

7. CONSIDERATION OF ALTERNATIVES

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7.1 Product Alternatives

Concrete has been described as the second most commonly used resource in the world after water. However, alternatives for cement-based products do exist, with principal replacements being steel and timber for housing and commercial construction. Plastics and steel are substitutes in pipe and drainage applications, and asphalt is the obvious replacement in road building. Nonetheless, given the economy, versatility and widespread application of concrete and other cement based products, the large scale replacement by substitutes is unrealistic. The use of cement in New Zealand is typical of other industrialised countries, however, on a per capita basis annual consumption is considered low by world standards.

7.2 Cement Supply Alternatives

There is growing demand for cement in New Zealand. The company’s Westport plant is presently running at capacity but it cannot meet the current domestic demand and Holcim is therefore importing around 20% of its requirements. To meet this demand, three principal cement supply alternatives exist for Holcim:

- Manufacture within New Zealand, either a new or substantially upgraded Westport plant, or a new plant elsewhere within New Zealand.
- The purchase and importing of cement from outside New Zealand, either in full or to augment production from the existing plant at Westport.
- The purchase of cement in New Zealand from another party.

The importing of cement into New Zealand to meet shortages has occurred at various times in the country’s past. The post-war Government of the late 1940s and 50s saw the creation of self-sufficient domestic cement capacity (and also that for other key industrial commodities) as essential given the war-time and post-war shortages the country experienced. Holcim is currently successfully importing cement but the frequent changes in overseas suppliers in the past 5 years are illustrative of the risks inherent in importing over a long timeframe. Cement manufacturers typically supply their own domestic markets first before considering exporting and the availability of shipping capacity together with exchange rate and freight volatility add to the challenges of importing.

The Golden Bay cement plant at Whangarei is the only other source of manufactured cement in New Zealand outside Westport. The supply of cement from this plant to Holcim on a permanent basis is competitively untenable and is also unlikely to be approved by the Commerce Commission.

Given these supply alternatives Holcim is considering a continuation of importing in the long term to augment production at the existing Westport works and is also considering increased manufacturing capacity in New Zealand to meet current and future domestic demand.

7.3 New Zealand Cement Manufacturing Alternatives

The manufacturing of cement fundamentally involves the quarrying of limestone and related materials, the calcination of limestone via burning in a kiln, cement grinding and bulk transportation. Therefore, when considering the manufacture of cement in New Zealand for domestic supply, four principal criteria are considered:

- Availability of raw materials.
- Ease of logistics.
- Availability of energy.
- Servicing and support.

Limestone is the primary mineral for the manufacture of cement. The availability of limestone and so-called 'secondary' minerals is the starting point for any investigation of a cement manufacturing location. The quality of these materials, in addition to their quantity, homogeneity, location and mining accessibility is all-essential to successfully base manufacturing.

The ease and economy of transportation links between raw material locations and manufacturing site and market is also essential for a heavy and relatively cheap commodity. Therefore, the proximity of road, rail and port infrastructure is an important consideration.

Significant thermal energy (coal, gas, etc.) is required for calcination and electrical energy is needed for grinding. Energy needs to be available, reliable and cost-effective.

The fourth principal criterion incorporates the manning, maintenance and servicing of a large manufacturing operation that is a modern cement plant. Staffing availability, along with ready access to servicing capacity and expertise, are important considerations for effective operation.

7.3.1 Criteria for assessment of manufacturing locations

Limestone exists across New Zealand in most regions apart from the volcanic regions of Taranaki and Bay of Plenty and the lower North Island. It exists throughout the South Island. The historic locations of cement making in New Zealand broadly identify the most suitable locations, in terms of raw materials:

- Northland.
- King Country.
- Nelson/Golden Bay.
- West Coast.
- Otago.
- Southland.

However, the composition, quantity and accessibility of these resources are highly variable. Holcim has undertaken geological analyses of all of these deposits to determine whether limestone quality is adequate, and on the basis of that analysis many deposits were removed from further consideration. Of those deposits considered suitable, accessibility of the limestone is the next important consideration, and again some have not been considered further where, for example, they are within the conservation estate or owned by Holcim's competitor.

These locations also vary in terms of their distance from the largest markets (upper North Island, Wellington and Christchurch) and links to transportation infrastructure. The King Country is well placed in terms of market proximity but is some distance to an operating port. The ports of the West Coast are shallow and are sometimes closed to shipping because of weather and bar conditions.

