bag filters remove the fine rock from this air and the air discharge is monitored continuously by a dust sensor. Automatic shutdown prevents dust being discharged due to a bag filter rupture or an internal malfunction in the mill system. The mill exhaust emissions are independently audited (CRL Energy Ltd) for PM10. The most recent audit stated, 'particulate concentrations are exceptionally low' with emission rates of PM10 particulate <0.01 kg/hr.

Superphosphate Plant

28 Ground phosphate rock, sulphuric acid, a solution of fluorosilicic acid (recycled scrubbing liquor) and water are mixed and react to produce superphosphate. Molten sulphur is added on occasions to produce a sulphur fortified superphosphate.

29 The components are metered into a Broadfield mixer which vigorously blends the ingredients. A reaction takes place in the mixer and a slurry is formed. This slurry is discharged into a Broadfield den which has a slow moving floor. The product forms a cake as the mix solidifies in the den for approximately 15-30 minutes, and this is where most of the reaction occurs. Rotary cutters situated at the end of the den cut the mix and this is conveyed to the granulation drum. The product entering the drum is of a wet sand consistency.

30 The reaction of sulphuric acid with the rock in the mixer and den converts the insoluble tricalcium phosphate to a mono-calcium phosphate form which is available for uptake by plants on application to soil.

31 The reaction also produces the following gases: carbon dioxide; sulphur dioxide; water vapour; silicon tetra-fluoride; hydrogen sulphide; and organic sulphur compounds.

32 These gases are extracted at a rate of 30,000 m^3/hr under vacuum from the mixer and den and scrubbed in the den scrubber. The scrubbing system is a multistage system with a venturi scrubber followed by eight in-series void tower scrubbers and then two odour scrubbers.

33 Make-up water is supplied to the last of the void towers and flows counter-current to the gas stream. This ensures that progressively cleaner air is contacted with progressively cleaner scrubber water.

34 Following the second stage (the void tower scrubbers) the gas stream then passes through two scrubbers, which are designed to reduce odorous compounds prior to discharging to air. This is achieved by using caustic (sodium hydroxide) dosing to adjust liquor pH to a level of 9.2. Ozone is injected to oxidise odorous compounds.

35 During the scrubbing process silicon tetrafluoride gas is wet scrubbed with water to form FSA (fluoro-silicic acid). This stream is recycled back to the mixer, where it is reincorporated back into the superphosphate product.

36 The exhaust from the den scrubber system is then combined with the exhaust from the hygiene scrubber system and discharged via a single 41.9 metre high stack.

37 The hygiene scrubber system has been designed to collect fugitive emissions that are released post the den stage. The system targets the granulator discharge point, transfer conveyors and general building air. The air extracted from the building (60,000 m^3/hr) is passed through the hygiene water scrubber which removes fluoride and acidic compounds before being discharged to atmosphere via the combined stack.

38 The superphosphate plant and scrubber system is monitored and controlled by a computer system.

39 The computer monitoring system assesses if the equipment and process is within a pre-set optimum range and will automatically shut down the plant in sequence if the process parameters deviate from the desired range.

Conclusions

40 Ravensdown strives to be a world leader in the manufacture of superphosphate fertiliser. The company's commitment to the environment is a guiding principle in its business planning and development. The Hornby Works is a long term strategic asset for Ravensdown.

41 A key aspect of being able to commit to ongoing capital expenditure to improve performance is the security that comes from having a legislative framework that enables industries to operate in an environmentally responsible manner.

42 The pCARP as drafted has no recognition of the importance of industry and the investment made in existing industry. Avoidance policies and prohibited activity status will likely mean this well-established operation commissioned in 1922 will need to close at the expiry of the consent or possibly sooner.

Peter Hay

11 October 2015