REPORT

Tonkin+Taylor

Central Interceptor Extension - Point Erin Tunnel

Air Quality Assessment

Prepared for
Watercare Services Limited
Prepared by
Tonkin & Taylor Ltd
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1 Introduction

1.1 Background

Watercare Services Limited (Watercare) is responsible for the provision of potable (drinking) water and wastewater services in Auckland. Watercare is a Council-Controlled Organisation (CCO) of the Auckland Council. The company's vision is to be 'trusted by our communities to deliver performance every day'.

The Central Interceptor (CI) wastewater conveyance and storage tunnel was consented in 2013. CI runs from the Mangere Wastewater Treatment Plant to Western Springs where it connects to the Grey Lynn Tunnel (GLT). The GLT section of the CI runs from Western Springs to Tawariki Street in Grey Lynn and was consented in 2019. CI provides additional sewer capacity, reduces wet weather wastewater overflow discharges and enables future works to improve freshwater quality in central Auckland waterways.

Watercare is proposing to extend the CI wastewater interceptor approximately 1.6 km from the terminus of the GLT at Tawariki Street to Point Erin Park in Herne Bay. The Point Erin Tunnel ('the Project') involves the continuation of the CI tunnel boring machine (TBM) through to a new shaft site in Point Erin Park which will allow for the retrieval of the TBM and connections to the local sewer network. The Project also requires the construction of a control chamber in the southwestern corner of Point Erin Park to pick up flows from the Sarsfield overflow collector and St Mary's Bay pressure line, and to allow for connection of future sewers from the Combined Sewer Overflow (CSO) network.

1.2 Purpose

This report describes a technical assessment of air quality effects of discharges to air from the Project and has been prepared for Watercare by Tonkin & Taylor Ltd (T+T) to inform a resource consent application for the Project[1].

Specifically, this report provides the following:

- A summary of the Project and activities associated with discharges to air (Section 2);
- Characterisation of the discharges to air (Section 3);
- Description of the existing environment setting of the discharges (Section 4);
- Assessment of the air quality effects of the discharges to air (Sections 5 - 7); and

Conclusions in relation to the assessment (Section 8).

[1] This report has been prepared by T+T in accordance with our Letter of Engagement dated 22 November 2022

2 Project description

The Project involves the construction, commissioning, operation and maintenance of a wastewater interceptor and associated activities at Point Erin Park in Herne Bay. The Project can be broken into two distinct parts:

- The wastewater interceptor tunnel which runs from Tawariki Street in Grey Lynn to Point Erin Park in Herne Bay; and
- The Point Erin Park shaft site.

These are described in further detail below (as relevant to this assessment).

2.1 Point Erin Tunnel

Point Erin tunnel runs from Tawariki Street in Grey Lynn to Point Erin Park in Herne Bay over a length of up to approximately 1.6 km. Excavation of the tunnel will continue using the existing CI Tunnel Boring Machine ("**TBM**"). The tunnel is located entirely below ground. There are no surface works required for the tunnel.

2.2 Point Erin shaft site

The works at the Point Erin Shaft Site are proposed to occur in two discrete locations within the park:

- The terminal shaft and associated construction area is proposed to be located in the grassed area immediately to the south of the Point Erin Pools (referred to as the main construction area). An air vent associated with the terminal shaft will be located in the north-western corner of the green space area of the park.
- The control chamber, plant room to house equipment to control the gates, and associated construction area is proposed to be located towards the southwest corner of Point Erin Park near the intersection of Curran and Sarsfield Streets (referred to as the southwestern construction area).

Construction activities require earthworks of approximately 5,000 m^2 in total across the two construction areas (approx. 3,150 m^2 in the grassed area to the south of the Point Erin Pools and approx. 1,880 m^2 in the south-western corner of the park).

The proposed layout for the above activities is shown in Figure 2.1.

The Project has been developed to a concept design stage. As it moves through the detailed design process and as construction methodology is confirmed, it is likely that some details will change but remain within the envelope of effects assessed in this assessment. All figures and dimensions provided are approximate and will be confirmed during the detailed design stage.

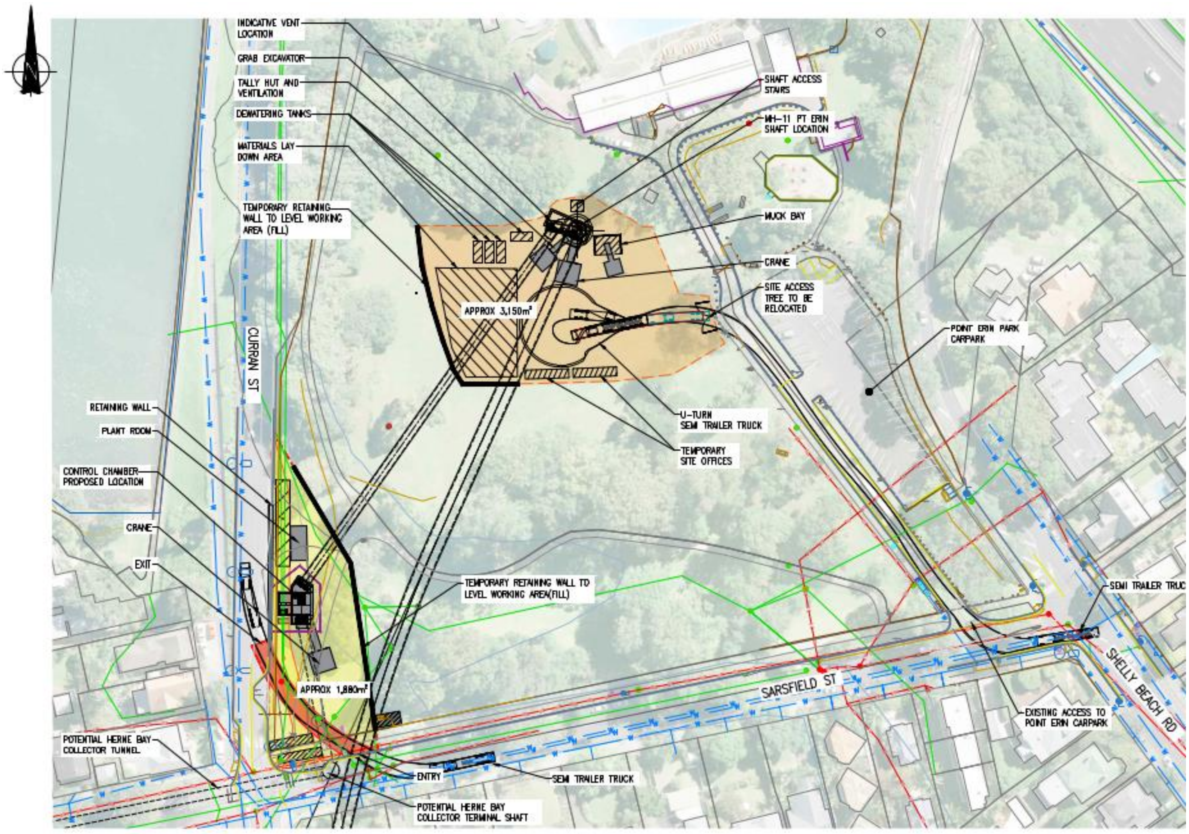

Figure 2.1: General site layout of Point Erin Shaft and Control Chamber *(note: not to scale)*

2.3 Operational activities

2.3.1 Existing CI ventilation approach

The CI ventilation approach with the Point Erin Tunnel in place will build on the existing approach for the already consented CI network (including the GLT). The CI network is intended to operate under negative pressure with air continuously drawn into the tunnel via air intakes along the sewer network.

The CI ventilation system is to be designed to achieve a target pressure differential of -100 Pa at the outer extremities of the CI network. To achieve this, air from within the network is to be extracted for treatment and discharge at the primary air treatment facility (ATF) at Mangere Pump Station.

Filling of the CI tunnel will occur in storm events where wastewater inflows exceed the treatment capacity of the Mangere WWTP (filling will occur from the downstream end at the Mangere WWTP).

Filling of the tunnel in these circumstances will result in pneumatic restriction that will reduce the capacity of the Mangere Pump Station ATF to maintain negative pressure at the extremities of the CI network. This may necessitate the release of air displaced by wastewater inflows from other locations in the CI network. The location of release will be dependent on the scale/intensity of the rainfall event and resulting extent of tunnel filling as follows:

- In the event that air cannot be extracted at the primary ATF at the Mangere Pump Station, extraction assistance is able to be provided from a secondary ATF, located at May Road, Mt Roskill. However, this extraction assistance will be insufficient to extract all of the air displaced by wastewater inflows to the CI tunnel and the balance will need to be discharged, preferentially from a pressure relief vent located at Western Springs [2].

- In the event that both the primary and secondary ATFs become inoperable, all of the air displaced by wastewater inflows to the CI tunnel will be preferentially released from the pressure relief vent located at Western Springs.
- In the event that the offtake for the Western Springs vent becomes surcharged during tunnel filling, air displaced from the remaining upstream section of the CI tunnel by wastewater inflows will need to be discharged upstream of the Western Springs vent. The resource consents for the GLT provide for the discharge via a pressure release discharge in these circumstances at Tawariki Street, Grey Lynn.

All of the above discharges to air from the ATFs at Mangere Pump Station and May Road and pressure relief vents at Western Springs and Tawariki Street are already consented as part of the overall CI project.

2.3.2 Proposed CI ventilation modifications for Point Erin extension

The Project will extend the CI tunnel from Tawariki Street to Point Erin. The existing CI ventilation approach, with extraction of air at the Mangere Pump Station ATF during normal operational circumstances, will be utilised to achieve the target pressure differential of -100 Pa at Point Erin (as the new extremity of the tunnel). Resource consent to discharge contaminants to air is therefore only sought as part of the Project to authorise the specific proposed venting arrangement in Point Erin Park.