Southland and Otago have access to sheltered deep ports but are remote from the main markets. Northland is very close to Auckland and has good ports but is remote from the rest of the country.

At 15 MW per annum maximum demand estimated for the Weston plant, cement plants are large users of electricity. Despite this high load the main described locations are well placed for electricity supply. Northland and the North and West of the South Island are the most remote for supply.

The availability of coal varies per location. Nelson and Northland are the most remote. Suitable quality coal exists in the West Coast, Otago, Southland and the King Country. However, strong demand reflected in the price for both coal and natural gas in the King Country offsets the advantages of local supply.

Westport is the most remote location in terms of the availability of services. Given the success of this plant over 50 years of operation it is unlikely that the availability of services or workforce would be a large impediment to any of the locations.

7.4 Cement Supply Alternatives being Considered by Holcim

In addition to considering a continuation of importing in the long term to augment production at the existing Westport plant Holcim has also considered new manufacturing sites in New Zealand.

The full set of options considered is:

- Importing all cement requirements (no domestic manufacturing plant).
- Importing to augment sales while retaining the existing Westport plant.
- A new or substantially upgraded plant at Westport.
- A new plant in the King Country.
- A new plant at Weston, near Oamaru.

Given the substantial investment (\$200 million+) and timeframe required for operating a new plant the company needs to consider whether to build new capacity or plan to import in the long term. Holcim's preference is to have sufficient production in New Zealand to meet demand, without having the uncertainties and risks associated with importing cement.

When considering a domestic location the advantages of redeveloping the existing Westport location need to be compared with other leading locations.

(a) New or upgraded plant at Westport

The Westport location has the inherent advantages of a suitable zoning of the plant, land ownership and the established workforce and services access. However, while port access is very close, there remain transportation issues associated with the Buller River bar in particular.

(b) New plant in the King Country

This region is reasonably well serviced by the main trunk railway, is well located relative to the northern domestic market and Holcim already operates a substantial industrial lime business in the King Country district (McDonalds Lime Limited). However, no specific zoning exists, the nearest deep harbour port is at Tauranga and sufficient land outside of the present operations is not owned by the company.

(c) New plant at Weston

Compared with possible sites in the King Country, significantly more is known about the Weston sites, the associated raw materials and the local environmental context as a result of the previous investigations and consents granted in the 1980's. Holcim also substantially owns the land required for the Weston option, and the main plant and quarry areas have specific zoning recognition.

7.5 The Advantages of Weston as a Cement Manufacturing Location

In contrast to the other two primary location options, all 4 principal criteria for establishing a cement manufacturing plant apply for Weston:

- A large deposit of suitable quality, easily accessible limestone and other materials exists at, or very near to, Weston.
- Within close proximity to the limestone deposit is a flat 40 hectare site suitable for a manufacturing plant, alongside rail infrastructure, and within reach of sheltered deep harbours.
- Suitable coal is available nearby at Ngapara (19kms).
- Oamaru is likely to be an excellent provider of services and support industry in conjunction with the wider district that includes Dunedin and Timaru.

7.6 Alternatives Considered for the Weston Project

At the Weston location various alternatives have been considered to improve the project. These are discussed below:

7.6.1 Plant location

Other plant sites in proximity to the limestone resource have been considered. However, the availability of sufficient flat land together with access to both rail and road connections makes the proposed plant site the preferred location.

7.6.1.1 Topography

The preferred plant site is flat to gently sloping. There is not sufficient flat/gentle land of the same area as the preferred site, and accordingly significant earthworks would be required elsewhere.

7.6.1.2 Zoning

The preferred plant site and main materials quarry has a Cement Policy Area zoning. Other sites have a rural zoning.

7.6.1.3 Ownership

The preferred site is owned by Holcim. Some land to the north and west of the quarry is in private ownership and may not be easy to obtain.

7.6.1.4 Proximity to rail

The preferred site adjoins the end of the designated rail corridor. There is no designated rail access to other sites and its establishment would be expensive in cost and obtaining required permissions.

7.6.1.5 Proximity to roading

The preferred site is located adjacent to the Weston-Ngapara Road, which is a main road. The land to the north and west of the quarry is serviced by local roads.

