TECHNICAL COMMITTEE AGENDA

WEDNESDAY 2 MAY 2018

8:30 am Auditorium, Toitū Museum
31 Queens Gardens, Dunedin

Membership

Cr Andrew Noone	*(Chairperson)*
Cr Ella Lawton	*(Deputy Chairperson)*
Cr Graeme Bell	
Cr Doug Brown	
Cr Michael Deaker	
Cr Carmen Hope	
Cr Trevor Kempton	
Cr Michael Laws	
Cr Sam Neill	
Cr Gretchen Robertson	
Cr Bryan Scott	
Cr Stephen Woodhead	

Disclaimer
Please note that there is an embargo on agenda items until 8:30 am on Monday 30 April 2018. Reports and recommendations contained in this agenda are not to be considered as Council policy until adopted.

TABLE OF CONTENTS

1. APOLOGIES

2. LEAVE OF ABSENCE

Cr Graeme Bell

3. ATTENDANCE

4. CONFIRMATION OF AGENDA

5. CONFLICT OF INTEREST

Members are reminded of the need to stand aside from decision-making when a conflict arises between their role as an elected representative and any private or other external interest they might have.

6. PUBLIC FORUM

7. PRESENTATIONS

8. CONFIRMATION OF MINUTES

Recommendation

That the minutes of the meeting held on 21 March 2018 be received and confirmed as a true and accurate record.

Attachments

1. Minutes of the Technical Committee - 21 March 2018 **[8.1.1]**

9. ACTIONS

Status report on the resolutions of the Technical Committee.

Report No.	Meeting	Resolution	Status
11.1 Director's Report on Progress	31/1/2018	*That Otago Regional Council enter into discussion with the Central Otago District Council (CODC) and the NZ Transport Agency (NZTA) with an aim to identifying, with acceptance by all parties, the STEDs in the Central Otago district and for the Dunstan Ward councillors to be kept informed as to progress.*	CLOSED Item 10.1 of the agenda 2/5/18

10. MATTERS FOR COUNCIL DECISION

10.1. Central Otago STED Site no. 2

Prepared for:	Technical Committee
Activity:	Governance Report Transport - Stock Truck Effluent Disposal Sites
Prepared by:	Chris Valentine, Manager Engineering
Date:	27 April 2018

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1. Précis

In response to stock effluent being spilled on Otago roads, and the health, safety and environmental issues this spillage raises, Otago Regional Council and Environment Southland (through the Otago/Southland Road Transport Committee), have adopted a strategic approach of installing a network of Stock Truck Effluent Disposal Sites (STEDS) in the lower South Island. There is presently one STEDS in Central Otago, at Raes Junction. The 2015/25 Long Term Plan (LTP) proposed the construction of two new STEDS in Central Otago. The construction of one STEDS has been approved at SH85 Brassknocker Road at Council Committee meeting on 11 April 2018.

The proposed second new site has been subject to further review at the request of Central Otago District Council (CODC). This report sets out the site selection and development process to date, provides detail on viable sites, and notes SH6 Ripponvale Straight is the most appropriate, and preferred site for the second new STED. The 2018/28 Draft Long Term Plan assumes both new Central Otago STEDS are constructed by 30 June 2018. We recommend Council requests for CODC to formally advise their preferred site for the second new STEDS in Central Otago by 31 July 2018.

2. Background

The Otago Regional Council and Environment Southland adopted a joint strategy that included installing a network of stock truck effluent disposal facilities at strategic locations throughout Otago/Southland. As part of this strategy the Otago Regional Council has two Annual Plan targets to design and construct two new STEDS in Central Otago. The 2016/17 and 2017/18 annual plans allow for the design and construction of these two STEDS.

In 2010, the number of stock effluent spills on the State Highway resulted in an investigation by the New Zealand Transport Agency (NZTA) to quantify the frequency and location of stock effluent spills. The NZTA commissioned Opus consultants to review key locations across the State Highway Network for the suitability to site new STED sites. The work completed by NZTA and Opus in 2010 and 2014 was the starting point for site selection in this project. It was identified early that a second site in the vicinity of Cromwell would be required to complete the network of STEDS across Otago and Southland. A facility located near Cromwell has been identified as a strategic and key location. This location was identified on proposed network maps as early as 2013.

In 2016, the Road Transport Association (RTA) surveyed their members to seek feedback on the frequency of stock movements along different routes and areas where a stock effluent disposal facility would be beneficial.

In March 2017, CODC were advised of the intent to build two stock effluent disposal facilities in Central Otago, with one site on the state highway in the Cromwell area. Discussions started at this stage about effluent disposal. Further consultation occurred from June 2017 onwards on effluent disposal and site options.

The ORC held workshops with the NZTA, RTA and one of the larger stock transporters to identify key preferred locations based on stock movements (present and future), distance to other sites, and known areas of frequent effluent spillage. Nonspecific locations were identified in these workshops. In April 2017, the RTA took these general locations back to their members for further feedback. Liaison with representatives of NZTA and RTA over March and April of 2017 confirmed that a site on SH6 near Cromwell would be preferred, as it covered stock routes travelling to both the Tarras/Omarama area as well as growing demand from the Hawea Flat area. Crucially, it would help alleviate effluent issues in the highly sensitive Frankton/Queenstown area amongst other areas.

In May 2017, Opus was commissioned to identify potential sites with consideration of the following criteria:
1. The site shall allow for safe entry/exit from both directions; and
2. Identify any conflicts with future NZTA works or developments; and
3. Identify any environmental or social restrictions or implications on the site; and
4. Consider ways to landscape to improve visual amenity of the site.

The final report submitted by Opus on 9 June 2017[1] considered nine possible locations with six sites recommended for further assessment. The SH6 Ripponvale Straight site was one of the sites recommended, the alternative SH6 site at Pearson Road was not recommended.

In June 2017, the ORC, RTA and NZTA held a further workshop to review the Opus report on specific sites. It was agreed at this workshop that SH6 Ripponvale Straight site would be progressed.

Opus Consultants were engaged by ORC in August 2017 to carry out specific design of the STEDS to be constructed in the 2017/18 financial year. In November 2017, CODC and other local businesses but not immediately adjacent landowners, raised concern about the proposed site as they felt it was not appropriate due to existing, and proposed, upmarket tourist developments in the area. ORC highlighted that the site would be landscaped and that other than a truck parked in the road reserve or the entry or exit roads, the site and effluent receiving or containment infrastructure would be hidden by appropriate landscaping.

3. Site Options

Opus initially identified two sites on SH6 in the vicinity of Cromwell which would address stock movements to both Tarras/Omarama area as well as Hawea Flat. A third site was identified on the western side of the Kawarau Gorge at Gibbston on Victoria Flats Road which would also address stock movements from both areas above, however it would be beyond the Kawarau Gorge in the direction that spillage has previously been identified as a reoccurring problem. Two further sites were identified that would only address stock movements to Tarras and Omarama on State Highway 8, these sites were Bendigo Loop Road and near Tarras on the Lindis Peaks Straight.

[1] Stock Effluent Disposal Site Evaluation – Central Otago, Opus International Consultants Ltd, 09 June 2017.

The proposed sites at Victoria Flat and Pearson Road have been excluded for safety reasons relating to potential for unsafe vehicle interactions. This site is included below for completeness, as the site was raised twice by CODC for further investigation. On both occasions Opus and NZTA concluded the site was not viable on road safety grounds.

Following a request from CODC on 14 February 2018, ORC commissioned Opus to review the site selection with a change in acceptability criteria to ensure that no sites were discounted due to constraints that could be addressed by other means. Opus reviewed STED site options around Cromwell and within the Kawarau Gorge, but no further viable sites were identified. On 2 March 2018, CODC indicated that they had identified alternative sites and Opus were instructed to contact CODC and investigate any further sites that CODC had identified. In the end, CODC were unable to put forward any further sites for investigation.

The only viable site that has been identified to address stock movements in the direction of Omarama and Hawea Flat is on SH6 at Ripponvale Straight. The site on Lindis Peaks Straight on SH8 would only address stock movements towards Omarama.

4. Site 1 – Ripponvale Straight (SH6)

The proposed location is located on the Ripponvale Straight – near Sarita orchard on State Highway 6, as shown on figure 2. The site adjoins land owned by 45 South Cherry Orchards Ltd.