In summary, during significant storm event, filling of the tunnel may occur to the extent that extraction of air from the ATFs at the Mangere Pump Station and May Road, or release from the pressure relief vents at Western Springs and Tawariki Street is not possible. Only in these limited circumstances will the air displaced by wastewater inflows to the CI tunnel need to be discharged at Point Erin.

The circumstances in which the discharges to air at Point Erin will occur are discussed further in section 3.2, However, based on previous network modelling undertaken as part of the CI and GLT designs, storms of this significance are expected to occur at a frequency of less than once in ten years.

2.3.3 Point Erin air vent

A pressure relief vent will be located at Point Erin Park to the southwest of Point Erin Pools. The approximate location of the air vent is presented in Figure 2.1.

The purpose of the air vent will be to provide an outlet for air and relieve pressure within the CI system in the infrequent event that the tunnel fills beyond the Tawariki Street Shaft.

On the very infrequent occasion when exhausting of air from the vent may be required, the discharge will occur vertically through a vent of a face area of approximately 2.6 m^2 from the roof of a discharge structure at a height of at least 3 m. The discharge vent will be uni-directional to allow the discharge when required but to prevent inlet of air (inlet air will be preferentially drawn through the Control Chamber).

[2] The CI consent also provides for an ATF at Western Springs in future if this is demonstrated to be required.

2.3.4 Control Chamber

The proposed Control Chamber in the southwestern corner of Point Erin Park enables:

- The diversion of flows from the Sarsfield Overflow Collector into the CI tunnel;
- Receipt of pumped flows from the St Mary's Bay Outfall Pump Station into the CI tunnel;
- Possible diversion of flows from the potential future Herne Bay Collector (if that project is progressed in the future) into the CI tunnel.

The chamber will have an automatically actuated Real Time Control (RTC) gate at the outlet to the chamber. This gate will be closed as required during wet-weather conditions to prevent adverse pressure surges in the tunnel if the CI tunnel is becoming overfilled.

On occasions when the Point Erin RTC gate is closed, inflows to the Control Chamber will be diverted into the northern portion of the existing Sarsfield Overflow Collector (this portion is to be referred to as the Sarsfield Overflow), which will function as an overflow to the St Mary's Bay Outfall and Storage facility.

At times when the RTC gate is closed, the air from the Control Chamber will be extracted to the CI ventilation system via an air bridge over the RTC gate meaning there will be no discharge.

As noted in section 3.2, on rare occasions emergency releases of the relatively small volume of air from the Control Chamber and connecting tunnel to the Point Erin Shaft may be required. This emergency release is to occur from the Control Chamber Plant Room adjacent to Curran Street, the location of which is illustrated in Figure 2.1 and Figure 4.2.

3 Nature of the discharges to air

3.1 Construction discharges

Construction activities require earthworks of approximately 5,000 m^2 in total across the two construction areas. If earthworks are not appropriately managed, there is the potential for the discharge of dust to air from the surface construction activities at the Main and Southwest construction areas, illustrated in Figure 2.1 and Figure 3.1.

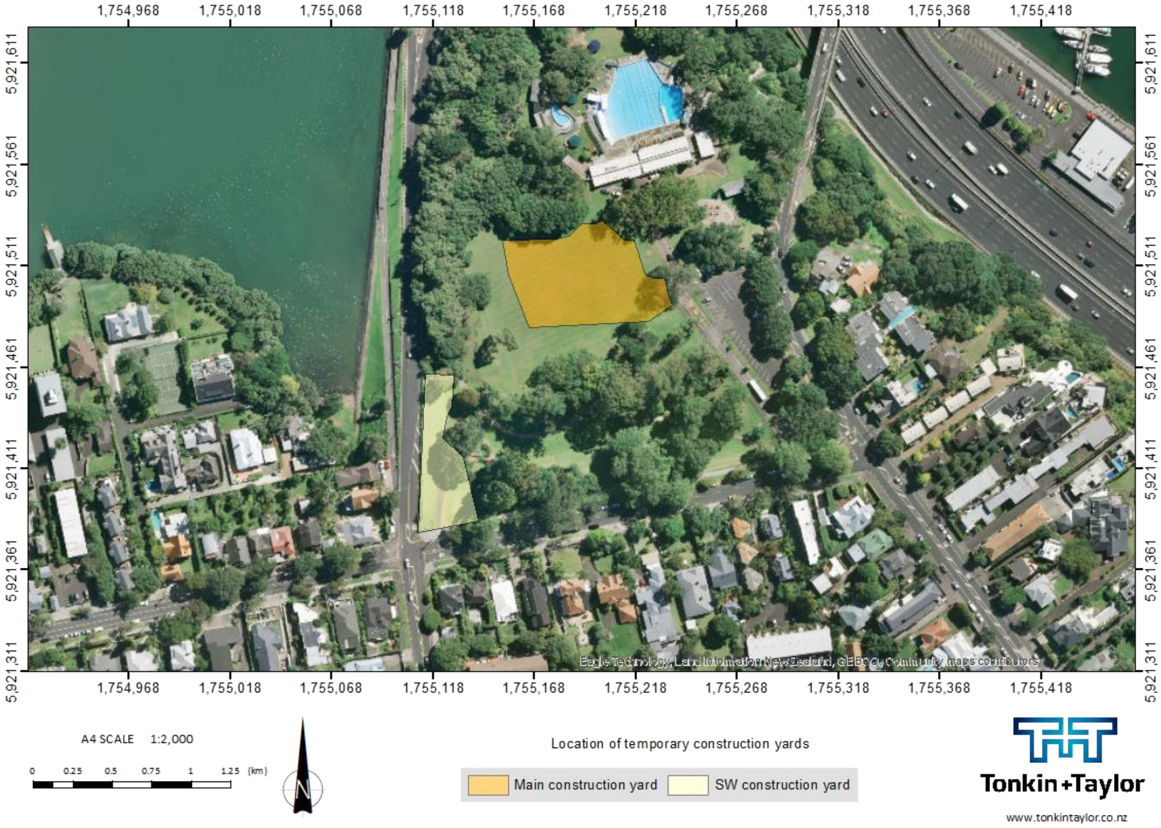

Figure 3.1: Proposed location of construction areas *(note: not to A4 scale)*

Based on the construction methodology at the time of writing this report, the potential sources of dust at the site are associated with the following activities:

- Excavation;
- Piling and drilling;
- Handling of spoil, aggregate and other solid materials;
- Wind erosion of spoil and other stockpiled material; and
- Movement of vehicles over unsealed surfaces (including trucks and earthmoving equipment).

Other minor discharges to air during the construction phase include combustion emissions from vehicles, equipment or stationary engines on site, which can affect respiratory health in the environment with sufficient exposure.

3.2 Operational discharges

3.2.1 Overview of operational discharges

The main air contaminant emitted from municipal wastewater reticulation is odour generated from anaerobic degradation of its organic components. Odour generated from anaerobic degradation of wastewater generally has a strongly negative hedonic tone (i.e. it is generally of a very unpleasant character).

For this project, the discharge of odour is anticipated to occur less than once in every ten years, and only during or immediately after significant storm events when substantial dilution of wastewater with stormwater inflows is likely to have occurred. As a result, although the odour will be of negative hedonic tone, the intensity of the odour is likely to be significantly lower than odour generated from undiluted (e.g. dry weather) sewer flows.

As noted in section 3.2.2, the CI ventilation system is designed such that there is to be no discharge of odour from the Site during normal operation. The discharge of odour from the Site is anticipated to be very infrequent and only intended to occur in the operational scenarios described in sections 3.2.3 and 3.2.4.

3.2.2 Normal operation

As noted in section 2.3.1, during normal operational circumstances, air contained within the CI system (including the proposed Project infrastructure) will be continuously extracted for treatment and discharge at ATFs located elsewhere in the network. As such, there will be no discharge of odour from the Site at Point Erin Park during normal operation.

3.2.3 Point Erin Shaft pressure release emissions in significant storm events

During significant storm events[3], the water level in the CI tunnel may reach a level where the vent intakes to all of the ATFs in the system becomes surcharged.

In this eventuality, the ATFs will not be operable and extraction of air for treatment from the remaining unfilled extent of the CI tunnel (including to the currently consented chainage to the Tawariki Street shaft and the proposed extension to Point Erin) will not be possible.

While the ATFs are not operable in these circumstances, air displaced from the remaining extent of the CI tunnel while it continues to fill will need to be discharged from pressure relief vents located at Tawariki Street and Western Springs (as currently consented) and Point Erin (as proposed).

In this tunnel filling scenario RTC gates located across the CI network will be used to control inflows and the rate and extent of filling of the CI tunnel. In this manner, the Point Erin RTC gate will be used to control inflows from the Control Chamber to the CI tunnel. The position of the Point Erin RTC gate (open or closed) will influence the rate and duration of the pressure relief discharge from the Point Erin Shaft.

Based on indicative design information for the Project[4], the following air discharge rates are considered in extreme events with the CI RTC gates open and closed:

- CI RTC gates open: 37.5 m^3/s of air for up to 15 minutes (assumes all CI system gates are in an open position).
- All CI RTC gates closed: 9.5 m^3/s of air for up to 1 hour.

[3] Based on previous wastewater network modelling undertaken as part of the CI and GLT designs, storms of this significance are expected to occur at a frequency of less than once in ten years.
[4] Jacobs New Zealand Limited, December 2022. Point Erin Air Discharge Parameters, Section 7.4.

The Point Erin pressure relief discharge will be exhausted vertically from the roof of a purpose-built building of approximately 3 m in height and located as illustrated in Figure 2.1 and Figure 4.2 (denoted as "indicative vent location").