7.6.2 Quarry – plant interface

In the 1980s cement plant proposal the quarry and plant were to be connected by an overland conveyor for limestone, tuff and siltstone transport. This conveyor utilised a cutting in the escarpment slope and the two sites were further connected together with an access roadway up the escarpment face.

An alternative to a conveyor is a roadway between the quarry and the plant site that would run from the northern entrance to the quarry (via Troublesome Gully) around the base of the escarpment inside Coal Pit Rd and Weston-Ngapara Rd. This connection concept was discarded in developing the current proposal due to landscape and noise effects.

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The current proposal instead uses a tunnel to allow a conveyor connection and has no road connection via the escarpment face. This allows minimal interference with the natural escarpment, provides the shortest route connection, lowers noise and the down-coming conveyor would also generate a small amount of electricity.

In designing the haul road location, alternative routes through the Troublesome Gully area were also considered. The chosen alignment does require the removal of part of the northern end of the escarpment but will avoid damage to the rock art and pre-historic rock shelters in Troublesome Gully. The alternative may have the potential to reduce visual change to the escarpment but would potentially impact on the rock art and pre-historic rock shelters.

7.6.3 Plant – market interface

In the 1980s cement plant proposal cement was to be transported from the manufacturing plant by trucks for both local deliveries and for ship loading at the Port of Oamaru.

Apart from fishing activity, the Port of Oamaru is effectively closed as a viable commercial port. To enable this harbour to be capable of sustaining cement shipping would require:

- substantial dredging inside and outside the harbour;
- new breakwater construction;
- new wharf construction;
- demolition and removal of old, and in some cases historic, structures; and
- establishment of port management and navigation systems.

These capital requirements, in addition to the port's sensitive location in terms of town location, wild life and heritage values, preclude the use of the port as a transportation alternative.

The Port at Timaru has sufficient capacity to comfortably support a domestic cement shipping operation for cement from Weston. It is also the closest deep-water port and has excellent rail and road connections.

Port Chalmers is also an alternative option but is further away from both the proposed plant site and from the greater cement markets.

Road transport of cement from Weston is required for local deliveries. Road transport is also an alternative for supplying cement to Timaru for ship loading. A factor of 50:1 of road vs. rail movements means that road trips would necessarily be many times more frequent than rail. The subsequent impact on road traffic and noise is such that this alternative is less desirable to the use of rail.

Consideration has been given to loading cement at a siding on the main trunk line, south of Oamaru and using an overland cement conveyor connection to the manufacturing plant instead of reinstating the branch railway line. This alternative would avoid the movement of trains through Weston but requires a further loading site and an over the ground conveyor. This alternative is more expensive than the reinstatement of the branch rail line, but most importantly it precludes the possibility of using rail to move any other freight to or from the site.

The use of new specialised rolling stock together with new welded track on renovated rail base and modern road crossings equipment will provide a rail connection to the most modern design standard.

7.6.4 Site access and interconnections

Subject to agreement being confirmed with the relevant landowner, preferred access to the sand pit site at Windsor is via the line of a disused railway connecting with Peaks Road and then on to Windsor Road. The alternative however would be to access the

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site via Victoria Hill Road at a point west of the Windsor Road/Victoria Hill Road intersection. While slightly longer in travel distance, the preferred option has the advantage of avoiding trucks having to pass through the main part of Windsor village.

It is proposed that the coal pit site at Ngapara is served via a new direct access to Weston-Ngapara Road. Consideration has been given to three possible alternative access options:

- The first would involve a new access onto Bobbing Creek Road in the vicinity of Patersons Road. This option would involve benching and cutting back of embankments on Bobbing Creek Road in order to improve visibility and safety along this route. This would be a significant undertaking for the volumes of traffic involved, and has not been favoured on that basis.
- The second alternative examined would be to form an access via a continuation of a minor road having existing access from a local gravel pit onto Weston-Ngapara Road (about 100m to the west of Paradise Gully Road). However again, sight distance constraints at the intersection with Weston-Ngapara Road have led to a decision not to consider this option further.
- The third option, which was discounted early, was to access the site from the northwest via Ngapara-Georgetown Road. This would necessitate all vehicle movements passing through Ngapara village, and would also bring the vehicle access closer to neighbouring dwellings. For these reasons, this option was not pursued.