The proposed site location has no immediate traffic conflicts and has excellent site visibility in both directions. In terms of proximity to residential properties or businesses, the proposed site is located some 400m away from the closest dwelling. It is considered relatively easy to screen/landscape the site.

Detailed design has been largely completed for this site.

Figure 1 - Ripponvale Straight - proposed site to be located on left side of photo, heading towards Cromwell.

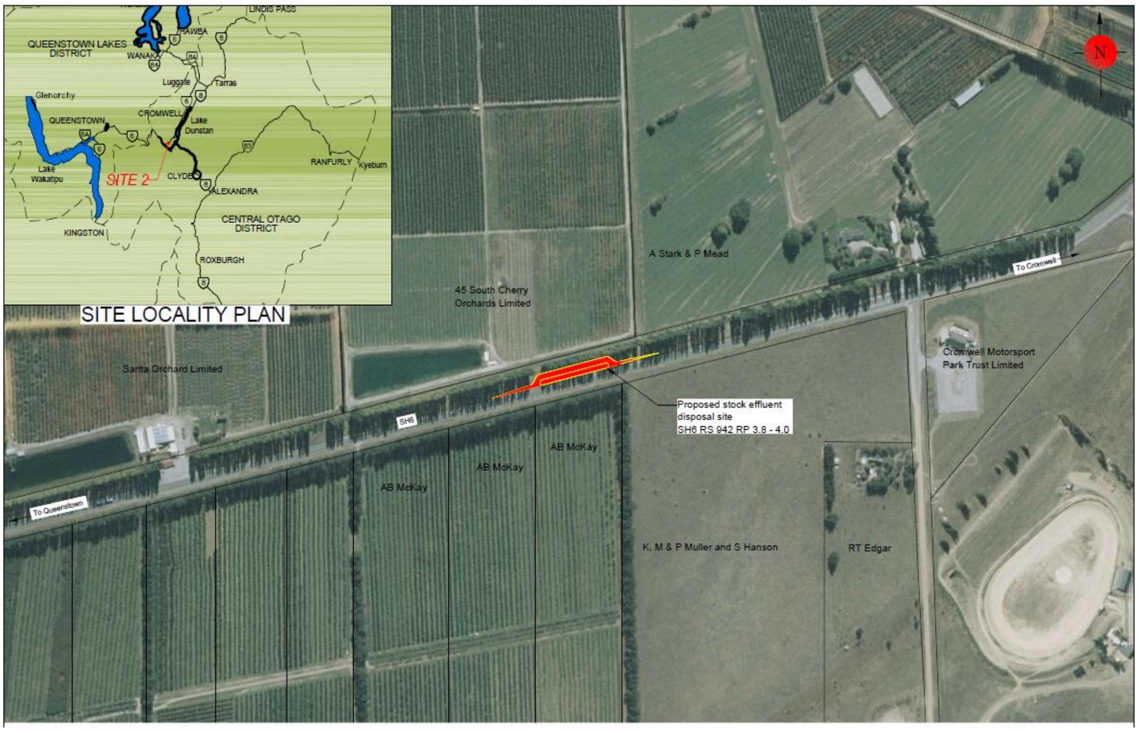

Figure 2 - Ripponvale Straight - Proposed Site

5. Site 2 – Tarras, Lindis Peaks Straight (SH8)

This site is on the right-hand side of SH8 approaching Tarras from the Lindis Pass.

This site has no immediate traffic conflicts and good site visibility in both directions.


Figure 3 – Lindis Peak Straight - proposed site to be located on right side of photo. Photo is taken heading towards Cromwell.

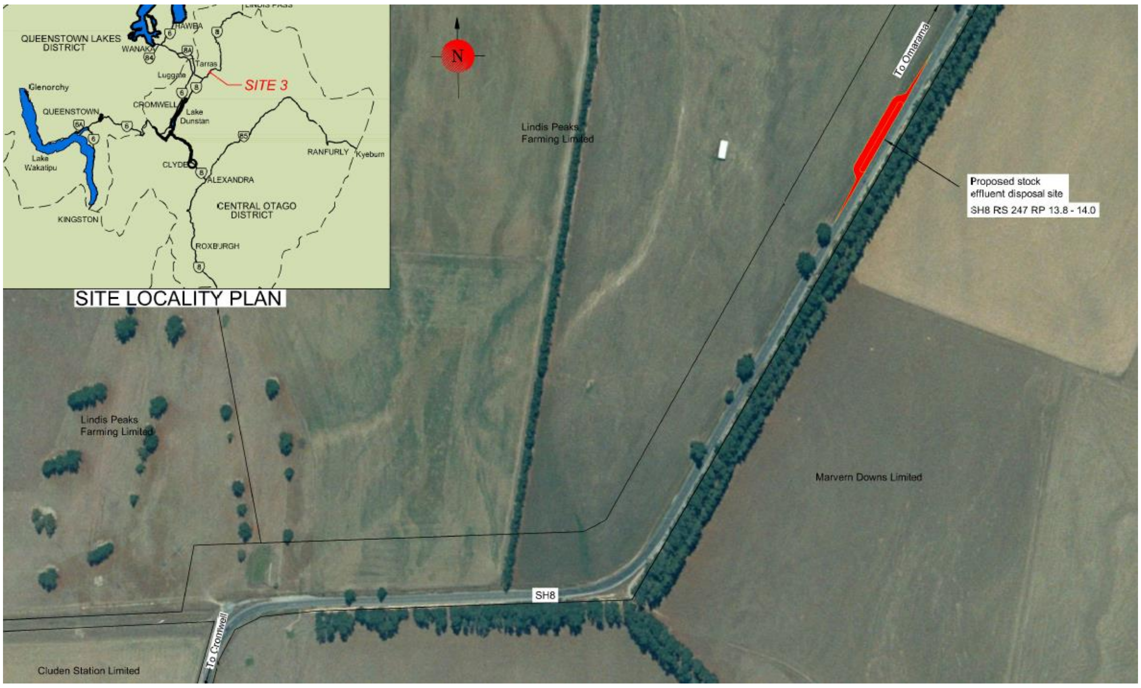

Figure 4 - Lindis Peak Straight - Proposed Site Plan

6. Site 3 – Pearson Road (SH6)

CODC have asked for a review of a site previously considered at Pearson Road. The proposed location is on the approach to the Kawarau Gorge shortly after Pearson Road on the true left beside the Kawarau River.

Due to the proximity of the adjacent properties there is conflicting traffic movements in this location. NZTA have said they will not allow this site to be used because of safety concerns[1].

[1] Letter, John Jarvis, Senior Network Manager Otago System Design & Delivery, NZTA, 18 April 2018.

Figure 5 - Pearson Road Proposed Site to be located on left side of photo looking west

Figure 6 - Pearson Road Proposed Site

The Pearson Road site was not recommended previously for the following reasons:

- Conflicting traffic movements with several access points
- Close proximity to existing fruit sale stalls and residential properties
- The section is an attractive entrance to the Kawarau Gorge
- The site is currently the location of the NZTA VMS boards and notification sites for the Kawarau Gorge which would require relocation. The VMS board needs to stay beyond the Pearson and Bannockburn intersection.

7. Conclusion

If a second site is to be progressed, the next step could be to complete detailed design and an outline plan, the latter would be submitted to CODC. In parallel to the outline plan process, staff would negotiate with the successful contractor for the SH85 Brassknocker Road STEDS to obtain pricing to incorporate a second site into their contract. Endorsement to incorporate this site into a construction contract could be sought at the June Council meeting.

A scope cost adjustment may need to be made to NZTA only if the projected NZTA cost of both this site and the existing SH85 site exceeds the NZTA approved funding. There is a small risk that additional funding may not be forthcoming. To secure the approved funding for a second site it is desirable to have a contract negotiated before 30 June 2018. If a decision is made to proceed with a second site, award of this site should be subject to approval of additional NZTA funding and any consents and approvals that maybe required.

It is noted that the SH6 Ripponvale Straight site is the preferred site as it meets road safety criteria and would provide the necessary infrastructure, in the right location, to address areas of known stock effluent spillage. It is recommended that Council requests for CODC to formally advise their preferred site for the second new STEDS in Central Otago by 31 July 2018.