3.2.4 Control chamber emergency release emissions

When the Point Erin RTC gate is closed and the Control Chamber fills and flows discharge onwards to the St Mary's Bay Outfall and storage facility, air from the Control Chamber will continue to be extracted via the proposed high-level air bridge over the Point Erin RTC gate to the ATFs located elsewhere in the network.

In the eventuality that the ATFs become inoperable due to filling of the CI tunnel, air from the Control Chamber and connecting tunnel to the Point Erin Shaft will be discharged via the pressure relief scenario described in section 3.2.3.

However, if the water level in the main CI tunnel at Point Erin exceeds the soffit[5] of the connecting tunnel between the Control Chamber and the Point Erin Shaft, this finite volume of air will not be able to be discharged via the Point Erin pressure relief vent and will need to be exhausted as an emergency release from the plant room for the Control Chamber.

In this scenario, the finite and reasonably small volume of air (estimated to be between 100 m^3 and 150 m^3) will need to be vented. The rate and duration of the emergency release will be dependent on inflows to the Control Chamber. However, the peak anticipated inflow from the Overflow Collector in wet weather and an additional pumped flow from the St. Mary's Bay Storage tunnel would equate to an inflow rate to the chamber of 1.5 m^3/s. A corresponding discharge rate of air from the Control Chamber and connecting tunnel of 1.5 m^3/s would occur for less than two minutes (100 seconds).

Although, the inflows to the Control Chamber will be diluted by stormwater in this scenario, the level of dilution may not be as extensive as will occur in the CI tunnel during wet weather events. As such, the intensity of odour released in the Control Chamber emergency release scenario may be slightly higher than in the Point Erin pressure release scenario.

3.2.5 Summary of odour discharge scenarios

The nature of air and odour discharges in each of the scenarios described in sections 3.2.2 to 3.2.4 is summarised in Table 3.1.

Table 3.1: Summary of odour discharges from Pt Erin site in CI operational scenarios

Discharge parameter	Operational scenario			
	Normal CI operation	CI Tunnel pressure release: RTC gates open	CI Tunnel pressure release: RTC gates closed	Control Chamber emergency release
Location of discharge	Air extracted to already consented ATFs elsewhere in CI network	Point Erin Shaft pressure relief vent		Control Chamber plant room
Frequency of occurrence	At all times except during other scenarios	Less than once in every 10 years		Very rarely (less frequent than once in 10 years)*

[5] Being the topmost internal level of the pipe.

Discharge parameter	Operational scenario			
	Normal CI operation	CI Tunnel pressure release: RTC gates open	CI Tunnel pressure release: RTC gates closed	Control Chamber emergency release
Air discharge rate	No discharge at Point Erin Site	37.5 m^3/s*	9.5 m^3/s	Variable flow discharge of small (100-150 m^3) volume
Duration		15 minutes	1-hour	
Intensity and character of odour discharge		Dilute wastewater odour**		Slightly less dilute wastewater odour

* Very rare event, peak exhaust rate at Western Springs based on wastewater network modelling conducted during design of GLT plus the anticipated Pt Erin Inflow occurring before the RTC gates are required to close and that pressure release at Western Springs and / or Tawariki Street is not possible

** Significantly lower odour intensity compared to odour intensities typically generated from dry weather sewage flows (without treatment)

4 Environmental setting

4.1 Site locality and zoning

The Point Erin Shaft site is located within Point Erin Park, adjacent to Point Erin Pools. The park is located on a coastal headland on the Waitematā Harbour between Herne Bay and St Mary's Bay. Broadly speaking, Point Erin Park is bounded by State Highway 1 (SH1) to the north and east (and the Waitematā Harbour and Westhaven Marina beyond, respectively), the Waitematā Harbour to the west and the residential areas of Herne Bay and St Mary's Bay to the southwest, south and southeast.

Under the Auckland Unitary Plan (operative in part) AUP, the Site is zoned as 'Informal Recreational Zone' and lies immediately adjacent to the 'Sport and Recreational' zone located within Point Erin Park. Facilities located in the park include public swimming pools and a playground.

Residential areas to the west and south of the Site are zoned as 'Mixed Housing Urban' and residential properties to the southeast and east are zoned as 'Terrace Housing and Apartment Buildings'. The location of individual residences and other sensitive activities around the site are described further in section 4.2.

It can be expected that residential receptors in the adjoining residential zones will have a relatively high sensitivity to odour and dust emissions in the area. While in use, Point Erin Pools, Point Erin Park, educational facilities (including schools and early childhood education facilities) and the Marina (including commercial businesses) will also have a high sensitivity to odour and dust. However, outside of operational times it is expected that these locations will have a low sensitivity to air discharges. Figure 4.1 illustrates the zoning of the local area under the AUP:OP.

Figure 4.1: AUP zoning

4.2 Sensitive receptors

As noted in Figure 4.1, the Site is located in a recreational reserve bordered by residential areas. Given the sensitivity of the immediate environment beyond the reserve there are a number of receptors that may have a high sensitivity to odour and dust from the construction and operation of the Site. T+T has identified residential receptors that are in closest proximity to the Site as well as other high sensitivity locations further afield such as parks, schools and aged care facilities to provide a representative selection of receptors. Receptors and the approximate distances from the Project emission sources are presented in Table 4.1

Table 4.1: Local sensitive receptors

Receptor		Distance (m) and direction of receptor from source						General sensitivity of receptor
		Point Erin Vent		Plant Room		Construction works		
R1	5 Masefield Avenue	165	W	150	WNW	145	WNW	**High sensitivity**: People in residential dwellings may be of high sensitivity to air quality effects as they can be of any age or health. People may also be present up to 24 hours, seven days a week.
R2	3 Masefield Avenue	170	WSW	100	WNW	95	WNW	
R3	7 Masefield Avenue	155	SW	50	WNW	45	WNW	
R4	74 Curran Street	145	SSW	35	WNW	20	WNW	
R5	72 Curran Street	150	SSW	40	W	20	W	
R6	70 Curran Street	240	SSW	80	WSW	20	WSW	
R7	32 Sarsfield Street	200	SSW	60	SSW	35	SSW	
R8	30 Sarsfield Street	215	SSW	80	S	30	S	
R9	28 Sarsfield Street	170	S	80	SSE	30	SSE	
R10	26 Sarsfield Street	170	S	85	SE	30	SE	
R11	24 Sarsfield Street	170	S	88	SE	35	SE	
R12	22 Sarsfield Street	165	S	100	ESE	50	SE	
R13	18 Sarsfield Street	170	S	110	ESE	65	ESE	
R14	14 Sarsfield Street	170	SSE	140	ESE	85	ESE	
R15	12 Sarsfield Street	170	SSE	135	ESE	100	ESE	
R16	10 Sarsfield Street	170	SSE	145	ESE	115	ESE	
R17	8 Sarsfield Street	165	SSE	150	ESE	125	E	
R18	6A Sarsfield Street	175	SE	165	ESE	140	E	
R19	4A Sarsfield Street	175	SE	175	ESE	155	E	
R20	82 Shelly Beach Road	200	SE	185	ESE	170	E	
R21	109 Shelly Beach Road	200	ESE	225	E	125	ESE	
R22	115 Shelly Beach Road	180	ESE	210	E	110	ESE	
R23	117 Shelly Beach Road	160	ESE	205	E	95	ESE	

Receptor		Distance (m) and direction of receptor from source						General sensitivity of receptor
		Point Erin Vent		Plant Room		Construction works		
R24	119 Shelly Beach Road	150	ESE	205	E	85	ESE	
R25	121A Shelly Beach Road	135	ESE	195	ENE	80	ESE	
R26	121B Shelly Beach Road	130	ESE	195	ENE	75	ESE	
R27	121C Shelly Beach Road	125	ESE	190	ENE	70	ESE	
R28	Point Erin Playground	80	ESE	155	NE	30	ESE	**High sensitivity** while in use. These facilities may be used by people of various ages and health conditions who are likely to have a high sensitivity to odour and dust emissions. Use of Point Erin Pools is seasonal (summer use only). Use of both facilities outside of daylight hours is likely to be limited.
R29	Point Erin Pools	50	NNE	130	NNE	20	NNE	
R30	Early childcare facility (Bear Park, 42 Shelly Beach Road)	400	SSE	360	SSE	320	ENE	**High sensitivity** while in use. Schools, childcare facilities and aged care facilities are considered to be the most sensitive of all receptors to air quality impacts as occupiers are of varying ages and health conditions. Occupation of educational facilities outside of office hours is likely to be limited.
R31	Ponsonby Primary School, 44 Curran Street	270	SSW	170	WSW	115	SSW	
R32	Rest home (Little Sisters of the Poor, 9 Tweed Street)	280	S	230	SSE	185	SSE	
R33	Sails Restaurant (103 Westhaven Dive)	270	ENE	340	ENE	210	ENE	**High sensitivity** while in use: Sails Restaurant is open intermittently throughout day, primarily from 12pm to late, 5 days per week. People dinning at this location, particularly outdoors may have a high sensitivity to air quality impacts.