The proposal is to truck sand and coal supplies from Windsor and Ngapara respectively to the plant site. As an alternative to trucking, consideration has been given to the possibility of reinstating the railway line along its historical route to the northwest beyond the plant site, potentially connecting with the Ngapara and Windsor sites. However, this option would require overcoming significant landownership and access constraints, and has an estimated cost of in the order of \$30-40M. In the context of the overall project, the total quantity of materials to be transported is too small to make this a viable alternative option to road transport for these raw materials.

In transporting gypsum and oil supplies to the plant site, there is no clear advantage in journey time for the selection of either State Highway 1 through Oamaru to Weston Road or Whiterocks Road, or the route using Seven Mile Road and Airedale Road. Similarly, there are no road safety concerns evident on either of these possible routes.

Generally, it is considered preferable for these journeys to be made using roads or highways that are higher in the roading hierarchy, which are anticipated to have a greater proportion of through traffic, and to have a significant role in supporting the local or regional economy. This might suggest that vehicles should instead use a route via State Highways 1 and 83. However, the intersection of the two highways is not conducive to accommodating an additional amount of traffic turning right from State Highway 1 to State Highway 83. Consequently, this option has not been assessed further.

The same philosophy would suggest that these trips should not be made using Weston Road/West View Drive (Collector Roads), as the remaining two routes (via Whiterocks Road, or the route using Seven Mile Road and Airedale Road) comprise entirely either Primary or Secondary Arterial roads. Furthermore, the bridge carrying Weston Road across the railway already has a speed limit due to identified structural deficiencies, and any increase in the volume of heavy vehicles using this route could adversely affect the structure.

7.6.5 Raw material sites

Limestone (to provide calcium) constitutes 80% of the raw materials required for manufacturing cement at Weston. To achieve the required cement chemistry other supplementary (or “secondary”) materials are required to provide elements such as

alumina, silica, and iron. Therefore, siltstone and tuff are needed in smaller quantities at Weston and silica sand is needed from Windsor.

The silica sand location at Windsor was chosen after a geological search for sand in the 1970s. Silica sourced from the other main materials is preferred but there is insufficient in the materials at Weston. If silica is unexpectedly found of sufficient quality and quantity through quarrying in Weston or Ngapara then the use of Windsor sand will be minimised, however, this is most unlikely.

7.6.6 Sources of Energy

Principal fuels for the firing of a cement plant include coal, pet coke, natural gas and oil. Pet coke is not available in New Zealand and natural gas is not reticulated in the South Island. Oil, diesel or other petrochemicals are prohibitive in cost.

In the South Island coal is mined in large operations in Southland and the West Coast. However, other small deposits do exist, most notably in Otago and Canterbury. The use of West Coast or Southland coals is feasible but will lead to longer transportation journeys via rail or road relative to coal sourced from Ngapara.

Used oil is proposed to be transported from the Port of Timaru to be used at the cement plant as a supplementary fuel. This is a shorter distance than alternative third party coal sources. This supply of used oil also utilises a waste stream as a fuel. Other disposal methods for this resource are environmentally less attractive (e.g. landfills, combustion in driers, use on roads for dust suppression).

Electricity supply would be sourced by the Transpower/Network Waitaki substations on Airedale Road. The main power feeder cable would be buried as it crosses the escarpment crest to eliminate any visual impact of poles.

7.6.7 Energy efficiency

Minimising fuel energy use in cement manufacture is achieved through:

- Preheating and precalcination to the fullest extent possible, considering the existing kiln system configuration.
- The use of modern clinker coolers to enable maximum heat recovery.
- Recovering heat from waste gas.

The kiln would have a modern 4-stage preheater with a precalciner, and a grate clinker cooler. Other than drying the raw materials and fuel, it is not feasible to extract any additional useful heat from the kiln exhaust gases.

Minimising electrical energy requirements is achieved through:

- Power management systems.
- Grinding equipment and other electricity based equipment with high-energy efficiency.

Power use would be managed by the central control system, including speed control to minimise electrical energy use on large fans. All grinding systems would feature modern vertical roller mills to give minimum specific power consumption.

Close liaison with the energy provider and distribution company may enable the sharing of any benefits from peak load shedding.

7.6.8 Size and selection of plant

Decisions regarding the capacity of the cement plant proposed have been made on the basis of:

- meeting current market demand for cement;
- being able to meet expected increases in future demand in the medium term;
- being a standard plant manufacturers build size; and

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- being efficient.