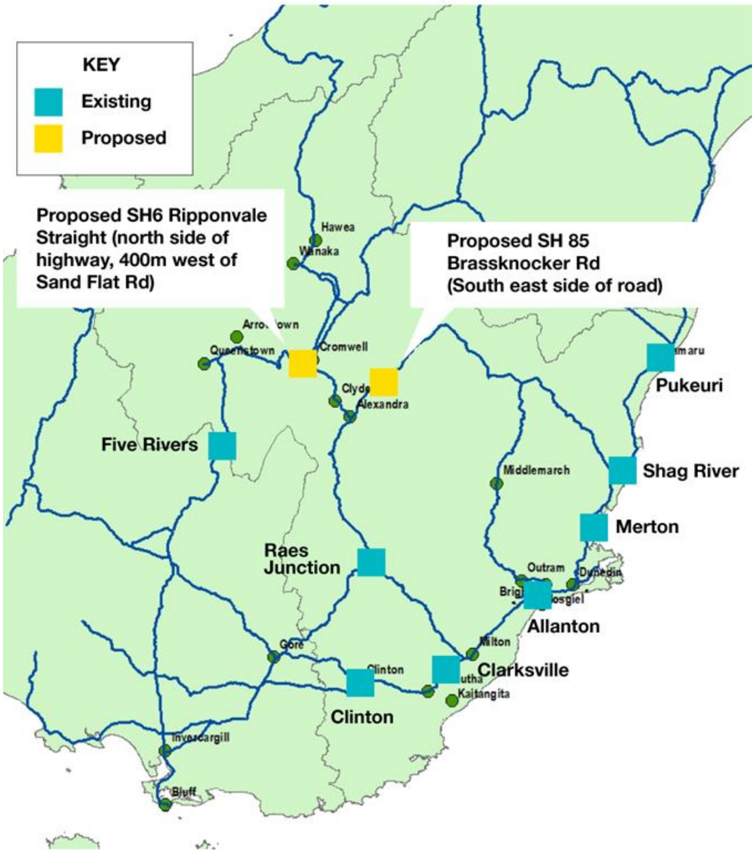

Figure 7 The Otago and Southland network of STEDS

8. Recommendation

a) *This report is received and noted; and*

b) *Council requests for Central Otago District Council to formally advise their preferred site for the second new STEDS in Central Otago, by 31 July 2018.*

Endorsed by: Gavin Palmer
Director Engineering, Hazards & Science

Attachments

1. Technical Committee - 2 May 2018 - Matters for Decision - Appendix A Stock Truck Effluent Disposal S **[10.1.1]**

11. MATTERS FOR NOTING

11.1. Implications of a PM2.5 standard on air quality management

Prepared for:	Technical Committee
Activity:	Environmental - Air Management Planning Environmental - Ambient Air Quality Monitoring & Reporting
Prepared by:	Deborah Mills, Environmental Scientist
Date:	2 April 2018

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1. Précis

The quality of outdoor (ambient) air is generally characterised by a suite of five pollutants, including particulates, sulphur dioxide, nitrous oxides, carbon monoxide, and ozone. The pollutant of concern in Otago is particulates, which are particles – either solid or liquid – suspended in the atmosphere. Particulates are referenced by their size, as PM_{10} (all particles with a diameter less than 10 micrometres) or $PM_{2.5}$ (all particles with a diameter less than 2.5 micrometres). Every PM_{10} air sample that our monitors collect contains particles of all sizes smaller than 10 micrometres; the distribution of those sizes in the sample depends on the sources of the pollution. The particles themselves are comprised of a multitude of chemical compounds with varying degrees of toxicity.

The 2004 National Environmental Standard for Air Quality (NESAQ) set a concentration of 50µg/m^3 for PM_{10} over a 24-hour averaging period. In 2015 the Parliamentary Commissioner for the Environment (PCE) reviewed the 2014 Air domain report[1] and recommended that an annual average $PM_{2.5}$ standard be investigated as a more appropriate metric for protecting human health[2].

This recommendation is in line with the World Health Organization's (WHO) 2013 report advising that annual average $PM_{2.5}$ levels are most closely aligned with indicators of adverse health impacts. Since the original 2005 WHO guidelines were developed, a large number of studies have provided evidence on the role of elevated particulates, and $PM_{2.5}$ in particular, on adverse health effects. Some of these effects include:

- Systematic inflammation associated with cardiovascular events
- Increased respiratory infections and asthma in young children
- Enhanced atherosclerosis
- Ischaemic heart disease
- Reduced cognitive function in adults

Evidence for these and other health effects are detailed in the WHO's latest scientific review of the health aspects of air pollution[3]. (See Appendix 1 for a list of other major scientific review papers summarising the literature).

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[1] Ministry for the Environment and Statistics New Zealand (2014). *New Zealand's Environmental Reporting Series: 2014 Air domain report.* Available from www.mfe.govt.nz and www.stats.govt.nz.

[2] Parliamentary Commissioner for the Environment, *The state of air quality in New Zealand: Commentary by the Parliamentary Commissioner for the Environment on the 2014 Air Domain Report*, March 2015, Wellington

[3] World Health Organization, 2013. *Review of evidence on health aspects of air pollution – REVIHAAP project technical report.* Conn: Centre for Environment and Health, World Health Organization.

In 2016, the Ministry for the Environment (MfE) began a review of the current standard, giving consideration to the PCE's findings; the outcome of the review is unknown, but it is likely that some form of a $PM_{2.5}$ standard will be introduced. This report discusses the implications of a $PM_{2.5}$ standard on Otago's ability to meet an amended NESAQ, and the subsequent effect on air quality management.

The key findings from this work are that in our polluted towns:

- $PM_{2.5}$ levels will exceed the WHO's recommended $PM_{2.5}$ values by a significantly larger margin than the PM_{10} levels already exceed the PM_{10} standard.

- Regardless of that larger margin, the approach to air quality management and scale of intervention required remain the same: in order to meet the current PM_{10} standard, or a stricter $PM_{2.5}$ standard, a wholesale shift to the cleanest heating appliances available – pellet burners, ultra-low emission burners, heat pumps, etc. – is required. That is, the change from using PM_{10} to using $PM_{2.5}$ as the measure of air quality does not in itself require more effort.

Section 2 discusses the structure of the current guidelines (recommendations) and standards (rules) as they relate to particulate matter. Section 3 explains the scope and methodology of this study. Section 4 describes the implications of possible $PM_{2.5}$ standards for Otago. Section 5 indicates the potential effect on air quality management, and a brief summary is provided in Section 6.

2. Guidelines and standards

The NESAQ ambient standards are a subset of the ambient air quality guidelines (AAQG, 2002) which were set by MfE to guarantee a level of protection to protect human health and the environment.[1] The ambient guidelines provide recommended levels of pollutant concentrations; most of these guidelines are taken from guidance provided by the World Health Organization.[2]

Three fundamental metrics related to particulate matter (PM) guidelines and standards are:

1. Size fraction
    a. PM_{10}: all particles, regardless of source, suspended in the air that have a diameter of less than 10 micrometres. At this size, particles are small enough to be inhaled. This size fraction generally includes natural and human-made emissions.

    b. $PM_{2.5}$: a subset of PM_{10}, these are the particles smaller than 2.5 micrometres in diameter. These are referred to as the "fine" fraction and are small enough to travel deep into the respiratory system; the smallest of these are capable of entering the bloodstream. This size fraction is generally made up of emissions from combustion.

[1] Ministry for the Environment, 2002, *Ambient Air Quality Guidelines*, Report ME437 prepared by the Ministry for the Environment and the Ministry of Health, Wellington.
[2] World Health Organisation, 2006, *Air Quality Guidelines Global Update 2005, Particulate matter, ozone, nitrogen dioxide and sulphur dioxide.* Denmark, WHO Regional Office for Europe.

2. Exposure
    a. short-term: regarded as exposure to PM concentrations over a daily period

    b. long-term: regarded as exposure to PM concentrations over an annual period

3. Number of exceedances
   This is the allowed number of breaches of a standard or guideline.

Current standards and guidelines related to particulate matter are shown in Table 1.