* Approximate distance from discharge point to nearest part of dwelling or building

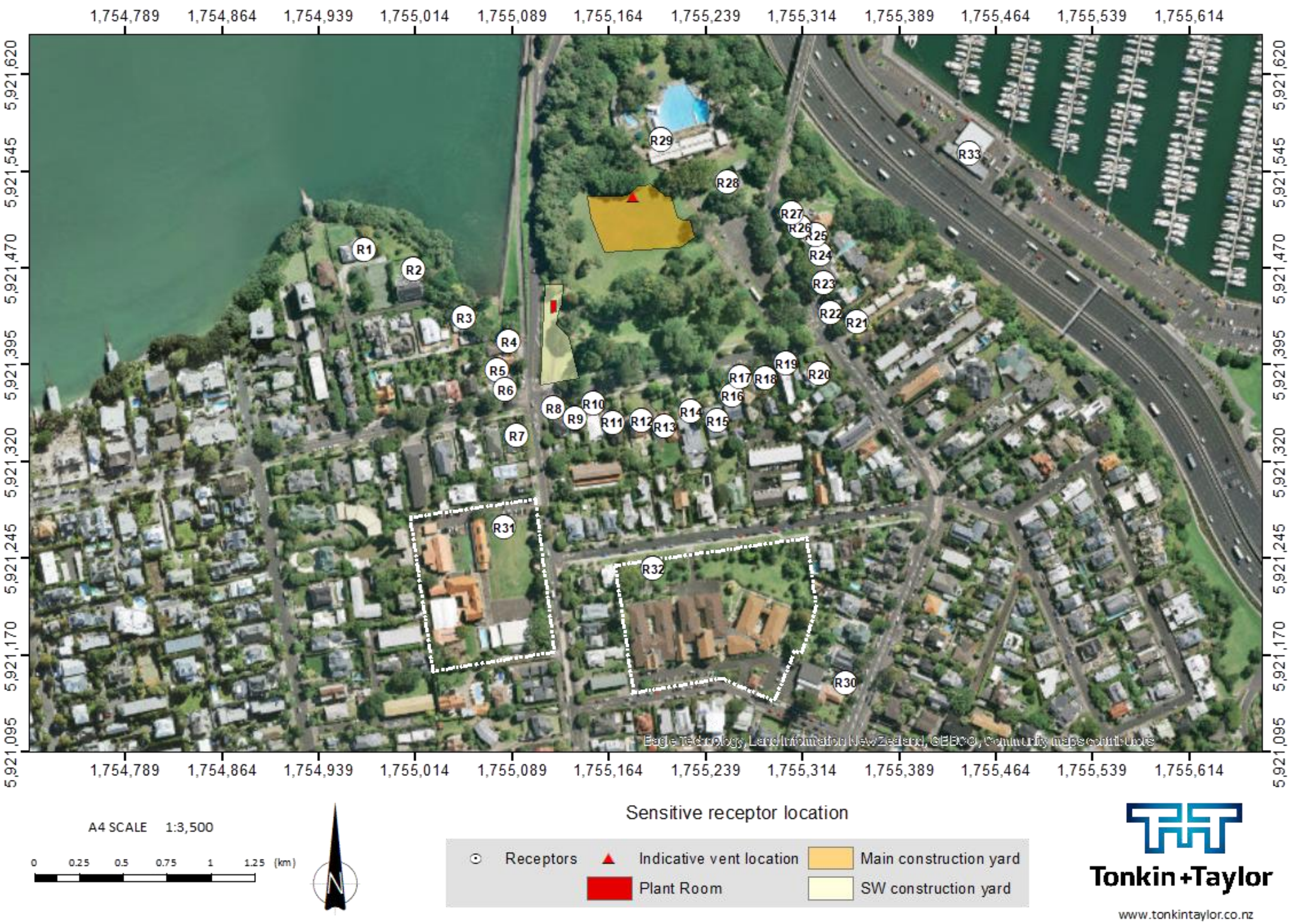

Figure 4.2: Location of sensitive receptors

4.3 Local meteorological conditions

Meteorological conditions, such as wind direction, wind speed and atmospheric stability, will provide an important influence on the propagation and dispersion of odour emitted from Point Erin Park. Wind speed and direction will also influence the generation and propagation of dust during the construction phase.

Detailed analysis of local predicted and observed weather conditions is provided in Appendix A. In summary of local meteorological conditions:

- Wind roses illustrating the frequency of wind speeds and directions predicted at Point Erin in 2005 and 2007 in Auckland Council's H3 meteorological dataset for dispersion modelling in this area are presented in Figure 4.3.
- Figure 4.3 highlights a prevalence for winds from the southwest quadrant with a secondary prevalence for winds from the northeast (which occur most frequently during summer months). This type of wind pattern is common across the Auckland Isthmus.

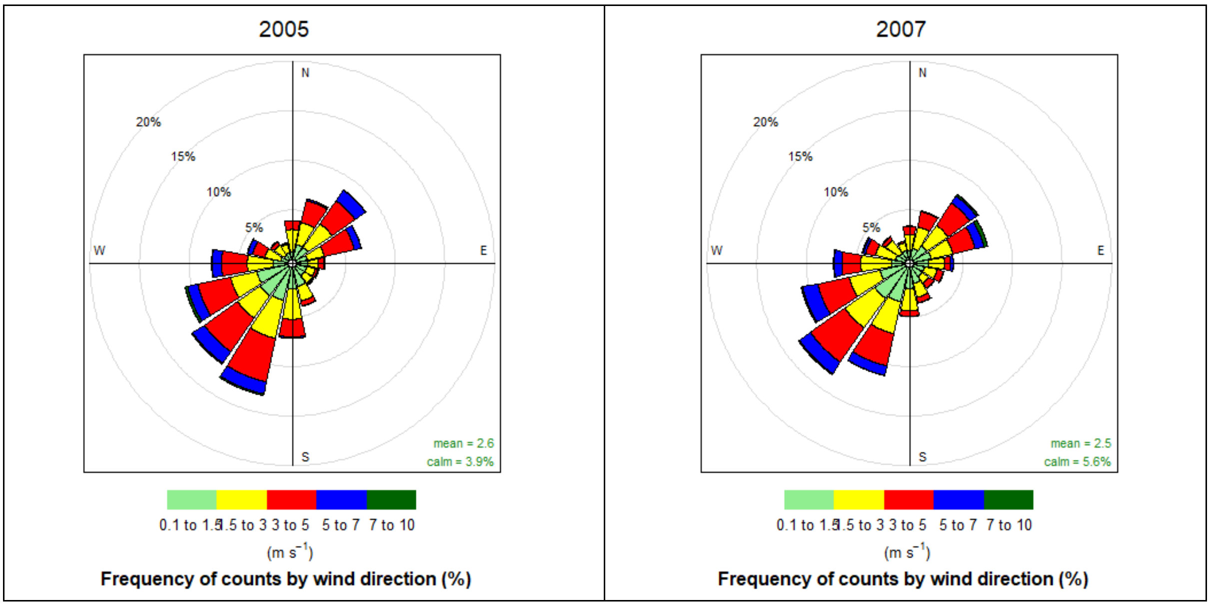

Figure 4.3: Wind roses for wind speeds and directions predicted at the Pt Erin site in the Auckland Council H4 CALMET meteorological datasets for 2005 and 2007 (1-hour average data)

- Both light winds (winds less than 3 m/s), in which odour dispersion is poor, and strong winds (winds greater than 5 m/s), in which dust propagation is most likely, follow a similar pattern with winds in these classes predominantly coming from the southwest quadrant with a secondary prevalence of winds from the northeast.
- The very high rainfall events that would trigger a release of odour at Point Erin tend to be accompanied by storm conditions and strong winds, during which dispersion of emitted odour will be extensive and people are less likely to be outdoors or use the recreational facilities at Point Erin.
- Filling of the CI tunnel to the extent that a release at Point Erin is required could potentially lag behind the cessation of the storm event (by up to a number of hours). It is therefore possible that weather conditions during the release of odour could differ to those occurring during the storm event.
- In the aftermath of storm events, dispersion of odour is likely to be poorest if calm and stable atmospheric conditions occur, which tend to occur overnight. The frequency of calm

conditions predicted to occur at the site is similar to that measured at the nearest meteorological station at MOTAT.

4.4 Local topography

Local topography provides an important influence on local meteorological conditions and the propagation of emissions to air.

As noted in Section 4.3, dispersion of odour is typically poor in calm and low wind speeds (e.g. wind speeds less than 3 m/s) and during stable atmospheric conditions, which typically occur overnight. Katabatic drainage air flows in these conditions tend to drift from high to low elevations.

Figure 4.4 illustrates terrain elevations[6] at and around the Site. Point Erin Park is located on a headland on the Waitematā Harbour between Herne Bay and St Mary's Bay. The proposed Point Erin pressure relief vent location is at an elevation of approximately 18 m RL and terrain at this location within the park slopes gently down to the west before dropping steeply to the Curran Street motorway on-ramp and the Waitematā Harbour beyond. In calm stable conditions, drainage air flow would likely drift westward from the vent location towards the coastal marine area.

The Plant Room is located towards the southwest corner of the park, adjacent to Curran Street. The plant room lies in a depression at lower elevation (approximately 8 m RL) than the adjacent stretch of Curran Street (construction of which has involved raising the original ground level). In calm stable conditions, drainage air flow would likely follow the terrain depression northward before reaching the coastal marine area.

Figure 4.4: Terrain elevations (2m terrain contours)

[6] Based on 2016 LiDAR data provided by Auckland Council

5 Policy framework for odour and dust assessment

The AUP includes provisions for the assessment of air quality effects of odour and dust emissions are set out in the AUP.

Specifically, Policy 14.3 (2a) of the AUP states odour and dust discharges must "*avoid offensive or objectionable effects from dust and odour discharges and remedy or mitigate all other adverse effects of dust and odour discharges*".

The "offensive or objectionable" effects threshold set out in Policy 14.3 (2a) is commonly applied to odour, dust and other nuisance contaminants in regional planning policies throughout New Zealand.

To assess whether an odour or dust event has the potential to be offensive or objectionable, MfE recommends, in its Good Practice Guide for Assessing and Managing Odour (GPG Odour) (2003) and Good Practice Guide for Assessing and Managing Dust (GPG Dust) (2001), that the FIDOL (frequency, intensity, duration, offensiveness and location) factors be considered[7]. The FIDOL factors concerning odour and dust are summarised in Table 5.1.