The choice of sufficient capacity to enable future growth is balanced by the consideration that surplus capacity requires frequent shutdowns and idle assets. The alternative of a smaller plant with higher utilisation in the initial years is the reality of a shorter time period before a return to importing cement from abroad.

The specific heights of stacks and preheater tower have been chosen as an engineering outcome to enable the most efficient use of the gas stream to dry incoming materials and to achieve requirements for emission mitigation. All building and structure heights are as low as possible (consistent with engineering and operational considerations) to minimise visual impact.

The type of cement kiln process selected has a major impact on energy use and level of air emissions. Holcim has chosen a short rotary dry kiln process. It is proposed to use a 4-stage preheater and precalciner. The system would be designed to ensure that all available heat from the clinker cooler and kiln exhaust gas is utilised in drying the raw materials and the lignite coal, and that no surplus heat is produced. The alternative considered was to use a 5-stage preheater. However, the expected raw material moisture is relatively high (around 15%). Due to the heat required for drying the raw materials and fuels, it is expected the heat consumption using a 5-stage preheater would be similar, or only marginally better than the estimated heat consumption using a 4-stage preheater (which is 3,300MJ/tonne clinker). Having a 5-stage preheater would increase the capital cost and height of the plant, while delivering at best only a marginal improvement in efficiency and no significant change in effects.

7.6.9 Plant operation

The best available techniques for the manufacturing of cement includes the following general primary measures:

- A smooth and stable kiln process, operating close to the process parameter set points, is beneficial for all kiln emissions and for product quality, as well as giving best energy efficiency.
- Process control optimisation, including computer-based automated control systems.
- The use of modern, gravimetric material and fuel feed systems.

The plant will feature a modern computer based central control system, and gravimetric solid fuel feed systems.

7.6.10 Air emissions

Careful selection and control of substances entering the kiln can reduce emissions. As far as possible, raw materials and fuels with low contents of sulphur, nitrogen, chlorine, metals and volatile organic compounds have been selected.

Quarry planning software would be used to manage the quarrying of the raw materials and coal in order to minimise fluctuations in the main emission generating elements and compounds. Such fluctuations would be further minimised by using modern online analysers and computer controlled blending beds for the coal and the main kiln feed raw materials.

The main stack height of 104 metres for the proposed cement plant was chosen as a height that would give adequate dispersion of contaminants based on experience with similar cement plants. It was also chosen to be 20m higher than the nearby pre-heater tower to avoid building downwash effects. When the dispersion of contaminants from the stack as designed was modelled, it was indeed found to give good dispersion of contaminants, with ground level concentrations of all contaminants within the relevant standards and guidelines.

The top of the stack would be 172m above sea level and would be below the escarpment behind the plant site, which ranges from 173m to 185 m above sea level.

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Modelling has shown that the plant would not be visible from either Oamaru or the Weston township. The discharge of water vapour from the stack would, in certain atmospheric conditions and depending on the moisture content of the raw materials, result in a visible water plume.

7.6.10.1 Oxides of Nitrogen

A range of possible processes have been considered to reduce NO_x emissions, including:

- Primary measures to control NO_x emissions.
- Flame cooling.
- Low-NO_x burner.
- Staged combustion.
- Selective non-catalytic reduction (SNCR).

Holcim has a target maximum NO_x (as NO₂) emission level (97% of daily averages to be below) of 500mg/Nm³ for new short kilns, and this is a part of the design criteria of the plant. Low NO_x burners are part of the proposed plant design but will be considered with caution, as they often do not provide the necessary flame properties for optimum product quality and good production rates. Flame cooling is also not desirable in that it increases heat consumption and is known to potentially cause kiln operational problems.

With staged combustion (as proposed) alone it may be possible to reduce NO_x to 500mg/Nm³, and this will be considered very carefully in the design phase of the project. However, raw materials, fuels, operation and AFR can have short-term impacts and give rise to peaks of NO_x. As a result, it is intended that selective non-catalytic reduction (SNCR) will be included in the plant design.

7.6.10.2 Oxides of Sulphur

The best available techniques for reducing sulphur dioxide (SO_x) emissions are the combination of general primary measures and:

For initial emission levels not higher than about 1200mg SO₂/m³:

- Absorbent addition.