Table 1: Current standards and guidelines related to particulate matter.

Contaminant	Concentration limit ($\mu g/m^3$)	Averaging period	Allowable exceedances (per annum)
National Environmental Standards for Air Quality (NESAQ)			
PM_{10}	50	24-hour average	1
World Health Organization Guidelines			
PM_{10}	20	Annual average	No exceedances
$PM_{2.5}$	10	Annual average	No exceedances
PM_{10}	50	24-hour average	3
$PM_{2.5}$	25	24-hour average	3

Note that for the WHO guidelines the recommended $PM_{2.5}$ values are half the PM_{10} values, i.e. 25 versus $50\mu g/m^3$ for a daily limit, and 10 versus $20\mu g/m^3$ for an annual average limit. This is due to an assumption that $PM_{2.5}$ comprises approximately 50% of a PM_{10} sample. This assumption may hold for environments with an diverse mix of particulate sources (e.g. Central Dunedin), but it is unlikely to be true where emissions from solid-fuel burning provide the vast majority of particulates (e.g. Air Zone 1).

The majority of emissions from wood burners are in the $PM_{2.5}$ size fraction therefore the $PM_{2.5}$:PM_{10} ratio is much higher for most Otago towns. This has implications for air quality management as discussed in Section 4.

3. Study scope and methodology

Four sites – Alexandra, Arrowtown, Central Dunedin, and Mosgiel – were chosen for this study for three reasons:

- These sites have run year-round for a number of years and therefore have the most robust annual averages

- These sites represent the three main Otago airsheds and can be viewed as proxies for the remaining towns. For example, Alexandra and Arrowtown results can be translated to Clyde and Cromwell.

- These sites are currently used for reporting to MfE. Results of this analysis will give an indication of whether Otago is likely to meet $PM_{2.5}$ standards.

Council does not currently monitor $PM_{2.5}$ in Otago[1]; therefore, a synthetic dataset of $PM_{2.5}$ values for each town was modelled by adjusting its existing PM_{10} record using appropriate ratios of $PM_{2.5}$-to-PM_{10}. Ratios were developed after an analysis of the existing New Zealand literature, and a review of the source apportionment work done in Dunedin[2] and Alexandra[3]. They follow closely the NIWA-developed ratios used by the Ministry for the Environment during their review of the NESAQ.

Ratios were then applied to the PM_{10} dataset to develop a synthetic $PM_{2.5}$ record which was assessed against limits that may be introduced in a revised NESAQ. (See Appendix 2 for a further description of the methods and ratios used in this analysis).

Assessments were made for annual averages, daily averages, and the number of exceedances against each $PM_{2.5}$ synthetic record. Evaluations of the PM_{10} records for current standards and guidelines are also provided to illustrate the comparative effect of changing to a $PM_{2.5}$ standard.

4. Implications of $PM_{2.5}$ standards for Otago

4.1 Annual Average

There are currently no New Zealand rules for PM annual averages. Current World Health Organisation annual average guidelines are:

- PM_{10} - 20µg/m^3
- $PM_{2.5}$ - 10µg/m^3

Figures 1-4 show each site's PM_{10} (left side) and modelled $PM_{2.5}$ (right side) annual averages in relation to their respective guideline figures.

[1] $PM_{2.5}$ monitoring is scheduled for Central Dunedin this year and an Air Zone 1 site next year.
[2] Davy, P et al., *Source apportionment of airborne particles at North Dunedin*, GNS Science Consultancy Report 2011/131, June 2011
[3] Ancelet, T et al., *Particulate matter sources on an hourly timescale in a rural community during the winter*, Journal of the Air & Waste Management Association, April 2014

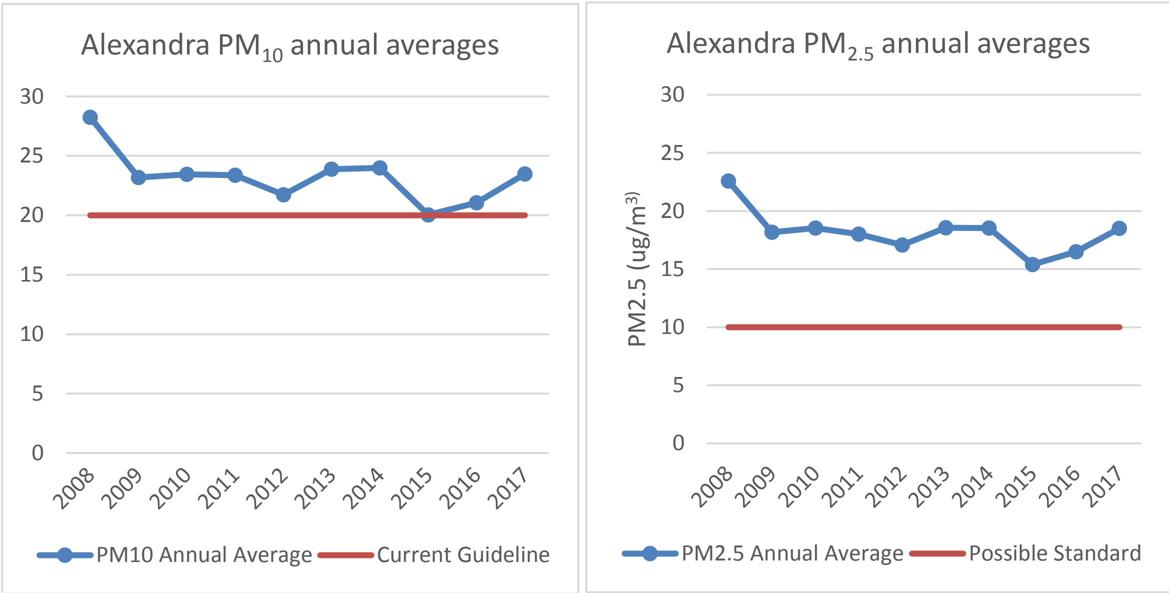

Figure 1. Alexandra: The left graph shows the actual PM_{10} annual average versus the PM_{10} guideline; the right graph shows the synthetic $PM_{2.5}$ annual averages versus guideline values (possible standard).

Alexandra's PM_{10} annual average (shown on left) has consistently been about 20% above the guideline value of 20µg/m^3 although it has been decreasing; in 2015, it did meet the guideline.

Annual averages of $PM_{2.5}$ (synthetic values shown on right) would not have met the lower annual average value of 10µg/m^3 and in 2017, the synthetic $PM_{2.5}$ annual average was nearly twice the lower limit of 10µg/m^3.

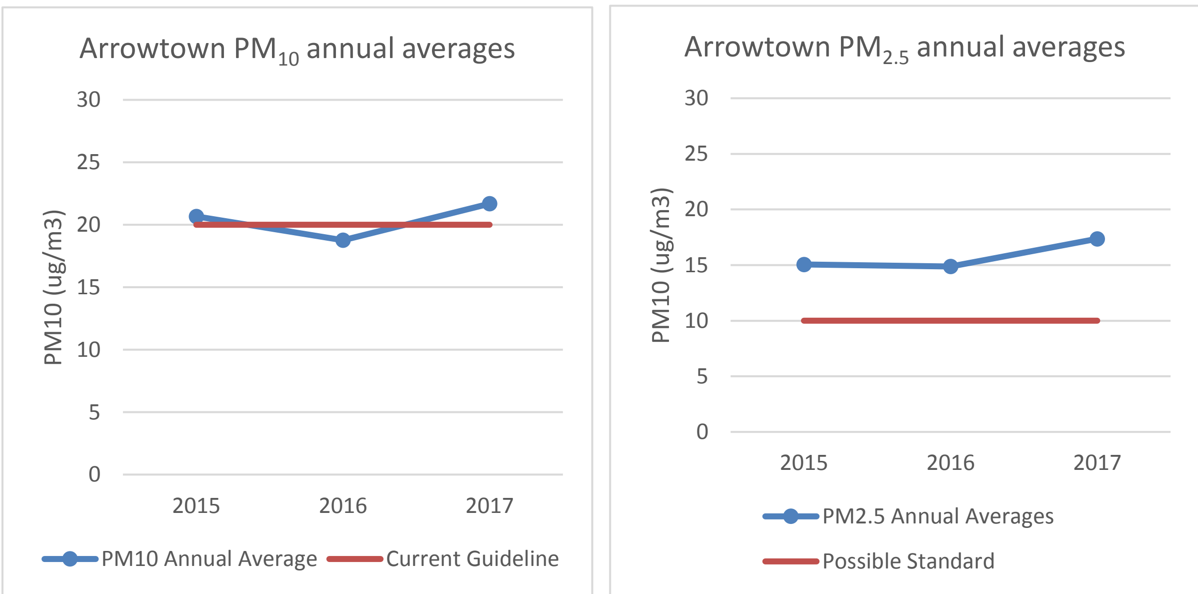

Figure 2. Arrowtown: The left graph shows the actual PM_{10} annual average versus the PM_{10} guideline; the right graph shows the synthetic $PM_{2.5}$ annual averages versus guideline values (possible standard).