Table 5.1: Summary of FIDOL Factors

FIDOL factor	Description
Frequency	The **frequency** factor relates to how often exposure to odour or dust occurs at the location in question.
Intensity	The **intensity** factor relates to the concentration or strength of odour or dust at the location.
Duration	The **duration** factor relates to the length of time that exposure to odour or dust occurs at the location.
Offensiveness	The **offensiveness** factor relates to the 'hedonic tone' of the odour, which may be pleasant, neutral or unpleasant. In terms of dust, **offensiveness** relates to the nature of dust.
Location	The **location** factor relates to the nature of activities present at the location in question and their sensitivity to odour or dust.

[7] The AUP OP also recommends the use of the FIDOL factors for *making a determination of adverse effects in relation to odour and dust* at Note 1 to section E14.6.1.1. (General permitted standards)

6 Assessment of odour effects

6.1 Approach to assessment of operational odour effects

The potential nuisance effects of odour emissions from the Project have been qualitatively assessed using the following assessment methods recommended in the MfE GPG Odour[8]:

- A review of odour generating activities and resulting odour discharges (Section 3.2);
- A consideration of the environmental setting in terms of sensitivity and separation distances between odour sources and receptors (Section 4.2);
- Analysis of local meteorological conditions that may influence odour propagation (Section 4.3);
- Evaluation of the measures proposed to manage odour emissions or mitigate potential nuisance effects (Section 4.4);
- An overall assessment of the potential for odour nuisance effects considering the FIDOL factors (frequency, intensity, duration, offensiveness/character and location) in relation to potential odour exposure in the environment (Section 6.3).

Use of olfactometry (or other means of determining the scale of odour emissions) in combination with atmospheric dispersion modelling to predict the propagation of odour emissions in the environment is an alternative approach that could be used for the assessment of potential odour nuisance effects. However, the proposed release of odour at Point Erin Park during the operational phase of the Project is expected to be very infrequent, likely to occur less than once every ten years and only in association with significant storm events. Atmospheric dispersion modelling is not well suited to the assessment of the impacts of acute exposure to this type of odour emission (i.e. emissions occurring on an infrequent and irregular basis). The MfE GPG Odour states that this type of assessment approach is "*not recommended as an assessment tool for occasional or periodic releases of odour*". An assessment approach based on atmospheric dispersion modelling has therefore not been considered appropriate in this instance.

6.2 Review of odour management and mitigation measures

The measures proposed to control and manage odour from the Point Erin Park pressure relief vent and plant room vent are evaluated in Table 6.1.

Table 6.1: Evaluation of proposes odour management measures

Management measure type	Proposed measures	Consideration of measures
Minimisation of odour generation at source and capture/containment of generated odour	• Design of the CI system to provide extraction of air to ATFs located elsewhere in all but significant storm events, expected to occur less than once in ten years. • Minimisation of need for pressure relief discharges at Site through CI gating strategy	• Due to the proposed extraction of air to already consented ATFs along the CI, the anticipated frequency of release of odour at the Point Erin Site is very low. • The target negative pressure differential within the CI tunnel at Point Erin (-100 Pa) is reasonably extensive for the purposes of maintaining containment of air.

[8] At *Table A2.1: Selecting odour assessment tools for preparing or evaluating resource consents for an existing industrial or trade activity*.

Management measure type	Proposed measures	Consideration of measures
	and maintenance of gates and other infrastructure. • Use of unidirectional air intake vents at the Point Erin Shaft and Plant Room.	Therefore, provided vents are operated and maintained as designed, containment of odour (and extraction to ATFs) should be effective and there is unlikely to be any fugitive release of odour at the Point Erin Site outside of intended releases during the infrequent scenarios described in section 3.2.3 and 3.2.4.
Emissions treatment	• Treatment of the odour emissions from the Point Erin pressure relief vent and Plant room vent is not proposed.	• The frequency of odour discharges from the Point Erin Site is anticipated to be very low and the discharges are likely to be dilute (of substantially lower intensity) compared to odour typically generated from wastewater reticulation. As a result, odour treatment (e.g. using physical adsorption or biological methods) of the discharge prior to release is not considered appropriate in this instance.
Emissions dispersion	• Vertical discharge of Point Erin pressure relief emissions. • Discharge of the less frequent Plant Room discharge via horizontal louvres	• The Point Erin pressure relief discharge is likely to involve a reasonably high flow of air. The resulting velocity (up to 15 m/s) and vertical momentum of the discharge is likely to aid dispersion of emissions. Given the nature of the immediate recreational reserve environment as well as the relatively dilute nature of the distance, a tall, wide stack is not considered to be appropriate in this instance. • The Plant Room discharge is small in scale and is anticipated to occur very infrequently. Vertical discharge is therefore less important. However, any horizontal discharge should be directed toward the north or east (away from the adjacent residential areas).

Overall, the Project is located in a reasonably sensitive environment but any discharge of odour is proposed to occur very infrequently and is likely to be of low duration and intensity. In this light, provided that emergency releases from the Plant Room are directed away from adjacent residential areas (i.e. towards the north or east), the measures proposed to control and manage odour from the Project are considered appropriate and to equate to the best practicable option for this purpose.

6.3 FIDOL factor odour evaluation and summary of potential odour effects

As noted in Section 5, assessment guidance prescribed in the GPG Odour recommends using the FIDOL factors to evaluate the potential for nuisance effects and offensive or objectionable odour. These factors are considered in relation to the potential for odour nuisance at receptor locations presented in Table 6.2.

Table 6.2: FIDOL assessment of odour

FIDOL Factor	Assessment
Frequency	The frequency of exposure to odour at a particular receptor location will be dictated by the frequency of emissions and the frequency of meteorological conditions that would propagate emissions towards the location. As described in section 3.2, odour discharges from the Point Erin pressure relief vent will only occur during significant storm events, at a frequency of about once every ten years. Emergency release emissions from the Plant Room will occur at an even lower frequency. In terms of coincidental meteorological conditions, the significant rainfall events which would necessitate a pressure relief discharge at Point Erin will often be accompanied by storm conditions, in which dispersion of odour is likely to be extensive. However, there is the potential for a lag to occur between the end of the storm event and a pressure relief discharge at Point Erin. During such instances, weather conditions following significant storm events may differ from those occurring during the event. In the aftermath of storm events, the prevailing wind conditions indicate that wind is more likely to come from the southwest quadrant. These wind conditions would propagate odour from the Point Erin vent toward the adjacent pools (which are open over summer periods, when northeast winds are more frequent) and the Westhaven Marina beyond. Odour from the Plant Room would be propagated through the park also towards the pools. North-easterly winds are more frequent in summer and if Point Erin vent emissions were to coincide with these wind conditions, odour would likely be propagated through the park towards residential properties on the opposite side of Curran Street. Odour from the Plant Room would also be propagated towards adjacent residential properties on Curran Street in these conditions. If odour emissions from the Point Erin vent were to coincide with calm, stable conditions, odour is likely to accumulate in the immediate area and drift westward towards the coastal marine area. As noted in Section 4.3, these conditions are most likely to occur overnight, when the immediately adjacent park and pool are likely to be unoccupied. Odour from the Plant Room is likely to accumulate in the immediate vicinity and drift northwards also towards the coastal marine area in these conditions.
Intensity	The intensity of odour exposure at receptor locations will be a function of the intensity of odour emissions and the degree of atmospheric dilution that occurs between the source and receptor, which in turn will be influenced by the intervening distance and by meteorological dispersion. As noted in section 3.2, due to significant stormwater dilution occurring during the operational scenarios in which emissions occur, the intensity of the odour emitted from the Point Erin vent is likely to be significantly lower than odour typically generated from undiluted dry weather sewer flows.

FIDOL Factor	Assessment
	The odour intensity of the Plant emergency release may be slightly higher than that from the Point Erin vent due to a lesser degree of stormwater dilution, though still likely to be significantly lower than typical dry weather sewer odour. The volume of this discharge is also relatively small, which will aid atmospheric dilution. In terms of meteorological influences, dispersion and dilution of odour will be increased in turbulent/unstable conditions and strong wind flows and reduce in stable calm and light wind conditions. As noted above, the needs for air releases at Point Erin are driven by significant rainfall events that are often associated with highly dispersive storm conditions. Notwithstanding this, there is the potential for the discharge to occur once the storm event has passed. If the discharge occurs following rather than during a storm event, the analysis provided in Appendix A indicates that strong winds conducive for dilution occur 8.5 % of the time and unstable atmospheric conditions occur 27% of the time, these conditions typically occur during the day and are conducive for dispersion. Conversely, light winds (58%) and stable atmospheric conditions (37%) typically occur during night-time and early morning. In terms of geographical separation from receptor locations, the Point Erin Shaft vent is located approximately 140 m from the nearest dwelling on Curran Street, downwind in north-easterly winds that are common in summer. A reasonable degree of dilution of an already dilute discharge is likely to occur over this distance. The Plant Room is located much closer to dwellings towards the southwest across Curran Street, and it is expected that there will be a lower degree of dilution between the discharge and these receptors in north-easterly winds compared to dilution of the main vent emissions in the same conditions.
Duration	As with frequency, the duration of exposure to odour at a particular receptor location will be influenced by the duration of emissions and by meteorological conditions. The duration of emissions from the Point Erin vent is likely to be brief, ranging from 15 minutes to an hour. Given the small volume of the Plant Room emergency release, the duration of this discharge is likely to be particularly low (less than two minutes at full influent flow from the Sarsfield Overflow Collector and pumped flow from the St. Mary's Bay Storage tunnel). Given the likely low duration period of the emissions, there is a reasonable likelihood that meteorological conditions will be consistent during an emission event. Except in calm and light wind conditions (occurring after a significant storm event that would necessitate a release of odour from Point Erin), when odour could accumulate around the emission source, duration of exposure at a downwind location is likely to broadly correspond to the duration of emissions.
Character/Offensiveness	As noted in section 3.2.1, odour associated with anaerobic degradation of wastewater generally has a strongly negative hedonic tone. The character of odour emitted from the Project vents on occasion is therefore likely to elicit a negative response where it is of sufficient intensity to be able to be recognised.
Location	The site is located in a recreational reserve adjacent to Point Erin Pool and urban residential areas. Sensitivity at Point Erin Park is likely to be high while in use. However, recreational use of Point Erin Park is likely to be intermittent, limited to during daytime hours and less likely to occur during storm events with which the discharges are associated.