For initial emission levels higher than about 1200mg SO₂/m³:

- Wet scrubber.
- Dry scrubber.

Holcim has a target maximum SO₂ emission level of 400mg/Nm³ for new short kilns, and this is a part of the design criteria of the plant.

In all kiln systems the solid material moves counter currently to the hot combustion gases, which means that there is the potential for gaseous pollutants to be absorbed. The proposed plant incorporates a kiln preheater, precalciner system and closed raw mill which together act as an effective scrubbing system. Many components that result from the combustion of the fuel or from the transformation of the raw material into clinker remain in the gas phase only until they are absorbed by, or condensed on, the raw material flowing counter currently. The adsorptive capacity of the material varies with its physical and chemical state, which in turn depends on its position within the kiln system. For instance, material leaving the calcination stage of a kiln process has a high calcium oxide content and therefore has a high absorptive capacity for acid species, such as SO₂, HCl and HF.

Based on SO₂ estimates for the manufacturing plant derived from raw material and coal analyses, it is not expected that additional abatement measures would be required in order to meet the target 400mg/Nm³ daily average emission level. Either wet or dry scrubbing is only required where initial emission levels are higher than

about 1200mg/Nm³ (which is not the case with the proposed plant). However, the plant would be designed so that it can be retrofitted with a sulphur absorbent addition system. This would consist of a dosing system to add dry hydrated lime (Ca(OH)₂) to the kiln feed. The addition would be controlled as a function of the SO₂ in the stack.

7.6.10.3 Dust

A range of potential options to minimise dust have been considered including:

- Electrostatic precipitators with fast measuring and control equipment to minimise the number of CO trips
- Fabric filters with multiple compartments and ‘burst bag detectors’ where applicable.

The main point source dust emissions of the proposed Weston plant are the kiln exhaust (de-dusting also the raw mill, the coal mill and the cooler) and the cement mill exhaust. Holcim standard is to use modern bag filters for all such process de-dusting. Bag filters collect particulate matter of any size and chemical composition by filtration, whereas electrostatic precipitators (EPs) collect only electrically chargeable particles. EPs must be shut off in cases of process disturbance (such as explosion protection in the event of excess CO formation) whereas baghouses are not process sensitive. The bag house dust emission is stable at low dust emission levels at any time. Modern bag filters have dependable dust emissions of less than 30mg/Nm³. Depending on bag filter technology and fabric type this may vary from below 10mg/Nm³ for pulse jet filter with membrane bags up to 30mg/Nm³ for reverse air filter with woven fabrics. In the case of Weston, pulse jet filters will be standard in all cases.

The main process filters (kiln and cement mill) would have continuous dust level monitoring, which would immediately highlight any bag damage. Some of the larger more critical nuisance dust filters would also have damaged bag indication. In most cases filters can be shut down to replace damaged bags. However, the main kiln bag filter would have individual compartments that would be automatically isolated by the control system when a problem was detected so that bags could be changed without taking the kiln off-line if necessary.

A large number of small jet-pulse fabric filters (current estimate 40-45) would be employed at all points within the plant where nuisance dust is likely to occur (e.g. conveyor transfer points, silo venting).

At the plant site, the main raw material and coal storage would be enclosed in buildings and have automatic stacking and reclaim systems. The clinker storage silos would likewise have automatic discharge systems.

The gypsum, corrective limestone and sand would be stored in out-door stockpiles. The gypsum and limestone are not expected to give rise to any dust issues, but the sand may require storage within concrete walls to provide a wind barrier. It is planned that gypsum be stockpiled at, or near, its receiving port and transported to the plant as required (gypsum is imported). The alternative is to campaign truck gypsum to a large stockpile at Weston, which would require significant round the clock truck movements.

In the pits and quarries, open piles would be avoided or kept to a minimum. Again, only sand is expected to give rise to any potential dust problems (the other materials tend to be higher in moisture and generally non-dusting). It is planned that sand stockpiles in the pit would be minimal, and dust would be controlled by watering in the event of significant wind.

Watering systems would be provided for roads and open stockpiles where dusting is likely to occur, especially in the event of significant wind.

On the plant site, all roads would be paved. Although the roads at the pits and quarries would be generally unpaved, mobile water tankers would be available for all sites to water the roads as required. Good housekeeping practices would form a part of the

management systems at all sites and a vacuum road sweeper would be used at the plant site to keep the roads dust free.