Arrowtown exhibits a similar pattern to Alexandra insomuch as the PM_{10} annual average is relatively close to the PM_{10} annual guideline; however, the synthetic $PM_{2.5}$ annual average is more than a third higher than a $PM_{2.5}$ annual average guideline. A three-year dataset was chosen for Arrowtown due to the monitor's move to its new location in 2014.

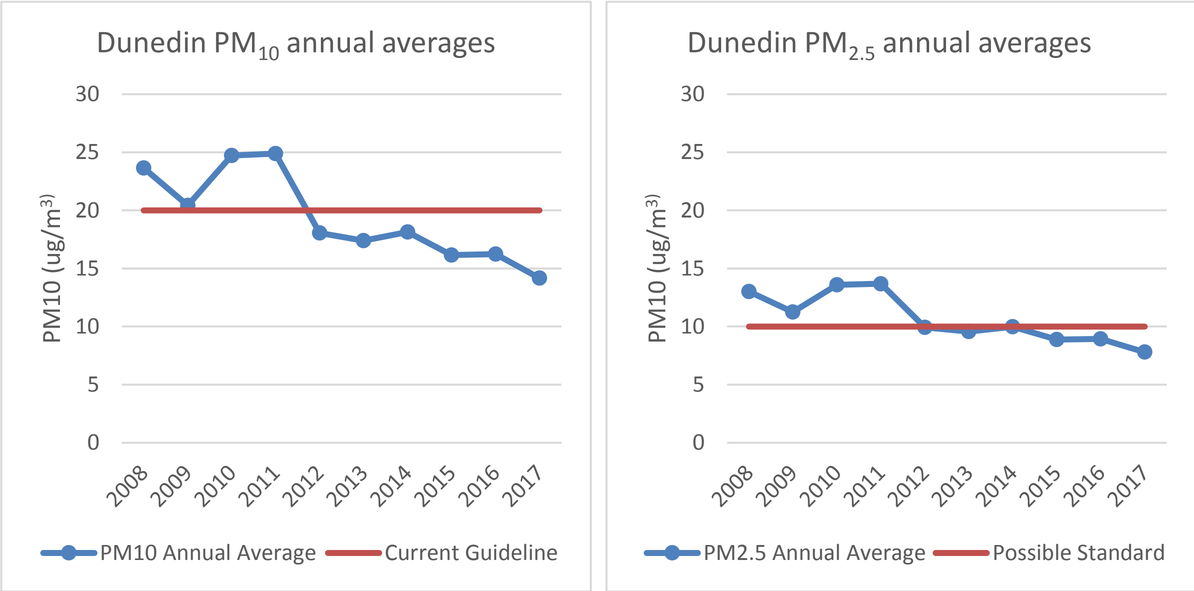

Figure 3. Central Dunedin: The left graph shows the actual PM_{10} annual average versus the PM_{10} guideline; the right graph shows the synthetic $PM_{2.5}$ annual averages versus guideline values (possible standard).

Central Dunedin has met the annual PM_{10} guideline of 20µg/m^3 for several years following improvements in outdoor air quality. Much of that improvement was a result of Council advocating for industry to upgrade coal-burning plant to include secondary emission controls (such as bag filters, etc.) and/or changing to wood as a fuel. The lower $PM_{2.5}$ standard could be more difficult to meet consistently since annual averages may be just at or lower than 10µg/m^3.

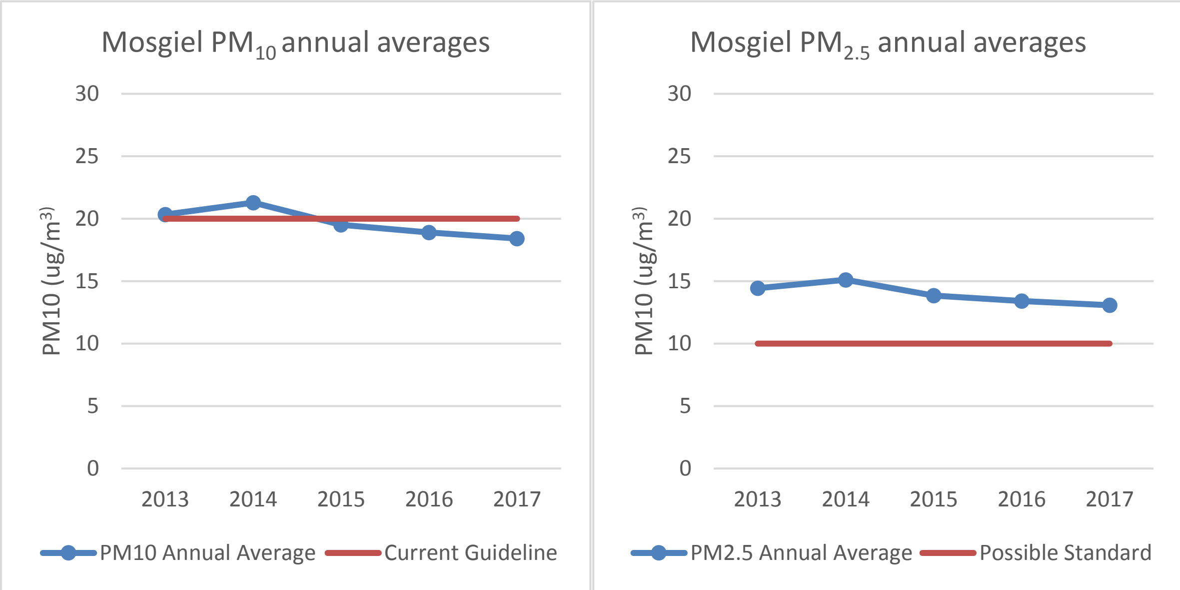

Figure 4. Mosgiel: The left graph shows the actual PM_{10} annual average versus the PM_{10} guideline; the right graph shows the synthetic $PM_{2.5}$ annual averages versus guideline values (possible standard).

In Mosgiel, PM_{10} monitoring indicates that air quality in town has met the annual PM_{10} guideline for the past three years; a lower $PM_{2.5}$ annual standard would reduce the likelihood of meeting an amended NESAQ.

Moving to an annual average $PM_{2.5}$ standard only reinforces what we already know, i.e. that achieving clean, healthy air requires a significant additional effort from our present activities in polluted towns. But whether the standard is PM_{10} or $PM_{2.5}$, the level of effort required is the same.

Central Dunedin may still meet new stricter standards, but with a much smaller margin of error. Mosgiel, currently in Air Zone 2 with passive air quality management, would require active management to ensure meeting a new standard.

4.2 Daily Averages

There is currently no daily $PM_{2.5}$ rule; the daily $PM_{2.5}$ guideline value is 25µg/m^3. The number of days that exceed the value is normally the metric used to measure whether the guideline has been met. Table 2 indicates the average number of exceedances for both the actual, measured PM_{10} dataset and the synthetic, modelled $PM_{2.5}$ dataset using a three-year record from 2015-2017. A full set of the data is shown in Appendix 3.

Table 2. Number of days, on average, that currently exceed the PM_{10} daily average standard compared with the number of days that would exceed, on average, a $PM_{2.5}$ daily standard.