FIDOL Factor	Assessment
	Sensitivity at the adjacent Point Erin Pool is likely to be similarly high while in use, during daytime operating hours (6am to 8pm) in summer. During summer months occupation is also less likely during storm events. At other times of the year and outside of operating hours, the pools are unlikely to be occupied. Occupation in the residential areas to the west, south and east of Point Erin Park is likely to be consistent and sensitivity to odour will be high in these areas.

In summary:

- Odour of negative hedonic tone will be emitted on a very infrequent occasion from the Point Erin vent and plant room.
- The immediate recreational receiving environment of the discharges is intermittently occupied and sensitivity to odour may be high during use/occupation but at other times will be low. Beyond Point Erin Park to the west, south and east are residential areas, where sensitivity will be high, and occupation is likely to be consistent.
- The CI system is designed to extract, treat and discharge odour at other locations in the network in all but extreme weather circumstances. The frequency of odour emissions at the Site is therefore projected to be very low, **occurring at most once every ten years**. The frequency of exposure at receptor locations will also be related to weather conditions. The need for odour releases at Point Erin will be associated with significant storm events, during which emissions are likely to be well dispersed and people are more likely to remain indoors. The emissions may occur once the storm event has passed. In this case, emissions are most likely to coincide with southwest winds (which will push emissions towards adjacent pools that are only open to the public in summer, when northeast winds are more frequent). Northeast winds would tend to push odour in the opposite direction towards the Herne Bay residential area beyond Curran Street.
- The duration of the discharge will vary depending on wastewater inflows during the significant storm events that could trigger the need for emissions at Point Erin. Notwithstanding this, the **duration of emissions is likely to be brief and occur for less than hour**.
- Due to the significant dilution of wastewater collected and directed to the Project infrastructure with stormwater during storm events, the intensity of emitted odour is likely to be relatively low (significantly lower than odour typically derived from dry weather sewer flows). Intensity of odour exposure will also be strongly influenced by atmospheric dispersion, which is likely to be substantial in the storm events which would necessitate the discharge.

Overall, the FIDOL assessment of exposure to the proposed low frequency, low duration and relatively low intensity odour discharge indicates that exposure to the odour at sensitive locations in the local environment, on the infrequent occasions that emissions occur, is likely to be minimal and unlikely to be offensive or objectionable.

7 Assessment of dust effects

7.1 Approach to assessment of construction dust effects

A qualitative approach to assessing the potential adverse nuisance or property effects of dust from the construction from the Project has been used. The qualitative assessment has included:

- Review of dust generating activities, factors which influence dust generation and the relative scale of dust emissions from each source/activity (Section 3.1).
- Evaluation of the environmental setting of the dust discharges in terms of sensitivity and separation distances between dust sources and local sensitive activities (Section 4.2).
- Analysis of local meteorological conditions that may influence dust generation and propagation (Section 4.3).
- Evaluation of the measures employed and proposed to manage dust emissions and mitigate potential nuisance dust effects (Section 7.2).
- An overall evaluation of the potential for dust nuisance effects considering the FIDOL factors (frequency, intensity, duration, offensiveness/character, and location) in relation to potential dust exposure in the environment (Section 7.3).

The dust effects assessment has been based on an indicative construction methodology. It is understood the methodology will generally be consistent with the shaft and chamber construction works at other existing CI sites. The proposed conditions of consent require that the Erosion and Sediment Control Plan (ESCP) for the Project sets out measures for dust control in accordance with GD05 and Good Practice Guide for Assessing and Managing the Environmental Effects of Dust Emissions, MfE (2016).

7.2 Review of dust controls

Table 7.1 provides recommendations for dust control measures taking account of the nature of the construction activities and dust emissions and the nature of the environmental setting. These controls will be reflected in the project's ESCP and also reflect standard practise at existing CI construction sites.

Table 7.1: Recommended dust control measures

Activity	Recommended minimum control measures
Earthworks	• Limit the extent of excavation and material handling activities in exposed areas carried out during dry and/or windy conditions as far as practicable. • Minimise to the extent practicable drop heights of material during handling. • Stabilise exposed areas not required for construction, access or parking, along with completed fill and spoil areas as soon as practicable. • Maintain surfaces of active earthworks areas in damp condition during excavations in dry weather. This should include pre-watering of dry soil surfaces, prior to excavation allowing enough time for moisture to penetrate the soil. • Remove excavated spoil from site on a regular basis.
Spoil/material handling activities	• Minimise loading or unloading during windy conditions where dust could be emitted beyond the site boundary.

Activity	Recommended minimum control measures
	• Cover loads of fine materials. • Minimise drop heights when loading and unloading dry material.
Wind erosion of stockpiles and unsealed surfaces	• Limit the area of soil exposed. • Stockpiles with dry, fine materials to be maintained adequately damp or covered. • Minimising heights of stockpiles to the extent practicable. • Use of water as a dust suppressant should visible emissions arise.
Vehicle movements	• Limit vehicle speeds over unsealed surfaces 15 km/h. • Watering of unsealed access routes in dry conditions to suppress dust generation. • Regular removal of spilled or deposited material from sealed surfaces (e.g. using wet suction sweeping) or application of water in dry conditions to suppress dust. • Covering of loads of potentially dust materials, such as fine aggregates. • In the event of visible tracking of material onto public roads, use of wheel cleaning facilities at the site exits.

The measures above are recommended to take account of the scale and nature of the construction activities and the sensitivity of the local environment to dust.

7.3 FIDOL factor dust evaluation and summary of potential dust effect

As noted in Section 5, assessment guidance prescribed in the MfE GPG Dust recommends using the FIDOL factors to evaluate the potential, for nuisance effects and offensive or objectionable dust. These factors are considered in relation to the potential for dust nuisance and adverse property effects at receptor locations in Table 7.2

Table 7.2: FIDOL assessment of construction dust

FIDOL Factor	Assessment
Frequency/Duration	The frequency and duration of dust experienced at receptor locations will depend on the frequency/duration of emissions from the dust sources and the frequency with which the receptor is downwind of the source. Dust generating construction activities could occur at any time during construction hours (7 am to 6 pm weekdays with reduced hours on Saturdays). Outside of these hours dust emissions are likely to be limited to wind entrainment or “pick up” of dust from exposed surfaces. As noted in the MfE Dust GPG “*dust pick-up by wind is usually only significant at wind speeds above 5 metres per second*”. Based on the wind data presented in Figure 4.3 and Figure 9.1it is expected that windspeeds of greater than 5 m/s will be experienced approximately 8% of the time in all directions and most frequently from the southwest quadrant. Based on the data presented in Figure 4.3, strong southwest and west-southwest winds are expected to occur approximately 1.5 % of the time. Taking into consideration the average monthly rainfall experienced in the area, the frequency of strong winds and site management protocols (including maintaining a fully stabilised site), the frequency and duration of exposure to dust from the construction works at receptor locations will be low.

FIDOL Factor	Assessment
Intensity	The intensity of dust experienced at receptor locations will depend on the intensity of emissions at source and the degree of deposition or dispersion of the emissions that occurs en-route to the receptor (which itself will be dependent on wind strength and the degree of separation between source and receptor). In terms the scale of the construction emissions, under guidance on the assessment of demolition and construction dust published by the UK Institute of Air Quality Management (IAQM)[9], the proposed scale of earthworks during site establishment has a "medium" dust emission magnitude. The dust management measures recommended in section 7.2 are consistent with the IAQM guidance and with the recommendations of the MfE Dust GPG to minimise the intensity of dust emissions from the scale of the proposed construction works. Given that coarse construction dust is subject to gravitational settling, dilution of dust emissions will be strongly influenced by geographical separation from the source as well as meteorological conditions (wind and rainfall in particular). The bulk of dust deposition occurs in close proximity to dust sources and reduces with distance. Provided the recommended management measures are implemented, the intensity of dust deposition beyond a distance of 100 m is unlikely to be discernible in most circumstances.
Character/Offensiveness	Offensiveness relates to the colour of the dust which may increase its potential for adverse effects. Dust generated from the proposed works will be comprised of soil and mineral aggregate, neither of which are likely to have particularly offensive characteristics.
Location	Although the immediate receiving environment within Point Erin Park is intermittently occupied and of likely of moderate sensitivity to dust, urban residential areas are located within a distance of 100 m of Project construction areas to the west, south and east. Sensitivity to deposition of construction dust at these locations will be high.

The effects of dust from the construction activities will generally be localised and the majority of particulate is expected to deposit out of the air within about 100 m of the source, except for strong wind speed conditions (greater than 5 m/s) which are occur most frequently from the southwest quadrant. Overall, the frequency of strong winds conducive for carrying dust to downwind receptor locations is low, occurring no more than 1.5% from any direction at a given time.

Provided that construction activities are managed in accordance with standard CI/industry practice to minimise the generation of dust under dry, high wind conditions, utilising the measures recommended in section 7.2, the frequency, intensity and duration of exposure to dust in the environment is likely to be low. Overall, provided the recommended dust management measures are implemented, the risk of nuisance dust effects from the construction activities at the nearest sensitive receptors is expected to be low and offensive or objectionable dust beyond the Site is considered unlikely. This is supported by the performance at other CI construction sites to date.

[9] Holman et al (2014). IAQM Guidance on the assessment of dust from demolition and construction, Version 1.1. Institute of Air Quality Management, London.