7.6.11 Cement kiln dust

Cement kiln dust (CKD) has been a past problem in the cement industry. However, based on the current raw material testing, all dust produced by the proposed Weston plant would be recycled into the clinker. In the future the use of alternative fuels and raw materials (AFR) may require the use of a kiln bypass to remove some alkali or sulphur. In this event any excess dust would be selectively incorporated into some of the cement produced.

7.6.12 Water supply

Several options have been considered in terms of supplying water to the various project sites. For the plant and other project sites a key principal in project design is the capture and reuse of water wherever possible. In augmenting that, the principal alternatives that have been considered for the plant site include:

- Local groundwater supply from bores located on-site (the preferred option).
- Reticulated supply from the Oamaru town water supply system.
- Surface water supply from the Waiareka Creek that could involve subscription to the North Otago Irrigation Company (NOIC) to augment water in the stream.

The preferred option of bore supply has been assessed to be both technically feasible and environmentally acceptable. It also has the advantage over other alternatives in terms of cost and security of supply.

At both the quarry and pit sites at Weston, Windsor and Ngapara, the proposal is again to wherever possible re-utilise water captured in the management of stormwater and groundwater inflows to the respective pits at each site, for purposes such as dust control. The limited potable water requirements at these sites would be met through supply from NOIC with on-site treatment. The proposed approach and possible alternatives at respective sites is summarised below:

- Weston (tuff quarry area):
 - Wherever possible re-utilise water captured in the management of stormwater and groundwater inflows to the respective pits for purposes such as dust control.
 - Source water from NOIC (via pipeline) to augment stormwater and into pit seepage for dust control.
 - Potable water requirements would be sourced from the NOIC supply via a small water treatment plant.

Groundwater bore(s) have been considered, but have not yet been investigated. There is uncertainty of drilling success for a groundwater bore and the potential that this could cause a draw down of groundwater levels in the surrounding area.

Given that NOIC supply offers a feasible solution, Holcim has not considered it necessary to investigate groundwater supply further at this time. If that were considered necessary in the future, a water investigation would be undertaken and consented.

- Ngapara:
 - Wherever possible re-utilise water captured in the management of stormwater and groundwater inflow into the pit for purposes such as dust control.
 - Source water from NOIC (via pipeline) to augment stormwater and into pit seepage for dust control.

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- Potable water requirements would be sourced from the NOIC supply via a small water treatment plant.

Given that NOIC supply offers a feasible solution, and that the area is within an aquifer recharge zone, groundwater bores were not considered as an option. Also there is uncertainty of success for a groundwater bore and the potential that this could cause a draw down of groundwater levels.

- Windsor:
 - Wherever possible re-utilise water captured in the management of stormwater for purposes such as dust control (although this is expected to be minimal).
 - As a preferred option, source water from NOIC (via pipeline) to augment stormwater for dust control.
 - Potable water requirements would be sourced from the NOIC supply via a small water treatment plant or by importing the minimal amounts required.

Given the very free-draining nature of the sand, it is expected that minimal stormwater would be captured and re-used.

The Windsor water scheme from the Kakanui River (used for home and stock water) was considered, but Holcim understand it is currently fully allocated. However, some users may surrender their allocations following their connection to the NOIC scheme, so this may become a viable option in the future.

7.6.13 Wastewater treatment and disposal

For the plant site, a number of options for wastewater treatment and disposal have been considered, including:

- Pumping untreated sewage to the Council's reticulated sewage system at Weston.
- Septic tanks.
- Intermittent sand filters or granular medium filters.
- Waste stabilisation pond (e.g. oxidation pond).
- Suspended biological process (such as activated sludge).
- Batch treatment system such as a sequencing batch reactor.
- Fixed film biological process.
- Membrane bioreactor (MBR).

The management strategy for the project of considering all water as a resource and providing for re-use wherever possible eliminates the option of pumping to the Waitaki District Council system. On-site treatment options are further reduced due to the requirement for a high quality treated wastewater suitable for non-potable use around the site (e.g. in the irrigation of landscaped areas). The selected option is use of a MBR process, known to offer benefits over other on-site treatment options in terms of reduced operational and maintenance costs, reduced sludge production, and high levels of reliability combined with high levels of contaminant removal.