Town	Number of exceedances (days)	
	PM_{10} (set at 50µg/m^3)	$PM_{2.5}$ (set at 25µg/m^3)
Alexandra	36	89
Arrowtown	36	69
Central Dunedin	0	0
Mosgiel	7	19

Alexandra, Arrowtown, and Mosgiel would show a marked increase in the number of exceedances when measured against a $PM_{2.5}$ daily value of 25µg/m^3. All of the exceedances would still occur during winter months (May-August). Central Dunedin would likely not exceed daily $PM_{2.5}$ limits, although maximum daily values may reach over 20µg/m^3.

5. Effect of a $PM_{2.5}$ standard on air quality management

This analysis shows that just like achieving the PM_{10} standard, meeting a $PM_{2.5}$ standard based on WHO-recommended values will be very difficult in our polluted towns. Emissions from solid-fuel domestic heating appliances are primarily $PM_{2.5}$. Therefore, where those emissions are the major source of pollutants, as is the case in Air Zone 1 and Milton, significant reductions in emissions will need to be targeted to domestic heating.

An emission-reduction analysis[1] was done following the completion of the 2016 Emissions Inventory[2] to estimate the amount of reduction in emissions required in key towns to meet the PM_{10} standard. Using the same methodology applied to the synthetic $PM_{2.5}$ dataset, reductions needed to meet a daily $PM_{2.5}$ were calculated (Table 3).

Table 3. Emission reduction estimates needed in Alexandra and Arrowtown to meet the current PM_{10} standard and a possible $PM_{2.5}$ daily standard (in percentages).

Town	PM_{10} standard	$PM_{2.5}$ standard
Alexandra	55%	70%
Arrowtown	60%	80%

Modelling a range of scenarios[3] for home heating appliance configurations indicates that if solid-fuel is to be used in Central Otago, *the most realistic chance of meeting either standard* is a wholesale change to pellet burners and/or the new ultra-low emission burners (known as ULEBs). Switching to no-emission methods such as heat pumps or retrofitting the community for district heating would also ensure polluted towns meeting either standard. As reported previously, continued reliance on MfE-compliant burners with 1.5g/kg emissions will not accomplish the goal of meeting the NESAQ – whether that be PM_{10} or $PM_{2.5}$.

In Mosgiel, a 50% reduction in emissions from home heating is required in order to meet a daily $PM_{2.5}$ standard. As in Central Otago towns, a change to all low-emission burners (1.5g/kg) will not be enough to meet a $PM_{2.5}$ standard. Achieving the amended NESAQ limits would involve some significant portion of residents switching to no-emission, and/or ultra-low emission appliances.

The Central Dunedin airshed appears to be very close to capacity in terms of $PM_{2.5}$ emissions. Should it fail to meet a $PM_{2.5}$ rule, it will be necessary to re-visit more stringent and active management of emissions.

$PM_{2.5}$ monitoring is scheduled for Central Dunedin this year and an Air Zone 1 town next year. Central Dunedin was chosen as the first Otago site because of the uncertainty about whether the airshed would meet a $PM_{2.5}$ standard.

5. Summary

[1] ORC File Note, Document Number A1097061, *Emissions Reduction analysis_2016,* 27 June 2017

[2] Environet Ltd., *Alexandra, Arrowtown, Mosgiel and Milton Air Emission Inventory – 2016 (2017 Amendment),* 2017

[3] NB: These scenarios do not account for new housing.

If the lower $PM_{2.5}$ daily average guidelines (25µg/m^3) were implemented as standards it is likely that the number of exceedances in most towns (except Dunedin) would at least double. If an annual average $PM_{2.5}$ guideline value of 10µg/m^3 is adopted as a standard, towns that are now close to the annual PM_{10} average limit of 20µg/m^3 would be anywhere from 30-90% over the $PM_{2.5}$ limit.

Otago already faces serious challenges in meeting the current PM_{10} standards in many areas. Moving to include a $PM_{2.5}$ standard simply reinforces the idea that a major change to the approach to home heating is required in polluted areas. Changing from PM_{10} to $PM_{2.5}$ as the measure of air quality does not in itself require more effort.

It has been previously reported[1] that relying solely on the use of MfE-compliant wood burners that meet the MfE-prescribed 1.5g/kg emission rate will not be enough to meet the current PM_{10} NESAQ; much more stringent action is needed.

In polluted areas, moving to the cleanest heating appliances such as ULEBs, pellet fires, and heat pumps in existing and new housing is required to meet air quality standards.

6. Recommendation

a) That this report be received.

Endorsed by: Dr Gavin Palmer
Director Engineering, Hazards & Science

Attachments

Appendix 1 – Selected review papers summarising international health research
Appendix 2 – Methodology used to calculate synthetic $PM_{2.5}$ datasets.
Appendix 3 – Metrics and measured PM_{10} and Synthetic $PM_{2.5}$ data

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[1] Otago Regional Council, Report Number 2014/0983, *Air quality in Otago – Issues and Considerations,* Presented to the Technical Committee on 24 July, 2014, and
Otago Regional Council, Report Number 2016/0698, *Technology-based solutions for air quality management: A Discussion Document,* Presented to the Technical Committee on 8 June 2016

Appendix 1 – Selected review papers summarising international health research

U.S. Environmental Protection Agency, *Integrated Review Plan for the National Ambient Air Quality Standards for Particulate Matter*, EPA/600/R-08/139F, Washington DC, December 2009

World Health Organization, *Review of evidence on health aspects of air pollution – REVIHAAP Project Technical Report*, Copenhagen, 2013

World Health Organization, *Residential heating with wood and coal: health impacts and policy options in Europe and North America*, Copenhagen, 2015

Naeher, LP et al, *Woodsmoke Health Effects: A Review,* Inhalation Toxicology, 2007

Pope, CA and Dockery DW, *Health Effects of Fine Particulate Air Pollution: Lines that Connect*, Journal of Air & Waste Management Association, 2006

Aphekom Project, *Summary report of the Aphekom project 2008-2011,* 2012

Utah Physicians for a Healthy Environment, *2017 report on air pollution and health research,* 2017

Lepeule J, et al., *Chronic exposure to fine particles and mortality: an extended follow-up of the Harvard Six Cities study from 1974 to 2009,* Environmental Health Perspectives, 2012

Kelly FJ and Fussell JC, *Air pollution and public health: emerging hazards and improved understanding of risks*, Environmental Geochemistry and Health, 2015

Brook, RD, et al., *Particulate matter air pollution and cardiovascular disease: An update to the scientific statement from the American Heart Association,* 2010

Ruckerl, R, et al., *Health effects of particulate air pollution: A review of epidemiological evidence,* Inhalation Toxicology, 2011

Kelly FJ and Fussell JC, *Air pollution and airway disease,* Clinical and Experimental Allergy, 2011

Van der Zee SC, *Air pollution in perspective: Health risks of air pollution expressed in equivalent numbers of passively smoked cigarettes,* Environmental Research, July 2016

Olmo, NRS, et al., *A review of low-level air pollution and adverse effects on human health: implications for epidemiological studies and public policy,* Clinics 2011

Appendix 2 - Methodology used to calculate synthetic $PM_{2.5}$ datasets

The ratio of $PM_{2.5}$ to PM_{10} varies depending on the source of the particulate emissions, and the sources of emissions will normally vary depending on season. This is particularly true of home heating emissions which peak during colder months.

Ratios of $PM_{2.5}$ to PM_{10} were developed based on information from other Councils where $PM_{2.5}$ and PM_{10} are monitored concurrently[1]. Adjustments were made based on data from NIWA[2] and GNS, as appropriate.

Annual Averages

In areas where there is a strong seasonal component to air quality (Alexandra and Arrowtown), monthly averages of PM_{10} were calculated and the appropriate $PM_{2.5}$ ratios applied on a seasonal basis. A synthetic $PM_{2.5}$ dataset of monthly averages was then used to compute the $PM_{2.5}$ annual average.

In towns with less of a seasonal component (Central Dunedin and Mosgiel), one ratio was deemed sufficient. In these cases, the ratio was applied to the annual PM_{10} averages.

The ratios used in this analysis are shown in Table 4.

Table 4. Ratios applied to PM_{10} datasets to produce a synthetic $PM_{2.5}$ dataset.