8 Conclusion

The following conclusions are drawn from the assessment of the potential effects of the discharge of contaminant to air from the Project on local air quality:

1. Watercare proposes to extend the CI wastewater interceptor tunnel that is currently under construction, from Tawariki Street in Grey Lynn (as currently authorised) to Point Erin Park in Herne Bay. In addition to the tunnel extension, the Project will involve construction of a terminal shaft at Point Erin Park as well as an adjacent control chamber to control influent flows to the shaft.
2. The Project has the potential to emit contaminants to air, including dust during the construction phase at Point Erin Park and odour during the operational phase of the Project.
3. The immediate receiving environment at Point Erin Park and the adjacent Point Erin Pool is occupied intermittently but will be of relatively high sensitivity while in use. Beyond the park to the west, south and east are residential areas where occupation will be consistent, and sensitivity will be high.
4. A range of measures are recommended to control dust from the construction works. Provided these measures are implemented and works are undertaken in accordance with proposed conditions of consent and the ESCP and GD05, the risk of nuisance dust effects from the construction activities at the nearest sensitive receptors is expected to be low and offensive or objectionable dust beyond the Site is considered very unlikely. This has been the experience at the other fifteen CI sites established to date.
5. During operation, the CI ventilation system is designed to avoid releases of odour at Point Erin in all but extreme weather circumstances. During significant storm events (of an anticipated frequency of once every ten years), where the ventilation system is not able to fully operate, odour will be released from a pressure relief vent at Point Erin Park. A smaller volume emergency release may also occur from the Plant Room adjacent to Curran Street at an even lower frequency. The potential frequency of the odour discharge is therefore very low, and the duration is anticipated to be short (typically less than one hour).
6. Wastewater odour has a negative hedonic tone. However, in this instance the significant dilution of wastewater flows with stormwater will mean that the intensity of released odour is likely to be significantly lower than is typically associated with dry weather sewer flows.
7. The assessment of odour effects indicates that exposure to odour from the proposed low frequency, low duration and relatively low intensity odour discharge at local sensitive receptor locations is likely to be minimal. The frequency, intensity, duration of exposure to odour beyond the Site is such that occurrence of offensive or objectionable odour is considered unlikely.
8. In order to minimise the potential for offensive or objectionable effects the following measures are recommended:
   - Implementation of the dust management measures discussed in section7.2.
   - Direction of emergency odour releases from the Plant Room away from adjacent residential areas (i.e. towards the north or east).

9 Applicability

This report has been prepared for the exclusive use of our client Watercare Services Limited, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

We understand and agree that our client will submit this report as part of an application for resource consent and that Auckland Council as the consenting authority will use this report for the purpose of assessing that application.

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Appendix A Analysis of meteorological data

A1 Overlying regional meteorological conditions

Overlying air flow over Auckland is predominantly from the southwest; this is particularly so from autumn to spring. In summer, the proportion of winds from the northeast increases[10]. Due to the coastal location of the Site, there will also be sea breezes which are local onshore daytime winds generated on fine days by the sun warming the land surface more than the sea surface. These tend to occur during the summer months (approximately 20% of the days during summer months) in Auckland (between November and March when the sunshine is greatest, and the wind flows are weakest) with speeds of less than 20 km/hr (approximately 5.6 m/s)[1].

A2 Comparison of predicted site wind and local observed wind data

T+T has extracted wind speeds and directions predicted to have occured at the approxaimte location of the proposed Point Erin Vent in Auckland Council's H3 meteorological dataset for 2005 and 2007. These files have been developed for Auckland Council to provide consistent meteorological data for dispersion modelling of air discharges in Auckland.

Wind roses illustrating the frequency of wind speeds and directions predicted for the Project site for the years 2005 and 2007 are provided in Figure 9.1.

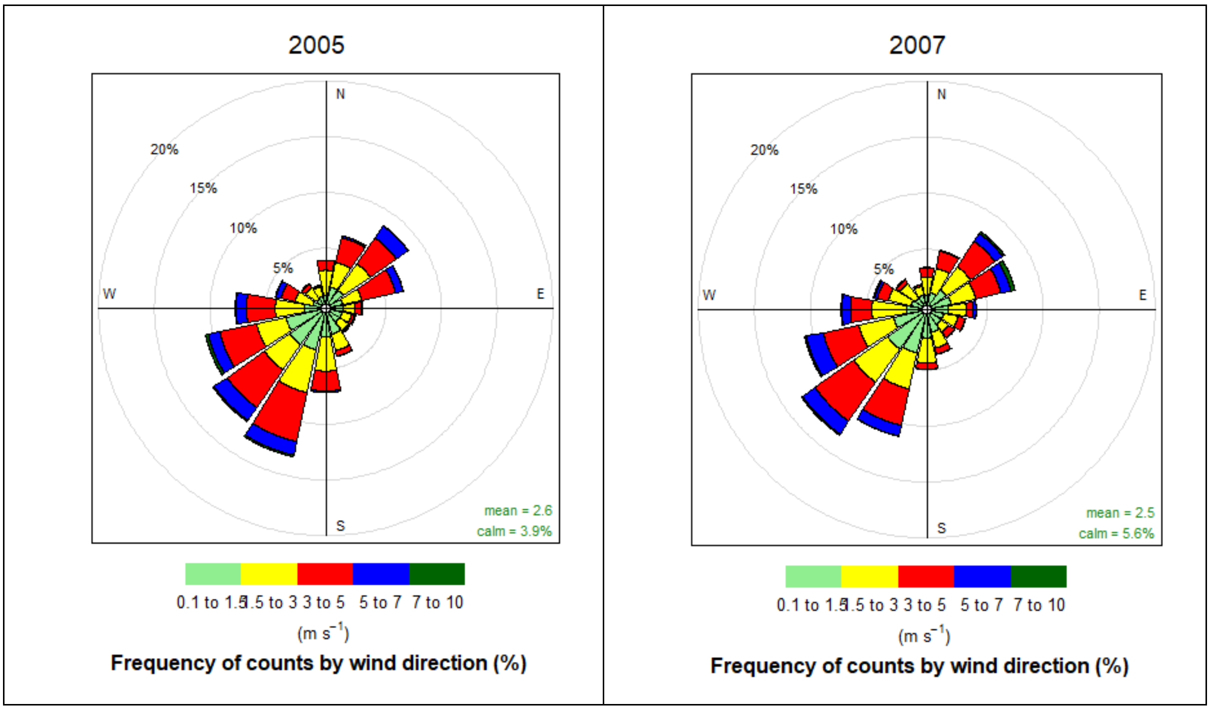

Figure 9.1 Wind roses for wind speeds and directions predicted at the Pt Erin site in the Auckland Council H4 CALMET meteorological datasets for 2005 and 2007 (1-hour average data)

[10] P.R. Chapell, The Climate and Weather of Auckland, 2nd edition, NIWA https://niwa.co.nz/static/Auckland%20ClimateWEB.pdf)

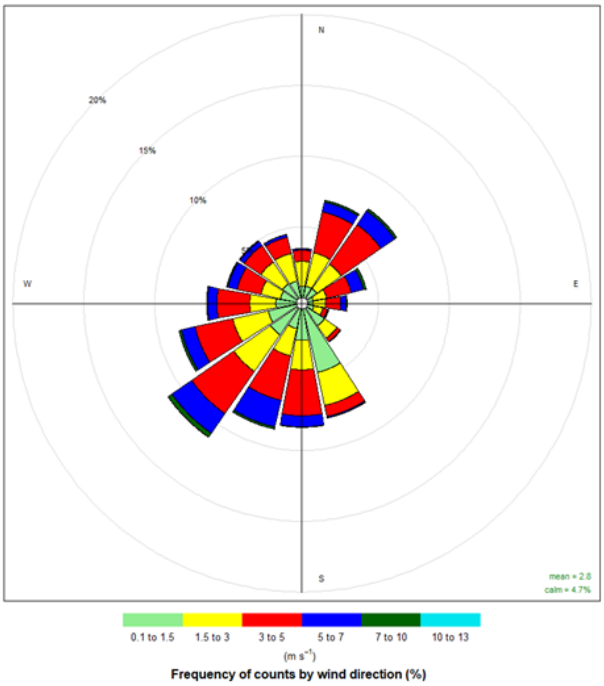

Figure 9.2 Wind rose for wind speeds and directions observed at the MOTAT between 1 January 2017 to 31 December 2021 (1-hour average data)

The CALMET-predicted wind data for the site has been compared to wind speed and direction data from MOTAT (see Figure 9.2, which is located approximately 3.4 km southwest of the site. The MOTAT monitoring station is operated and maintained by National Institute of Water and Atmospheric Research (NIWA). The general wind direction patterns are similar between the two sites and reflect the overall pattern expected in Auckland.

The MOTAT monitoring station is located in a relatively flat area approximately 600 m inland from Meola Reef on the lee side of the Westmere. Conclusions drawn from the comparisons of the CALMET predicted Site data and MOTAT observed data are as follows:

- The pattern of wind predicted by the CALMET model is generally reflective of that observed at MOTAT, with a general prevalence for winds from the southwest and northeast. There is a higher frequency of winds (and of winds of speeds of less than 3 m/s in particular) observed from the south-southwest and south at MOTAT. This is likely an artefact of the local topography and buildings around the MOTAT weather station.
- There is little difference between the average wind speed measured at MOTAT (2.8 m/s) and that predicted at Site (2.5 m/s for 2005 and 2.6 m/s for 2007).
- Likewise, the average frequency of calm conditions (wind speeds of less than 0.5 m/s) measured at MOTAT (4.7%) is in the range predicted at Site (3.9% for 2005 and 5.6% for 2007).