Under normal circumstances treated wastewater would not be discharged to the environment, and instead would be reused as toilet flush water, for truck washing and in the process of cement manufacture. However, provision has been made for disposal via drip irrigation in the event of excess wastewater generation.

At the Weston quarries, toilet and wastewater facilities are proposed to be located in the workshop and at the crusher facilities. Sewage and grey water from the crusher facilities would be captured and stored in a self-contained tank before being pumped to the wastewater management system at the nearby cement plant.

At both the Weston quarries and at Ngapara the low volume of wastewater to be generated limits the wastewater treatment options available. Three viable options have been identified and considered – septic tank, aerated wastewater treatment and a textile packed bed treatment system (TPBR). Of these options the TPBR system would provide the best treatment performance at each site, offering a relatively robust process with a greater ability to respond to sudden changes in organic loads. The septic tank option would be a relatively poor performer while aerated systems are expensive to operate and typically do not remove organic nitrogen from the waste stream.

The disposal of treated wastewater at the Weston quarries and at Ngapara would be to land by either subsurface drip line or field drain. It is proposed that the respective disposal fields at these sites be located outside of the ORC A zone groundwater protection zones and more than 50m from any surface water body or bore. As a subsurface system, no direct human contact is anticipated.

At Windsor, there would be no requirement for any on-site wastewater treatment or disposal. Toilet would either be of a composting type or provide for collection and disposal of wastewater to an approved facility off site.

7.6.14 Pit water treatment - Ngapara

The purpose of the water treatment facilities proposed for Ngapara is to treat coal and sediment contaminated water from exposed coal faces, stockpiles and engineered landfills (ELF) and load out areas within the pit. The treatment plant would also provide for the correction of pH, by adding lime, should periods of low pH be experienced.

The physical properties of the suspended coal fines and colloidal sediments means that conventional gravity separation would not be effective in removing them, and to improve separation chemical coagulation would be required.

Three options have been examined in determining a suitable water treatment plant configuration for Ngapara. They are:

- Chemical treatment, flocculation, settling pond and sludge remove and air drying.
- Chemical treatment, flocculation, mechanical clarifier (lamella), sludge consolidation pond.
- Chemical treatment, flocculation, mechanical clarifier (lamella), sludge dewatering via belt press.

All require an alum dosing facility followed by flash mixer and flocculator. The difference lies in the final treatment stage. All three options would provide effective treatment.

7.6.15 Stormwater Management/Discharge

The water management strategy for the Weston plant is based on providing high environmental standards that are consistent with sustainable development principles. To provide a sustainable approach to water management, all water (potable water, stormwater and wastewater) will be treated as a resource and recycled and reused onsite. Among other things, achieving the water management strategy requires the collection and storage of stormwater.

The stormwater management concept is based on the principle of maximising the amount of stormwater that can be captured and used. Stormwater from the plant site and the crusher area of the quarry is held in two on-site ponds for re-use. Stormwater exceeding the capacity of the two on-site ponds will flow into soil adsorption basins designed to capture a 50 year, 72 hour rainfall event and be discharged slowly to ground through an engineered soil media. The total storm retention volume concept based on a 2% AEP event of 72 hours duration provides a significant level of service for on-site management and disposal of stormwater.

Consideration of Alternatives

The combined water holding pond and soil adsorption basin system will only discharge directly to surface water during events greater than a 2% AEP (approximately once every 50 years) event of 72 hour duration. The discharge to surface water via secondary overflows is thus expected to be a very rare occurrence. The overflows will be via natural secondary overflow paths and the flows from the site will be no greater than for the existing pre-development situation.

The option of treating stormwater and discharging directly to the Waiareka Creek was considered. However this option would not meet the objectives of sustainable development and maximising water utilisation and re-use, and would require the construction of a new outfall drain to the Waiareka Creek through private land or along the council's road reserve. The issues associated with purchase of a drainage corridor and constructing a drain through private property (or council's road reserve), along with the higher levels of treatment obtained in a soil adsorption basin resulted in the proposed option being adopted.

For the quarries and pits, there are very limited opportunities to construct adequately sized soil adsorption basins below the sediment settling ponds of the respective quarries / pits. Thus for the quarries and pits the approach adopted is of treating the pit inflows and stormwater and discharging directly to nearby waterways.