Town	Months	Ratio
Alexandra & Arrowtown	May-August	90%
	Remainder of year	55%
Central Dunedin	All year	55%
Mosgiel	All year	70%

Daily Averages

The same ratios were applied to daily PM_{10} averages to develop a $PM_{2.5}$ dataset. The number of days exceeding 25µg/m^3 were calculated.

Sensitivity Analysis

A sensitivity analysis was performed using ratios varying approximately plus/minus 20% from the above ratios. The slight changes that were seen in the resultant values were not enough to change the conclusion; i.e. incorporating a $PM_{2.5}$ standard will prove more challenging to meet than the current PM_{10} standard.

[1] Environet Ltd., *Air quality management in Nelson – the potential impact of an annual average PM2.5 NES*, Prepared for Nelson City Council, October 2015
Environet Ltd., *Assessment of the impacts of regulatory measures targeting domestic home heating on annual average PM2.5 in Invercargill and Gore,* Prepared for Southland Regional Council, Envirolink Report 1748-ESRC278, May 2017
Environet Ltd., *Assessment of the impacts of regulatory measures targeting domestic home heating on annual average PM2.5 in Richmond,* Prepared for Tasman District Council, Envirolink Report 1777-TSDC134, May 2017
Internal communications with Environment Canterbury, 2017

[2] Communication from MfE re: NIWA's PM2.5 to PM10 ratios for Otago, 7 June 2017, Document ID A949892.

Appendix 3 – METRICS FOR MEASURED PM_{10} AND SYNTHETIC $PM_{2.5}$ DATA

The SoE (State of the Environment) category represents the average of the last three years of data; in this case, it covers 2015-2017.

ALEXANDRA	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	SoE
MEASURED PM10											
Annual average	28.6	23.2	23.8	24.3	21.8	24.9	25.4	20.3	21.8	23.6	21.9
Number of exceedances	74	40	51	40	40	47	48	22	38	49	36
Maximum day	150	137	126	143	93	130	105	110	116	103	110
SYNTHETIC PM2.5											
Annual average	22.9	18.2	18.9	19.4	17.2	19.8	19.9	15.7	17.3	18.6	17
Number of exceedances	110	91	88	98	102	96	95	88	80	99	89
Maximum day	135	123	113	129	84	117	95	99	104	93	99

ARROWTOWN	2015	2016	2017	SoE
MEASURED PM10				
Annual average	21.3	19.6	22.1	21
Number of exceedances	30	32	45	36
Maximum day	169	115	158	147
SYNTHETIC PM2.5				
Annual average	17.6	15.7	17.7	17
Number of exceedances	66	65	77	69
Maximum day	152	103	142	132

CENTRAL DUNEDIN	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	SoE
MEASURED PM10											
Annual average	23.8	20.3	24.7	25.1	18.1	17.4	18.0	15.8	16.1	14.2	17
Number of exceedances	9	6	12	14	1	0	0	0	0	0	0
Maximum day	70	77	62	70	71	46	40	41	39	40	40
SYNTHETIC PM2.5											
Annual average	13.1	11.2	13.6	13.8	10.0	9.6	9.9	8.7	8.8	8	8.4
Number of exceedances	11	10	21	17	1	1	0	0	0	0	0.0
Maximum day	39	42	34	38	39	25	22	22	22	22	21.9

MOSGIEL	2013	2014	2015	2016	2017	SoE
MEASURED PM10						
Annual average	20.3	21.4	19.4	18.9	18.6	19.9
Number of exceedances	5	5	7	9	9	7
Maximum day	62	107	93	116	89	106
SYNTHETIC PM2.5						
Annual average	14.4	15.2	13.8	13.4	13.2	13
Number of exceedances	21	24	22	13	21	19
Maximum day	44	76	66	83	63	71

11.2. Director's Report on Progress

Prepared for:	Technical Committee
Activity:	Governance Report
Prepared by:	Dr Dean Olsen, Manager Resource Science Chris Valentine, Manager Engineering Chris Hawker, Director (Non-Executive) Emergency Management Otago Dr Gavin Palmer, Director Engineering, Hazards and Science
Date:	20 April 2018

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1. Précis

This report presents an update on the following matters:

1. Civil Defence and Emergency Management (CDEM);
2. Climate, river flow and groundwater situation, and
3. Leith Flood Protection Scheme.

It is recommended that this report is received and noted.

2. Civil Defence and Emergency Management (CDEM)

2.1. Ministerial Review of Civil Defence and Emergency Management

In June 2017, an advisory group was established by the then Minister of CDEM to investigate; "*Better responses to Natural Disasters and other Emergencies in New Zealand*". The Otago group formally submitted to the review and met with the review panel on three occasions. The group's submission is attached as Appendix A. The review panel's findings and recommendations were presented to the current Minister of CDEM, Hon Kris Faafoi, in January 2018. Staff will present a paper to the next meeting of Council summarising the panel's findings and recommendations.

The Minister is now meeting with Mayors, Chairs, Chief Executives and CDEM Groups around the country and we are advised that we can expect more formalised response regarding outcomes from the Minister in late June or early July.

2.2. Lifelines

The Otago regional lifelines[1] committee was first established in February 2017. Membership of the committee includes engineering teams from across all territorial authorities, critical infrastructure including transport, power and water, and key stakeholders including emergency services and the District Health Board.

The initial focus of the committee during 2017 was on building relationships within the greater lifelines sector and updating the 2014 Otago Lifelines Vulnerability project. This has now been updated and is known as the Otago Lifelines programme. This is a 'living document (referenced by version number) that is updated as soon as new information is received.

The first annual Lifelines Forum was held in Dunedin on 30 January 2018, with 96 attendees from around the region and across most lifelines. Key speakers included representation from the national Lifelines Council and national and other regional Lifelines Programme Managers. Workshops focused on GIS, public information

[1] Lifeline utilities are defined in the Civil Defence Emergency Management Act 2002. They include, for example, Port Otago Ltd and entities that generate electricity for distribution through a network. They do not include entities that provide a flood protection scheme.

management (community engagement and education), future funding models and priorities.

Priorities for 2018 include more detailed planning for areas such as communications (radio/satellite) across the region, and greater integration of GIS mapping for situational awareness, for both business as usual and during events. Integrated air operations and fuel plans are already being developed outside of the Lifelines Committee, which will feed into work currently underway.

2.3. Otago Risk Register

The risk register supports the Otago CDEM Group Plan and areas of work being undertaken including, welfare, recovery, lifelines, public education and training projects, committees, and programmes. Block Seven were contracted in the first quarter of 2017 to undertake the development of a comprehensive risk register for the Otago Region. This included human-caused hazards as well as natural hazards.

A workshop was held in Alexandra in March 2017 with representatives from Tourism (Ngai Tahu, Real Journeys, Wanaka Tourism, Enterprise Dunedin, Destination Queenstown), Health, Otago University, Road/Rail/Air Transport, Chamber of Commerce, Otago Southland Employers Association (business/commerce), Agriculture (Federated Farmers, Agri-plans). Discussion centred on the natural and human caused risks that impact on their sectors and identifying some of the interdependencies between them. Further engagement and meetings were held during April and May with the Fruit Growers Association and the apiarist sector, through Honey Products New Zealand.

Amendments were made to the risk reduction register to reflect information relating to these sectors and the final draft version was accepted as final.

3. Summary of climate, river flow and groundwater in the 2017-2018 season

3.1. Rainfall

Figure 1 shows the rainfall distribution comparison by Standardised Precipitation Index (SPI) between this (Oct 17 - present) and last (Oct 16 – Apr 17) low-flow seasons over Otago. The seasonal rainfall totals for this low-flow season were lower for Manuherikia, North Otago, parts of South Otago, and particularly for the areas in the west of Central Otago being from severely dry to extremely dry.