A3 Analysis of CALMET predicted meteorological conditions at the Site

A3.1 Predicted frequency of low winds and strong winds

Wind direction and wind speed influence the propagation of dust and odour, as well as generation of dust, within the local environment. The features of particular interest in this assessment are:

- The frequency of wind directions (of all speeds) blowing towards receptor locations;
- The occurrence of stable calm and light wind conditions (wind speeds less than 3m/s), where dispersion of odour tends to be poor; and
- Strong winds (winds over 5 m/s), where dispersion of emissions is good, but dust pick up and wind entrainment may occur (and increase with higher wind speeds).

Table 9.1 presents the frequency of light and strong winds by wind direction predicted to occur at the Site location based off Auckland Council's H3 meteorological dataset for 2005 and 2007[11].

Table 9.1: Frequency of light and strong winds by direction predicted at Point Erin

Wind direction	% of wind between 0.5 – 3 m/s	% of wind >5 m/s
N	2.8	0.0
NNE	3.4	0.1
NE	4.3	1.2
ENE	3.4	1.0
E	2.6	0.2
ESE	2.1	0.1
SE	1.9	0.0
SSE	3.2	0.0
S	4.5	0.1
SSW	6.6	1.2
SW	6.8	1.5
WSW	5.8	1.5
W	4.3	0.9
WNW	2.8	0.4
NW	2.2	0.1
NNW	1.6	0.0

A3.2 Analysis of predicted atmospheric stability

Atmospheric stability substantially affects the capacity of a pollutant such as dust or odour to disperse into the surrounding atmosphere upon discharge and is a measure of the amount of turbulent energy in the atmosphere.

There are six Pasquill-Gifford (P-G) classes (A-F) used to describe atmospheric stability, and these classes are grouped into three stability categories: stable (classes E-F), neutral (class D), and unstable (classes A-C). The climate parameters of wind speed, cloud cover and insolation (solar radiation) are

[11] Average values for the combined 2005 and 2007 dataset are presented

used to define the stability category as shown in Table 9.2. As these parameters vary from day to night, there is a corresponding variation in the occurrence of each stability category.

Table 9.2: Summary of Pasquill-Gifford stability classes

Stability class	Wind speed range (m/s)	Stability characteristics
A	0 – 2.8	Extremely unstable atmospheric conditions, occurring near the middle of day, with very light winds, no significant cloud
B	2.9 – 4.8	Moderately unstable atmospheric conditions occurring during mid-morning/mid-afternoon with light winds or very light winds with significant cloud
C	4.9 – 5.9	Slightly unstable atmospheric conditions occurring during early morning/late afternoon with moderate winds or lighter winds with significant cloud
D	≥6	Neutral atmospheric conditions. These occur during the day or night with stronger winds, during periods of total cloud cover or during the twilight period
E	3.4 – 5.4	Slightly stable atmospheric conditions occurring during the night-time with significant cloud and/or moderate winds
F	0 – 3.3	Moderately stable atmospheric conditions occurring during the night-time with no significant cloud and light winds

Notes:

- Data sourced from the Turner's Key to the P-G Stability Categories, assuming a Net Radiation Index of +4 for daytime conditions (between 10:00 am and 6:00 pm) and –2 for night-time conditions (between 6:00 pm and 10:00 am)
- E and F class stability classes assumed to only occur at night, during Net Radiation Index categories of –2.

Figure 9.3presents the frequency of stability class for all hours of the model generated dataset.

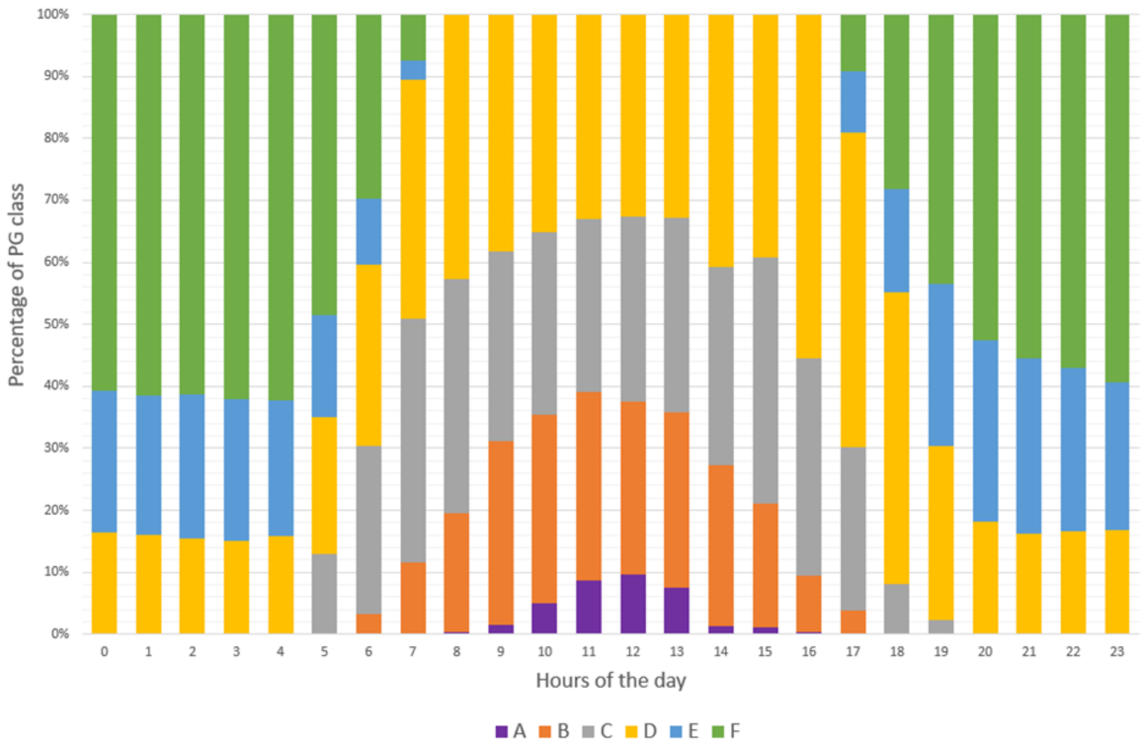

Figure 9.3: Diurnal frequency distribution of CALMET predicted atmospheric stability classes at the Site

The following observations were made in relation to predicted atmospheric stability at the Site:

- Neutral atmosphere conditions (class D) are the most common stability class at the Site, predicted to occur approximately 30 per cent of the time, at any time but most frequently during the day;
- Stable conditions (classes E and F) occur approximately 37 per cent of the time, overnight; and
- Unstable atmospheres (classes A, B and C) occur approximately 27 per cent of the time, primarily during the middle of the day when solar radiation is highest.

A4 Analysis of Rainfall data

In addition to strong winds, it is also important to consider rainfall when assessing dust generation. Dust emissions are more likely to occur during dry, windy conditions and are conversely supressed under wet conditions. Rainfall data measured at MOTAT is presented in Figure 9.4 The driest months of the year are in the summer (December – March) when particular attention to dust management is required.

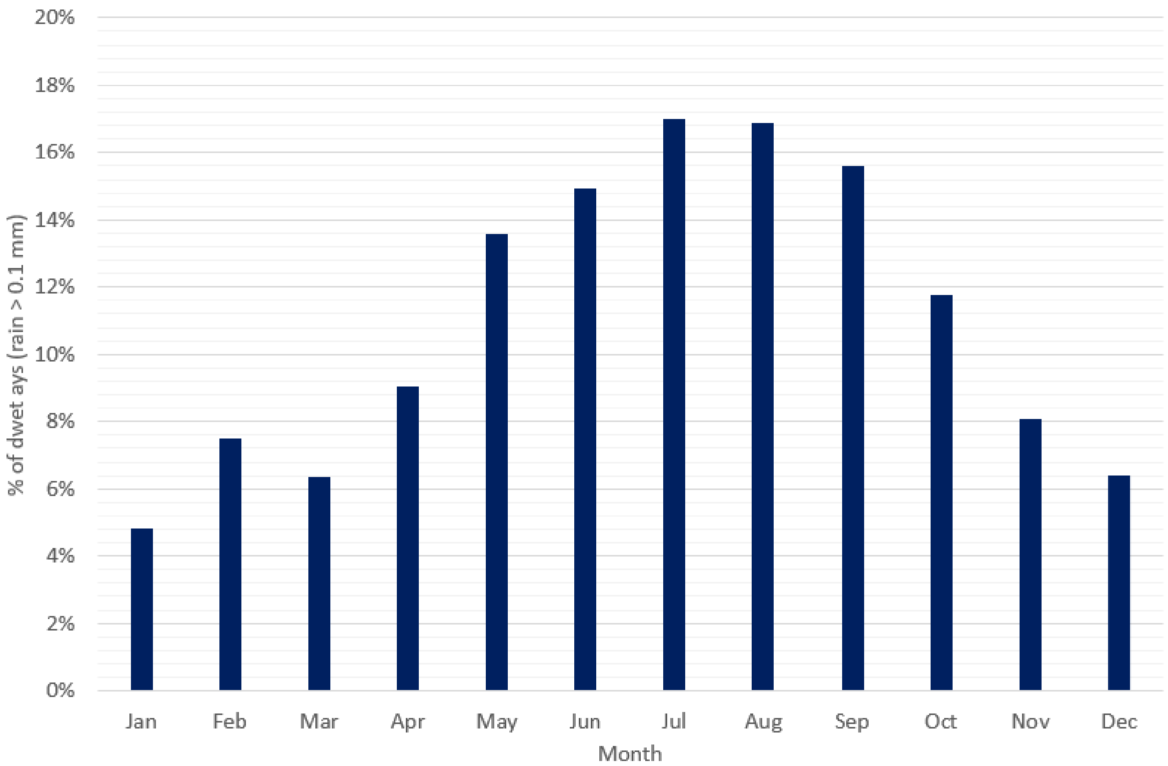

Figure 9.4: Average monthly rainfall data at MOTAT between 2017 to 2022

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