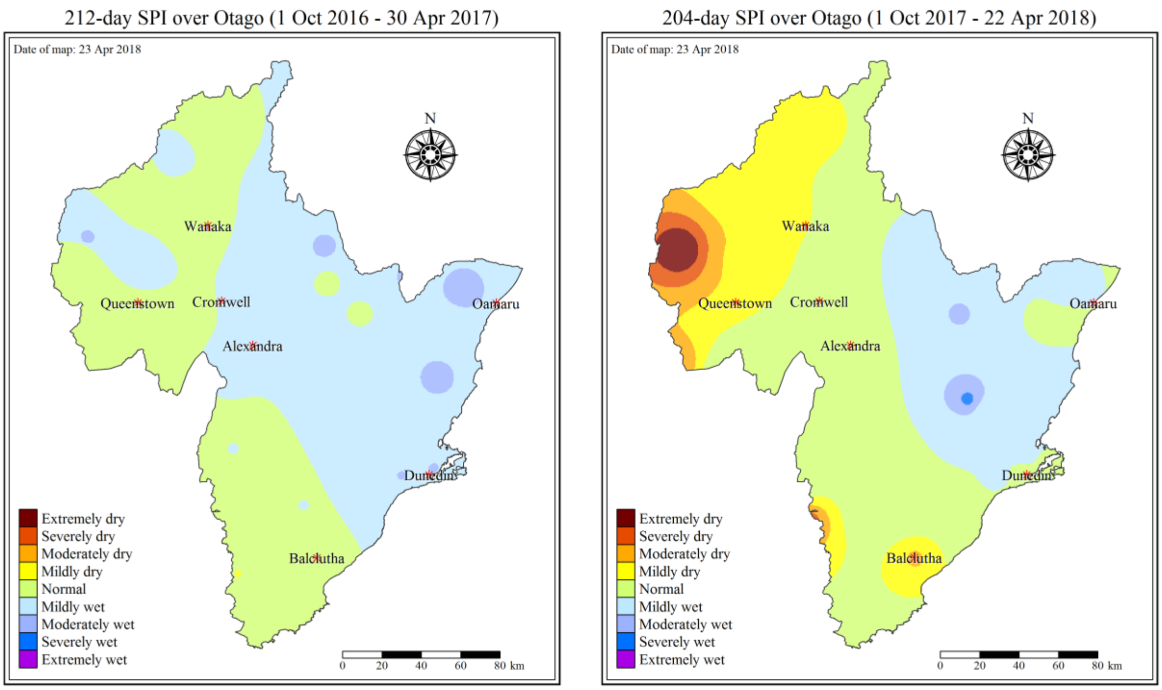

Figure 1: Rainfall distribution comparison by Standardised Precipitation Index (SPI) between this (Oct 17 - present) and last (Oct 16 – Apr 17) low-flow seasons over Otago

The detailed monthly rainfall distributions for this low-flow season can be found in Appendix C.

3.2. River Flows

Similar to the rainfall pattern, river flows were well below normal across the whole region since early October last year almost across the whole region, particularly for those recorders along the Taieri River. Taieri at Canadian Flat reached the lowest seven-day low flows (7dLF) on record for October, December, and January. The Taieri River at Waipiata also reached its lowest November 7dLF on record. This well-below-normal-flow situation was relieved after several rainfall events since early February this year. As for the seasonal low flow regime for this season, it showed a similar pattern to that of rainfall totals. Comparing to both the long-term 7-day Mean Annual Low Flow (7dMALF) during Oct – Apr and 7dLFs from last season, the recorded 7dLFs for this season were generally lower, particularly for the Taieri River. Table 1 lists the comparison among the long-term 7dMALFs (Oct – Apr), and 7dLFs for last and this low-flow seasons along the main rivers in Otago.

Site	Minimum flow (m³/s) in Water Plan	7dMALF (Oct - Apr) in m³/s	7dLF (Oct 16 - Apr 17) in m³/s	7dLF (Oct 17 - present) in m³/s	7dLF (Oct 17 - present) vs 7dMALF in %	7dLF (Oct 17 - present) vs 7dLF (Oct 16 - Apr 17) in %
Kakanui at Clifton Falls Bridge	#N/A	0.566	0.665	0.368	-35	-45
Kakanui at Mill Dam	0.25	0.437	0.868	0.327	-25	-62
Kakanui at McCones	0.25	0.431	0.696	0.315	-27	-55
Waianakarua at Browns	0.2	0.222	0.376	0.263	18	-30
Shag at Craig Road	0.15	0.151	0.23	0.105	-30	-54
Leith at Leith Street	0.094	0.21	0.249	0.12	-43	-52
Taieri at Waipiata	1	1.452	1.019	0.813	-44	-20
Taieri at Tiroiti	1.1	1.819	1.37	0.985	-46	-28
Taieri at Sutton	1.25	1.982	1.936	1.29	-35	-33
Taieri at Outram	2.5	4.057	3.876	2.169	-47	-44
Deep Stream at SH87	#N/A	0.432	0.49	0.178	-59	-64
Taieri at Canadian Flat	#N/A	0.88	0.945	0.441	-50	-53
Kye Burn at Water Take d/s 300m	#N/A	0.206	0.267	0.222	8	-17
Dunstan Creek at Beattie Road	#N/A	0.343	0.329	0.223	-35	-32
Manuherikia at Ophir	0.82	2.185	1.89	1.724	-21	-9
Manuherikia at Campground	#N/A	0.907	0.866	0.888	-2	3
Waitahuna at Tweeds Bridge	0.45	0.734	0.802	0.548	-25	-32
Pomahaka at Burkes Ford	3.6	4.427	4.299	2.678	-40	-38
Lovells Creek at SH1	0.005	0.021	0.036	0.003	-86	-92
Mill Creek at Fish Trap	0.18	0.275	0.293	0.169	-39	-42
Waikouaiti at 200m d/s DCC intake	#N/A	0.192	0.368	0.232	21	-37

Table 1: Comparison among the long-term 7dMALFs (Oct – Apr), and 7dLFs for last and this low-flow seasons along the main rivers in Otago

3.3. Groundwater Levels for the Restriction Bores

The minimum groundwater levels observed on the Regional Plan: Water restriction bores between October 2017 and March 2018 are summarised in Tables 2 and 3 in Appendix C. Location maps outlining the position of these reference bores are provided in Appendix B.

The only bore where the 25% restriction level was reached is Momona Bore monitoring the West Lower Taieri Aquifer. This restriction level was “breached” for 16 days in

January 2018 and one day in February 2018, with a lowest level observed on 30/01/2018 (0.125 m below the 25% restriction level but still above the 50% restriction level).

4. Leith Flood Protection Scheme

Engineering works on the Union to Leith Footbridge stage of the Leith Flood Protection Scheme are progressing. The work is focused on the walls on both sides of the channel and reconstruction of the weirs (Figures 2, 3). A value engineering workshop is taking place with the main contractor (Downer New Zealand Ltd) on 26 April to review the programme and work towards completion of the project by June 2018.

Figure 2: Construction of walls and terraces upstream of and beneath the Information Technology Services (ITS) building (north side of channel).

Figure 3: Installation of weir and buttresses within Water of Leith near the wall on the south side of the channel (the outside of the river bend).

A design risk assessment with staff and consultants in attendance was held to understand and mitigate risks associated with the proposed design for the Dundas Street works. Detailed design of the culvert and associated retaining walls is underway. Final design drawings and technical specifications will be completed by WSP Opus in late June 2018.

The physical model study at the University of Auckland has now changed focus to inform risk and effects, including debris loading, super design flows, and channel breakout and overland flow paths in a super design event. Figures 4 and 5 below show the hydraulic physical modelling of the final design concept. Discussions are continuing with the Dunedin City Council in relation to future maintenance and ownership of the proposed new culvert.

Figure 4: The proposed Dundas Street culvert and upstream retaining wall at an equivalent design flow of 171m^3/s (100-year Return Period). The flow is from right to left. The existing Dundas Street bridge and proposed new culvert are at the top left of photograph. The wooden objects are buildings.

Figure 5: The proposed Dundas Street culvert and downstream retaining wall at an equivalent flow of 140^{3}m/s. The photograph is looking upstream. The proposed new culvert is at the centre of the photograph.

5. Recommendation

a) *That the report be received and noted.*

Endorsed by: Gavin Palmer
Director Engineering, Hazards & Science

Attachments

1. TC Appendix A - Otago Group submission to Ministerial CDEM Review - Final **[11.2.1]**
2. Appendix B - Monitoring Bores Location Maps **[11.2.2]**
3. Appendix C - Climate tables and figures - additional information **[11.2.3]**

12. NOTICES OF MOTION

13. CLOSURE